

University of Southern Queensland

A FRAMEWORK FOR STRATEGIC GUIDANCE TOWARDS A SYSTEMIC HOLISTIC MODEL FOR THRIVABILITY

A Thesis submitted by

Mauro (Morris) Dino Fedeli
BAppScMaths;BBusComp;CMACS(ProjMgmt);
GradDip(IT/TechMgmt);MBA(TechMgmt);
JP(Qual);TESOL(ProfCert);FACS

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ABSTRACT

A framework for strategic guidance
towards a systemic holistic model for thrivability

The fate of society is at a critical juncture, and unless we take immediate action to transform our way of life, we are destined for extinction. In recent years, the study of designing regenerative ecosystems has gained momentum as a means to achieve sustainability. However, to create a thriving society, we must develop sustainable entity models based on proven empirical outcomes that are scalable across regions, sectors, and organisations. This study leverages machine learning (a branch of artificial intelligence) to link categorical business model patterns to empirical sustainability performance measures, informing management theory and determining which business models are more sustainable at each scale level. Employing a design science research approach, the study develops nascent theory, devising the basis for technological rules, and creating the THRIVE Framework and Platform artefact. The THRIVE Framework includes 12 Foundational Focus Factors, and the THRIVE Platform is a software tool for demonstrating the impact of sustainable business models. The study also showcases the impact of the top 30 keystone actors through the Seafood Stewardship Index case study. Built on the framework for strategic sustainable development, the THRIVE Framework and THRIVE Platform features scenario analysis, allowing for experimentation and guiding society towards thrivable transformations. This study represents a crucial step towards a thrivable future and highlights the urgent need for immediate action at speed, scale, and scope. Thrivability is within our reach!

CERTIFICATION OF THESIS

I Mauro (Morris) Dino Fedeli declare that the PhD Thesis entitled "*Framework for strategic guidance towards a systemic holistic model for thrivability*" is not more than 100,000 words in length including quotes and exclusive of tables, figures, appendices, bibliography, references, and footnotes. The thesis contains no material that has been submitted previously, in whole or in part, for the award of any other academic degree or diploma. Except where otherwise indicated, this thesis is my own work.

Date: 1st, September, 2024

[redacted]

Endorsed by:

[redacted]

Dr Anup Shrestha
Principal Supervisor

[redacted]

Dr Paul O'Brien
Associate Supervisor

Student and supervisors' signatures of endorsement are held at the University.

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I wish to express my sincere gratitude to the Delphi expert panel who contributed their time and expertise. Many thanks also to early supervisors Eric Kong and Fernando Padro and the THRIVE Project organisation. Also, thanks to Antony Upward, Dr Florian Lüdeke-Freund, Dr Mark McElroy, Dr Frank Figge, Bill Baue, Ralph Thurm, Dr Anders Bjørn, Eric Fath-Kolmes, and several others who were in my circle of influence, helping me shape the ideas which ultimately gave rise to the THRIVE Framework.

Most importantly, I am indebted to my long-term partner Femelyn Gallego without whom I would have not had the strength to continue, especially during my many times in need. Her support allowed me to push through the hard times, when hospitalized on over two dozen occasions, attending to many different medical procedures, and in taking care of homely matters as we moved country, place of employment, and much more. This extensive and detailed work on the THRIVE Framework could have not been possible without the belief of all those involved that it is worth pursuing.

DEDICATION

To future generations navigating polycrisis, a scientific offering…

This thesis is dedicated to those bravely confronting our era's greatest challenge—the impending collapse of our civilisation. With unwavering courage and intellectual rigour, this work serves as a guide amid looming darkness. As we grapple with the unsettling prospect of civilisation's end, we seek wisdom, insight, and a call to action in these pages.

In the words of yours truly, "There are no sustainable entities on an unsustainable Earth". These words embody our struggle. Once a nurturing haven, our planet now buckles under environmental degradation, social inequality, and systemic instability. In this context, this academic endeavour aims to dissect, analyse, and offer paths to address threats to our shared existence so each one of us can transition towards sustainability and beyond - thrivability.

To explorers and researchers, whose dedication has illuminated global crises' intricate interconnections, we express deep gratitude. Your commitment to unveiling uncomfortable truths and facing them head-on is a beacon of hope for change through knowledge.

To those dedicating their lives to preserving our planet's sanctity and humanity's dignity, we honour your tireless efforts. Your struggles, triumphs, and resolute determination has paved the path for this monumental work.

To thinkers, activists, policy makers, and citizens defying apathy amid odds, we unite in purpose. This dedication testifies to your collective spirit—the spirit reminding us that every action, thought, and word shapes a future transcending our current darkness.

May this thesis spark change, igniting curiosity, responsibility, and transformation within us. Let its pages remind us that civilisation's end isn't inevitable, but a challenge met with ingenuity, resilience, and renewed commitment to our planet and its inhabitants and beyond, wherever we may seek to journey among the stars.

With humility and hope,

Morris D Fedeli

1st September, 2024

PREFACE

The author

Born in Australia in 1967, from Italian immigrants, from a young age, I was fortunate enough to have travelled the world with my family. At age 4 we travelled around Asia, Europe, the Middle East, and the Mediterranean, including Italy where we eventually relocated to Venice when I was 9 years of age. As a bright, inquisitive young kid, I often skipped years of schooling as my knowledge was often re-evaluated following each relocation. Upon finishing high school in Italy, we relocated back to Australia, repeating my high school examination, yet going on to complete three degrees back-to-back at university by age 21. My university studies, at the time, included operations management, statistics, computer science, business and eventually project management – all areas that have been applied in this study.

As a kid, I went on to teach elder folks, 2 or 3 times my age on how to use computers. I spent every waking hour programming and with my heads in books. I had little friends and no social life. I loved scientific discovery and was happy. In the mid '80s I was given the opportunity to tutor and then teach at my university – QUT. I went on to become an IT consultant, trainer and then hardware and software solutions supplier for my own company – Techmore Pty Ltd - around the time the personal computer was born.

Techmore Pty Ltd – which still exists to this day - and its seven divisions spanning hardware, software, consulting, and training, went on to become a top 10 ICT privately held company in Queensland, on the GITC government approved registry with clients ranging from CITEC to BHP, Qantas, News Limited, the Sydney Olympics, and several other small to medium enterprises. We supplied and financed equipment and provided installation and training services. We broadened our scope to desktop publishing and bought our own 2-story building with 700sqm

office space in the Fortitude Valley area long before the Brunswick Street mall even existed.

With the emergence of the internet and web development fields in the early '90s, a second top 10 firm was established: Odyssey World Pty Ltd and its famous WebFactory division with operations in Switzerland, Hong Kong, San Francisco, Manila, and Brisbane. Starting with internet access, it diversified into web development, ecommerce, SEO services, business consultancy, and more, again pre-empting real-time streaming media (eLearning), and online distributed database solutions, as well as being a leader in ecommerce through our Hong Kong based S7 network. We were wholesalers, developing tools and technologies for other IT and web development firms in the sector.

A broken marriage, lost child, and large group of opinionated passers-by convinced me at age 33, to give up my business interest as a serial entrepreneur to pursue my dream of travelling around the world once more – just as I did as a child - to discover how the world truly works. As a result, I have spent two-thirds of my life outside of my home country and in doing so learnt a great deal. Sure, I am a teacher but foremost a forever learner. It also allowed me to revisit a life-long passion in magic which I find is deeply connected with science and mathematics. There are no supernatural powers or 'acts of God', simply a phenomenon we are yet to understand well enough to explain. Travel demonstrated to me that maths and magic transcends age, language, culture, geo-locale, and politics.

During my travels I saw how other folks live. Lots of pain. Lots of suffering. Lots of damage. War, pollution, waste, disease, natural calamities and more. Much, if not most, unnecessary it would seem. Surely, we can do better. We owe it to the next generation to leave the world in a better place than how we found it. Our legacy is to ensure respect, appreciation, and admiration by the next younger generation, as they will be the ones that are able to attend at our funeral and carry on

the baton. Let's ensure they have a world to live in that is far better than what we have inherited.

The vision

It is fair to say that this thesis is as much an exploration of the sciences that informs the field of industrial ecology and business modelling, as much as a labour of love. It is the result of the relentless pursuit for the truth surrounding the notion of thrivability. If one characterizes sustainability as breakeven, mere survival – living hand to mouth – then thrivability is flourishing, going beyond day-to-day surviving. The pursuit of thrivability delivers the impetus for long-term resilience and regeneration among all life-forms for the benefit of us all.

When working all those years ago as a sustainability and business innovation consultant I was constantly told by corporate clients, "*great idea, but there is little I can do, however, do go and see our competitor/neighbour/fellow countryman across the road, they are more in need for what you are exposing/proposing*". In short no one wanted to admit to their share of the problem, whether it was about waste, pollution, or scarcity. Most were simply waiting for others to make a move first, feeling they were not the '*most'* responsible for the issues at play.

As we live in a world faced by many social ills and environmental challenges, I find this to be urgent and important. A recent IPCC report articulates how we have already entered the 6th mass extinction level event (P.R. Shukla 2022). The imperative to innovate and for organisations and others to transform towards thrivability is at the core of much of my experience as a pracademic over the last three decades across three continents (a pracademic is a practitioner and an academic all rolled into one). My pursuit for well-being and the social good is aimed at encouraging organisations to *do good to do well* (O'Tooie 1991). This has earnt me the title of the altruistic atheist and quiet activist or as I prefer 'actionist', as I have donated all of my life effort, freely, towards this cause.

My reason to pursue this thesis is largely based on my first-hand lived experience over the last twenty years in some of the poorer countries in the world, such as Cambodia, Philippines, and Thailand. I have lived or studied, worked, or built business, in China, Australia, Italy, Singapore, Thailand, Philippines, Germany and several other countries. I have lived 2/3rds of my life as a minority in the Global South, and have personally witnessed much injustice, abuse, inequality, and other social harm, as well as a complete disrespect for Mother Earth, and many of the essential resources we take for granted daily. This includes access to clean drinking water, reliable power, decent sanitation, access to medication and education, reliable infrastructure, just to name a few. During this time, I have experimented with living in a cave, in a hut, without running water, or electricity, and far from basic conveniences for months at a time. I have also experienced being left on a desolate island for three days with minimal supplies, thereby needing to fish for food.

Furthermore, as a social entrepreneur in my former life, I believe understanding the link between sustainability performance and strategy (entity model) allows business leaders and alike to make better decisions and ensure long term thrivability. I certainly wish I knew when I started out, back in the 80's, which strategies were more sustainable and likely to succeed than others. This is of great value to any start-up, business owner, or leader. Indeed, policymakers within government would benefit with a clearer understanding of the relationship between these variables.

The other major learning from undertaking this dissertation is the understanding of how to undertake good design and research as well as the application of a first principled approach. The rationale from the outset was to produce a well-grounded analysis of the underlying factors which informs the THRIVE Framework and instance as developed in the THRIVE Platform. This necessitated a comprehensive investigation and integrative review of the literature and desire to be as thorough as possible, whilst acknowledging the breadth of the trans-disciplinary nature of the research. I was thus motivated to personally make trips over the

years to Europe to participate in several conferences, meetings, workshops, and generally interact with the best and most influential in the field.

From my perspective, my passion for the sciences, interest in producing an innovative, meaningful, and outstanding original contribution, and above all useful to industry, academia, and consumers, is what has led me to make this detailed analysis, and development, spurred by the THRIVE Project team to achieve the impact and accolades it so richly deserves.

The challenge

Of all my qualities, persistence and tenacity, discipline, and focus, in the face of adversity, difficulties and losses, are traits that I have developed over time. I am not physically strong, but mentally extremely tough and determined. So without too many details, in the midst of this thesis, I moved home country (Philippines to Australia), setup a new not-for-profit and for-impact venture THRIVE Project (grown the organisation from 1-80 people worldwide with over 25k+ followers), experienced the new norm we call COVID, had to endure with my elderly (80 years+ old) Father when he was hospitalised following a fall and broke his ankle, my Mum suffering a major stroke, hospitalised and moved into a nursing home, lost my brother-in-law to COVID (at half my age), supported my partner during her hospitalisation/operation regarding an organ removal, and generally worked very long hours under a great deal of stress. I was hospitalised many times myself, including undertaking 24 surgeries on my eyes. In fact, due to diabetes my vision deteriorated rapidly after Oct 2020 at which time I started to seek time off from my research and study. I am told my vision will never return as I am sadly on the path to becoming legally blind, so I have had to make do and complete this thesis urgently.

There were periods of many months where I was working 110 hours a week (for THRIVE Project, and not on the thesis). Quite frankly, during

much of this time I was faced with very little family support as they objected to several of my choices in priorities. I am also the legal guardian of my Asian partner who throughout this time has become an Australian resident and most recently a citizen. Dealing with her residency caused much distress, as there were so many challenges involving her documentation, including dealing with formal papers and VISA requirements she was missing, and needing to travel back and forth abroad over several years, to secure the same, exacerbated by COVID restrictions. I, however, owe a great deal to her both in terms of learning from another culture/region as well as her patience and forever ending support for me in my times of need and as I worked through this thesis.

I am fortunate that I generally work well under pressure and am resourceful. From early on in my career I learned to venture out both physically as well as intellectually outside of my area of expertise and comfort zone. I started my career as an R & D manager, albeit for my own venture. Science, technology, and innovation along with social entrepreneurship has always taken centre stage during my career.

The resolve

I can say that my research and work has dovetailed back to where I started with my passion for science, technology, innovation, and social entrepreneurship. With the establishment of the THRIVE community and movement we are now democratising knowledge in the field of thrivability (arguably civilisation most important cause yet), developing a collaborative collective global network model that delivers on providence and prosperity for all living life forms. Under the auspices of Providence - **P**assion, **R**esponsibility, **O**ptimism, **V**irtue, **I**ntegrity, **D**etermination, **E**nthusiasm, **N**urture, **C**ourage, and **E**quity – the meaning is a timely reminder that we ought to prepare for future eventualities. Providence Solutions, which I started 20 years ago, is the parent organisation for the THRIVE Project and its positive influence should be a reminder of the great work achieved as well as the much-needed work that still lies

ahead. This work has taken me from the early days to travelling the globe, meeting with counterparts in Europe, Germany, the Netherlands, Bulgaria, Austria and Belgium; in Asia, Singapore, The Philippines, Thailand, Sri Lanka and Malaysia; and in UAE in the Middle East. Locally have catalysed the Thrivability Matters movement in Australia and extended it to our colleagues in Northern and Southern America, Europe and Africa, and Asia. Around the world, organisations seek me out as an expert in my own right in the field of thrivability. Have now participated in a number of webinars and podcasts as well as live events. I continue to be of value to those around me in the movement towards thrivability - towards a future that benefits us all.

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ABBREVIATIONS

Brief selection of abbreviations used in this thesis.

7Cs	The seven C's
12FFF	12 Foundational Focus Factors
AI	Artificial Intelligence
BAG	Business Activity Groups
BM	Business Model
BMI	Business Model Innovation
DSR	Design Science Research
FSSD	Framework for Strategic Sustainable Development
GRI	Global Reporting Initiative
MVP	Minimal Viable Product
SBM	Sustainable Business Model
SHM	Systemic Holistic Model
SPi	Sustainability Performance Index
SSI	Seafood Stewardship Index
THRIVE	The Holistic Regenerative Innovative Value Entity
TF	THRIVE Framework
TP	THRIVE Platform

A comprehensive glossary of THRIVE Project related terms can be found at https://glossary.thrivabilitymatters.earth.

CHAPTER 1: INTRODUCTION

1.1. Background

Research in the field of model innovation has largely focused on design tools for business, generically referred here in this study as enterprises. Informed by theoretical underpinnings, it has been argued that, for example, through the adoption of just-in-time practices or circular business models, can lead an enterprise to become more efficient and thus more sustainable. Yet there is a growing realisation among academia and industry that simply doing better may not be enough (O'Neill et al. 2010). A fundamental new approach is necessary, drawing on the outcome of the application of such envisioned ideals (Adams et al. 2015). Radical innovation may be our way out and forward, towards a newfound approach to strategies for model innovation, supported by theoretically grounded technological rules and evidence-based sustainability performance metrics.

Here we define sustainability as the ability to sustain, to break even, survive yet another day, and thrivability as going beyond sustainability. An extended explanation follows in subsequent chapters. This thesis develops a conceptual framework linking measurement (assessment) of entity performance (e.g., corporate sustainability performance) with categorisation (classification) of entity (e.g., business) model patterns (*vis-a-vis* strategy), based on audited and publicly available sustainability reports using context-based data sources within science-based targets. This study includes the construction of a demonstration software tool (instantiation) containing empirical data from the worldwide seafood industry, demonstrating how to achieve thrivability.

Given the holistic nature of the issues at hand, this study by design takes a top-down approach to the investigation, recognising the inter-connectedness of the scientific fields involved, and the finite resources on hand. In subsequent chapters the study outlines the concept of the 7Cs -

Cosmos, Continent, Country, City, Community, Company, Creature (Fedeli 2020) - which provides a structure to the various levels of impact upon which an analysis can be conducted, such as the corporate, industry, portfolio, bioregion or country level. The concepts in this study apply throughout these levels and at times the reader will be directed to examples at a particular level of granularity, most often in relation to business, sectors, or governments.

The structure of this chapter is such whereby the problem definition, significance, research questions and outputs are introduced together with key concepts and the scope of the study. This is followed by findings including those of theoretical and practical significance and finally some background on the author and the initiative that this study gave birth to and the THRIVE Project organisation that emerged from this investigation (***Figure 1.1***).

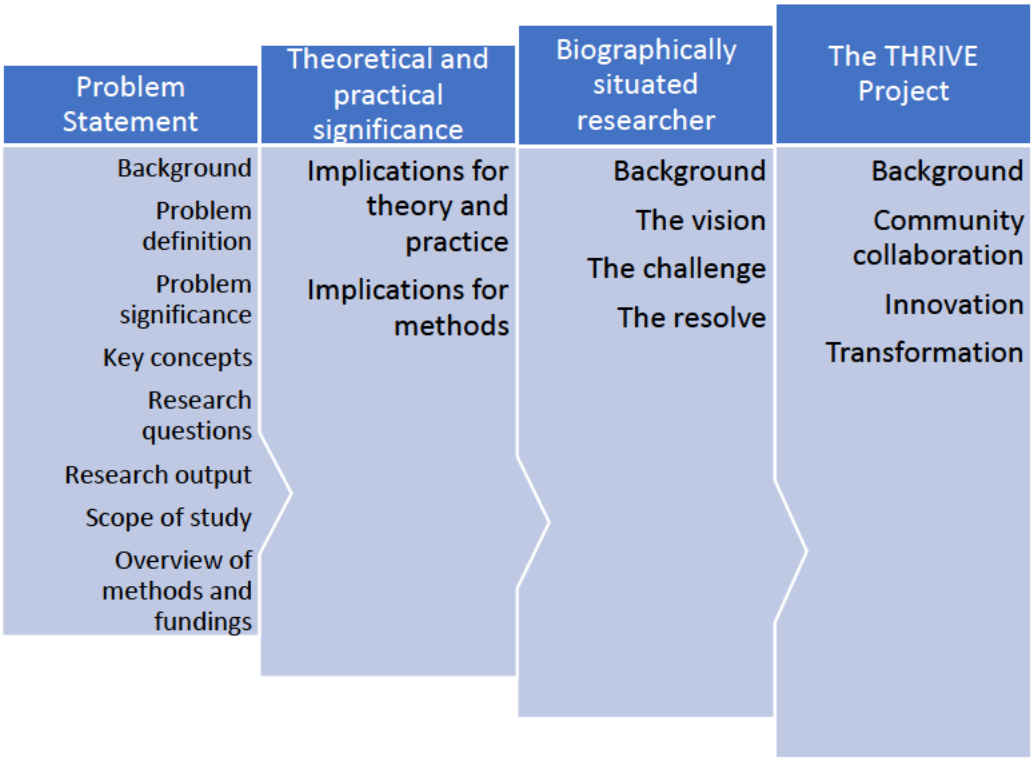


Figure 1.1. *Chapter 1 INTRODUCTION chapter layout.*

1.1.1. The why, how, and what of this study

Planet Earth needs a strategy - if humanity is to survive and endure for the long term - given its finite resources and human-induced

deteriorating climate. Business and governments alike have been aiding its demise; however, some studies show that innovative business strategy or business models represent our best source of successful redress, with business leaders and innovators identifying innovation as the key to success (Nidumolu et al. 2009; Kiron et al. 2013; Pansera & Randles 2013; Morioka et al. 2016; Varadarajan 2017).

Morioka et al. (2017) have shown a positive correlation between strong sustainability and innovation. Breiby and Wanberg (2011) have linked business model innovation with improved competitive advantage, and a UNEP (2014) study identified over 200 academic reports that demonstrate positive and statistically significant relationships between sustainability performance and financial performance (Evans, Vladimirova, et al. 2017). The business model provides a global perspective on how business is conducted with an emphasis on value creation for all business model stakeholders including recognition of its partners and the social and ecological environmental value network within which it operates (Evans, Vladimirova, et al. 2017). Business model innovation is best approached holistically from a systems level thinking perspective (Williams et al. 2017). Research shows there are few studies quantitively connecting strong sustainability performance of entity models such as business models with in-context science-based measurement of sustainability performance (Abdelkafi & Täuscher 2015). So exactly how does innovation, for example, of the business model lead to sustainable outcomes for profit, people, and planet?

From an ecological economist risk minimisation perspective – at the macro- / meso- scale - this study conceptually develops *The Holistic Regenerative Integrated Value Entity* (THRIVE) framework; providing the basis for developing tools which openly rank the sustainability performance of an entity alongside their strategy or business model; thereby informing the public (provoking consumers) and encouraging business leaders, policymakers, and individuals to actively compete for greater sustainable global shared value creation and collaborative

peaceful partnerships for people, planet, profit with purpose, and prosperity.

1.1.2. The scope of this study

As conceptualised in this study, the utility of the THRIVE Framework and the THRIVE Platform tool's Sustainability Performance Scorecard (SPS) can encourage radical innovation, compatible with the natural sciences, driving maximum creativity within natural socio-environmental constraints. The framework and factors, design tools and techniques, apply novel methodologies and methods as indicated below, demonstrating and validating the usefulness of the approach for business leaders, investors, and the public, by providing transformative benefits for society at large.

Beyond the real-life case study example provided for the seafood industry, it does not empirically assess the sustainability performance and associated entity (e.g., business) model for a range of enterprises or industries. This study instead constructed and evaluated a tool that demonstrated usefulness in determining sustainability impacts, thus providing the practical basis for real enterprises to transform their business from business-as-usual to thrivable businesses. In this respect the study provides a more generalizable understanding of the prevailing methodology that informs this space. By way of extension the entity under examination can be extended from an organisation down to an individual or up to groups of organisations (such as an industry sector or portfolio), to a city or region, to a state or country. Doing so requires measuring performance within context at all levels, relative to the finite resources available in this world and at our disposal.

NOTE: As revealed throughout the integrative literature review and referenced in this dissertation, the terms business, firm, organisation, enterprise, group, institution, or company are used interchangeably as they appear in the literature. However, as this study reveals, the super-ordinate levels of community, city, country, continent, and cosmos can equally benefit from the findings herein.

1.2. Problem definition

1.2.1. *The premise*

The traditional approach to creating strategies for a prosperous future has focused on designing business models for sustainability using tools such as the Business Model Canvas (Osterwalder & Pigneur 2010) or the Flourishing Business Canvas (Upward & Jones 2016). The presumption has been that by invoking best practice principles, one can develop a better model than previously in place. Whilst this line of reasoning seems reasonable, there is no assurance that such an approach is actually going to yield a more sustainable enterprise. This is always the case, as to determine real sustainability one would need to measure performance in situ. Through evaluations of the business model of an organisation pre- and post- implementation of a particular strategy, one could then empirically report if indeed one approach is better than another.

Thus, going beyond good intentions, the author seeks to measure empirically performance relative to norms, thresholds and allocation and within the safe and just operating space of the ecosystem. This will deliver a reliable measure of the sustainability of an entity at various scales. Linking this to its business model will then provide a way to associate an entities' strategy with performance. Therefore, the initial approach was centred around evaluating the business model, and then - following a deeper understanding gained during the study - expanded with the 7Cs (Fedeli 2020). This study will often refer to business model (level 2, e.g., enterprises) as this is what most are familiar with, but the concepts apply equally at each of the levels. For technical reasons, some parts of the thesis will refer to other levels or the whole hierarchy and will be addressed as such. It is hoped that this will not pose any confusion as the concepts are equally applicable at all levels. For example, when discussing a multinational enterprise, its sphere of influence (entity model) would cross multiple countries, areas of economic trade, jurisdiction, and affect many individuals – employees, suppliers, and

customers. Some multinationals revenue is on par with that of some small countries.

1.2.2. The approach

How can we determine which strategy, or model leads to a more sustainable outcome? The aim was to develop a framework and tool to assess the business model and sustainability performance of each entity. The tool needs to be formulated based on the best available science. Hence, development of the THRIVE framework and sustainability performance score (SPS) assessment tool is as follows.

- THRIVE framework is a universal uniform unbiased (based on external audited data sets) top-down approach providing a just and fair comparative framework (Clauss 2016).
- The framework is a robust first-step approach contributing to theory, methodology, and empirically with practical business tools (Gregor & Hevner 2013).
- The Sustainability Performance Scorecard (SPS) is methodologically transparent and constitutes an agnostic approach and thus dependably useful in its application.
- The intended utility comes from consistency in assessment (uniformity and universality), ability to forecast trends, choice of formula engine and weight engine to conduct 'what-if' analysis for backcasting purposes (Costanza et al. 2009).
- Evaluation of the framework shifts focus from mandatory statutory disclosure (WBCSD 2017b) (compliance) to purposeful voluntary exposure (advocation).
- The solution is predicated upon a systems thinking approach, recognising the complexity and interdependent nature of the environment we seek to understand, analyse, and model (Gharajedaghi 2006).

- The artefact includes the quantitative THRIVE Platform tool which measures impacts and can be used by individuals, analyst, through to policymakers, and business leaders to inform and make strategic decisions in the field of sustainability (Kurucz et al. 2017).

1.3. Problem significance

The ongoing research into the sustainability of business practices highlights the fact that continuing with business-as-usual poses a significant threat to the future of civilisation (consider the COVID epidemic) (Messerli et al. 2019). It is critical to our well-being to have a clear understanding of our current situation, and one way this can be achieved is by using a comprehensive and externally focused 'inside-out' tool that measures the sustainability performance at large of entities such as enterprises upon our external environment and society. Unfortunately, such tools do not currently exist, and even when metrics are referenced, they are often not aligned with the natural and social constraints of our world (Bjørn et al. 2017). It is an imperative to identify the most effective business models in terms of corporate sustainability performance in order to encourage entities to compete for the creation of greater global shared value (Kolk et al. 2017). This competition will result in the formation of collaborative partnerships that prioritize the well-being of people, the planet, and long-term prosperity, leading to a more sustainable future for all.

To achieve this, this study devises a science-inspired framework in support of new tools that measure the sustainability performance of entities based on publicly available, audited reports, and links this performance to the entity's model or strategy. This framework then takes into consideration the natural and social constraints of our world and provides a comprehensive and externally focused perspective. The development of such a framework not only provides a better understanding of the current state of sustainability, but also helps to determine which business models are most effective in achieving sustainable outcomes. This information can be used to encourage entities

to compete for greater global shared value creation, leading to the development of innovative and sustainable business practices.

In addition, the framework and tool provide a means of measuring the long-term impact of an entity's strategy on sustainability. This is a critical aspect, as it would allow entities to assess the long-term viability of their business practices and adjust as needed. Understanding the relationship between strategy and long-term sustainability may prove to be one of the most significant scientific advancements of this century. The development of such a framework and tool to measure the sustainability performance of entities based on publicly available audited reports, linked to its entity's model or strategy is crucial to our collective well-being and future as a civilisation. This framework and tool will provide the means of understanding the current state of sustainability, determine which entity models are most effective in achieving sustainable outcomes, and measure the long-term impact of an entity's strategy on sustainability, indeed thrivability. The importance of this scientific advancement cannot be overstated, and its development should be a priority for all those working towards a thrivable future.

1.4. Key concepts

What is the best framework and tool we have, to evaluate our performance - as a society, industry, government - and provide guidance during the transition to becoming sustainable and thrivable? What ought entities such as enterprises and governments be doing to become more sustainable?

- Thrivability: is defined as going a step beyond sustainability. Whereas sustainability is about surviving, break-even, living within one's needs, day by day and being comfortable and secure, thrivability is accepting those as given, and therefore being able to choose one's own interest and purpose in life to pursue.
- Sustainability: is "*meeting the needs of the present without compromising the ability of future generations to meet their own needs*" (Brundtland 1987, p. 15).

- Strategy (business model): (Business) strategy which is the enactment of a set of business models across the three pillars of sustainability, being the economic, social, and environmental provides the basis for advancement (Lüdeke-Freund, Carroux, et al. 2018).
- This study extends the concept of business model beyond organisations to include portfolio strategy, city governance models, and country-wide policies. Entity models, as hereby defined, span across these holonic levels. For example, it is known that cities are inextricably linked by the human, material, and communications networks to their bioregion (Doughty & Hammond 2004).
- Radical or disruptive Innovation: a term that describes a process by which a product or service takes root initially in simple applications at the bottom of a market and then relentlessly moves up market, eventually displacing established competitors (Christensen 2005).

1.5. Research questions

As a design science research study (DSR), this thesis examines the "ought" rather than the "is" (Simon 1969) as it relates to the field of sustainability. More specifically we aim to inform the field of industrial ecology deriving the basis for technological rules (Joan E. van Aken 2004) which aid us in developing trajectories towards thrivable transformations i.e. thrivability. Several studies to date focus on ex-ante business model design predicated on the assumption that by adopting sustainable methodologies yields to (PREDICTED) sustainable business model and thus sustainable outcomes. This study wishes to examine OBSERVED ex-post business model implementations that empirically deliver on sustainable outcomes and thus can be classified as sustainable business models. This is what is termed OBSERVED (ex-post) vs PREDICTED (ex-ante) sustainable business model and is the first study known to make this distinction.

In achieving this objective the author posit the world we seek full of providence and prosperity and then using backcasting methods (Robèrt

2009) devise techniques to transform today's society into the future we aspire. More specifically, this study examines the strategies employed in undergoing these transformations by measuring status quo of impacts "a priori" and then "a posterior" to identify patterns which are conducive to successful outcomes. Pattern theory is a well-developed field of science supporting the discovery of relationships between the "a prior" and "a posterior" worlds (Alexander 1977).

For example, given a set off organisations all exhibiting a particular category of strategy – a pattern – one could infer that given a particular outcome for one other in the group, all else being equal may also exhibit a similar outcome. As larger sets of organisations with nuanced differences and outcomes are studied and catalogued based on these characteristics, one can with varying degrees of accuracy predict the likely outcome.

This is the essence of predictive analytics, a relatively new realm of artificial intelligence. Given a sufficiently large set of data, adopting the latest machine learning technology, one can model the likely outcome. Even though the outcome is non-deterministic, the system of systems (von Bertalanffy 1968) behaves in a way that can be modelled and therefore predictable. Thus, the author considered and analysed the following provocations:

- The impact of mainstream sustainability is assessed as a long-term corporate strategy and as a common practice (Ioannou & Serafeim 2019), whereby sustainability risks are assessed as business risks (WBCSD 2017b).
    - Are these two sides of the same coin?
- It is said that sustainable business models hold the key to transitions to implementing Business Model Innovation for Sustainability (Schaltegger, Lüdeke-Freund, et al. 2016).
    - If so, are we measuring what matters most?

- Current reporting lacks context (McElroy 2013b) or most often use self-referential indicators (Haffar & Searcy 2018), and thus are oblivious to the limits of our natural resources.
    - Given our finite resources, how do we determine which business models are more successful than others?

Therefore, in an effort to determine how business, or more generically, entity model innovation drives a successful sustainable (e.g., business) innovation strategy, we state our objectives in the form of these generic research questions:

RQ1: How to recognize (identify and categorize) a sustainable entity (e.g., business) model pattern? [This study develops the THRIVE Framework in answer to this question]

RQ2: How can the sustainability performance of an entity (e.g., business) model be assessed? [This study evaluates the artefact using the DSR approach with a case study in the seafood industry]

And thus, how to assess sustainability performance of enterprises (business model), industry (sector model), or city/country (governance model)?

NOTE: In this study we will refer generically to entity or business model, on the understanding that the term may apply also to industry sectors, city governance, bioregions, countries, and any properly defined entity.

1.6. Research output

As this study uses a DSR approach, the output of the study is a set of tools and techniques of predictive utility (Gill & Hevner 2013). From an ecological economist risk minimisation perspective (Redclift 1998), the THRIVE platform ranks corporate sustainability performance alongside the business strategy or business model. It can similarly evaluate other business or more generally entity models at each of the scales as identified in the 7Cs (Fedeli 2020). Key outputs include construct, model,

and instantiation as items delivered by this study (***Figure 1.2***) following the design and evaluation stages of the adopted DSR approach (***Figure 1.3***).

RESEARCH ACTIVITY STREAM / OUTPUT ELEMENT	GOALS	METHODS	OUTCOME
CONSTRUCT	Identify Key Constructs	Literature Review: Sustainability Innovation Strategy	12 Foundational Focus Factors
MODEL	Describe the 'logic'	Literature Review: Sustainability Innovation Strategy	Conceptual Framework
INSTANTIATION	Tool allowing for each use case: THRIVE v1.x ex-ante THRIVE v2.x ex-post	Software Development	THRIVE Platform (Instantiation)

Figure 1.2 *A list of research outputs from this study.*

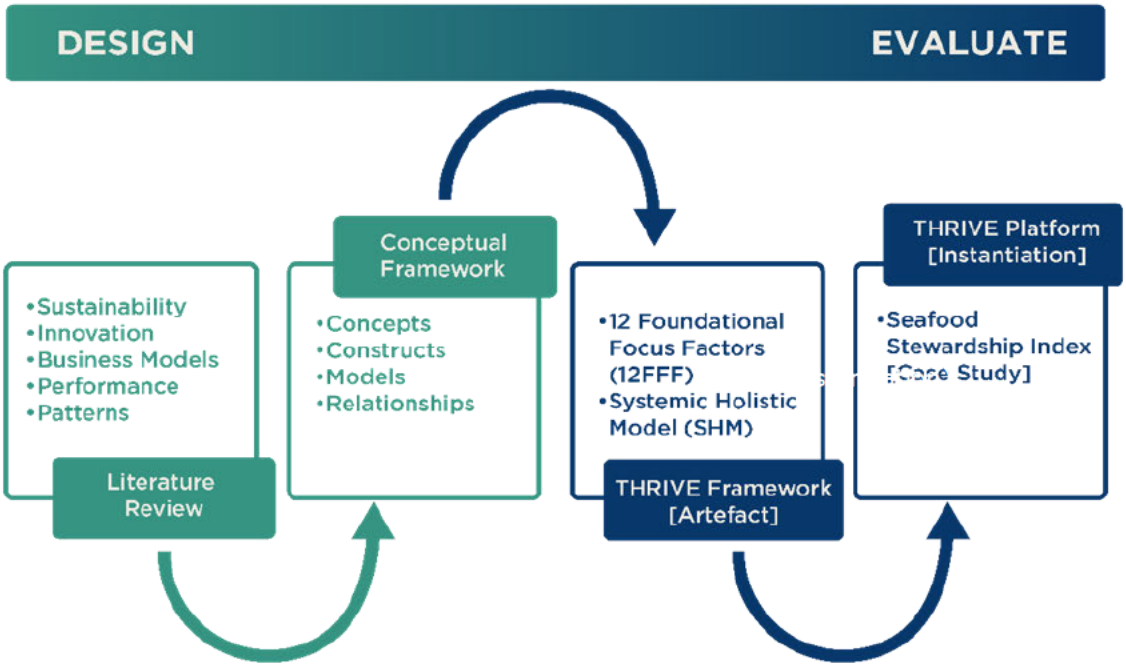


Figure 1.3. *Overview of the Design and Evaluate process deliverables as undertaken by the author in this study.*

The research outputs from this study are discussed in more detail in the conceptual framework in ***Section 2.5***. This section was added to provide better clarity and separation between the literature review and the methodology as the conceptual framework is predicated on the understanding arising from the literature review but also harnesses the choice in the chosen methodology of design science research. As the outcome from this study includes methodological insights, an artefact, and a tool - a detail treatise of this aspect of the research - is included on its own in ***Section 2.5***. We encourage the reader to familiarize themselves with the design science approach and the artefact before embarking on subsequent chapters of this dissertation.

1.7. Scope of study

Initial investigation revealed that to identify which organisations were acting sustainably that the scope of the study had to be enlarged to multiple organisations such as a sector. This seemed to fit in with established approaches by some other groups looking to evaluate the sustainability performance of organisations across an industry. Careful evaluation of the literature then revealed that this was short sighted and still insufficient as it failed to measure impacts within context, reducing any calculations to simply nominal numerator accounting (Baue 2019). Whilst there was pressure early on by supervisors to constrain the broadness of the study, this author felt strongly that the scope should be enlarged.

Given the fundamental nature of evaluating impacts to give rise to meaningful sustainability metrics, it was strongly argued that "*there are no sustainable entities on an unsustainable Earth*" (Fedeli 2020). Indeed, further research confirmed this and ultimately this precept is encapsulated in one of the 12 foundational focus factors that contends on taking on a strong sustainability stance (Upward & Jones 2016). As a result, this study discusses entity models in the general sense, although often making references to the business model (of an organisation or enterprise) in the narrowest sense.

Early on it was thought that this study would not calculate the actual corporate sustainability performance and link to the business model of real enterprises. Instead, the idea was to use illustrative values or historical data based on the Global Reporting Initiative (GRI) reports to demonstrate the same. Later at the end of 2019, we gained access to raw context-based data for the seafood industry as used in the creation of the Seafood Stewardship Index. This base data coupled with the learnings from this study was sufficient to provide empirical confirmation of the accuracy of the THRIVE Platform model for this particular sector. In this study, one can compare between using the THRIVE Platform approach and that of another ratings provider.

What is notable is the similarity in the top line results, albeit those provided here by the THRIVE Platform demonstrate a higher level of transparency and precision, providing a greater level of granularity as one can zero in on a particular material topic and examine how a value is determined. Even more importantly, and uniquely on offer by the THRIVE Platform and not found anywhere else, is the link between sustainability performance measurement and the employed entity (business) model. One can envision using the outcome of such analysis for determining the best course of action in terms of strategy. Whilst in this study the results of the entity model analysis were obtained using machine learning following an offline analysis, future versions could integrate machine learning directly into the core application greatly extending the scope of the system by linking entity model in real time to actual confirmed data from publicly released sustainability reports.

1.8. Overview of methods and findings

This thesis includes a Design Science Research (DSR) study that uses a literature review to develop a model/framework to guide the design of an artefact which is then evaluated using a Delphi Study and a case study. It is a transformative (Mertens 2007) conceptual study incorporating an extensive Literature Review over 7 years, of over one thousand top-tier journal articles (311 Q1 articles), conference

proceedings, reports by seminal authors, discussions with experts, and examination of case studies including integrated corporate sustainability reports and corporate websites. Szekely and Vom Brocke (2017) have revealed how applying natural language processing and machine learning (Binkhonain & Zhao 2019) is a suitable method to extract the meaning of "strategy" or "entity model" from sustainability reports. Thus design science research studies, such as this one, may contribute to theory, methodology, and empirically (Gregor & Hevner 2013).

The unit of analysis is the entity model such as the business model of an organisation or the governance model of a country. Due to the popularity of this term, it is used in this study to represent all models. Material topics under consideration are those identified by standards such as the Global Reporting Initiative Standard (GRIs), the United Nations Sustainable Development Goals (SDGs), Sustainability Accounting Standards Board disclosures (SASB), and so forth. Construct validity is attained through the evaluation of multiple data sources coupled with the maintenance of the chain of evidence. Reliability is achieved through the development of a thematic analysis database (Braun & Clarke 2006; Maguire & Delahunt 2017) with all concepts, codes, categories, and themes stored together with narratives and reports. Rigour is maintained throughout the study by the explicit documentation of choices made for included truths during discovery and evaluation coupled with maintenance of the chain of evidence providing both theory and method triangulation. Multiple secondary data sources are assessed for consistency, transparency, triangulation and verification, thus improving the trustworthiness and credibility of the study (Krefting 1991).

Initially, a kernel theory is advanced, together with illustrative case studies and other public data, to explain and provide justification for the underlying approach. The study incorporates a discussion on economic theory, predicated on linear thermodynamic mathematics, and the theory of change by considering business enablers and moderators, such as leadership, culture, globalisation, collaboration, risk, and regulation. It

combines context-based 'doughnuts' (global thresholds and allocations) with science-based targets, using advanced aggregation techniques built on unique formula and weight engines. The study includes the real case examination and evaluation of the seafood industry through the Seafood Stewardship Index as compared to other methods (WBA 2018).

The trans-disciplinary and wicked nature (Foss & Saebi 2018a) of the projected phenomenon under evaluation means this study develops nascent theory using a systematic Design Science Research (DSR) approach incorporating an extensive literature review (theory) informed by case studies (evidence) and a thematic analysis of the incumbent theory. This is further strengthened by expert feedback much like in the Delphi evaluation (Day & Bobeva 2005). The outcome of this study indicates that even though there is a vast set of data to be examined and analysed, the application of the emergent technological rules (Joan E. van Aken 2004), informed by the natural and social sciences, coupled with the latest in machine learning instructs us clearly on what we ought to do as a civilisation. Much like zero-knowledge proofs (Goldwasser et al. 1989), we need not know all the reasonings nor answers, however, informed by the outcomes we seek, we may steer ourselves and society towards thrivability. After all, we know the destination (break-even sustainability), we just must devise the trajectory to get civilisation there.

1.9. Theoretical and practical significance

1.9.1. Implications for theory and practice

This study breaks away from the conventional approach to sustainability research by adopting a robust and science-based perspective. It takes into consideration the multi-capital and value-based aspects of sustainability and evaluates material topics within a context-based framework, based on both inner (social) and outer (environmental) limits and allocations. The outcome of this study is the THRIVE framework and a sustainability performance score card tool (the THRIVE Platform) that objectively identifies sustainable entity models.

This tool is a significant contribution to the field of sustainability as it provides a quantitative measure of sustainability performance, accompanied by a nominal entity model pattern identification. It encourages entities to adopt sustainable practices and sets a benchmark for sustainability performance. This tool and accompany framework are the first of its kind and serves as a valuable resource for entities looking to adopt sustainable business practices.

The study's unique approach sets it apart from other studies in the field and demonstrates a commitment to providing a comprehensive and scientifically sound framework for sustainability. The THRIVE framework and sustainability performance score card tool helps entities to understand impacts and adopt sustainable practices, and thus contribute towards a sustainable future. The study's strong sustainability stance and focus on science-based solutions make it an important contribution to the field of sustainability and a valuable resource for those working towards a more sustainable future. As indicated by Von Wehrden et al. (2017) in their call for method plurality, projects with a backcasting approach would, for instance, with perfect utility, be able to implement approximations towards solutions for wicked problems into a sustainability science agenda.

1.9.2. Implications for methods

The THRIVE framework and its associated tool, the THRIVE Platform, represent a significant advancement in the field of sustainability. The framework provides a scientifically robust approach to sustainability, which is reflected in the design and functionality of the THRIVE Platform. This tool, emanating from the case study (Johansson 2007), allows for the assessment of corporate sustainability performance at the business model level and provides insights into which business models or strategies are the most successful in terms of sustainability.

The THRIVE framework and its associated tools are designed to drive transformative change towards a more sustainable future. They are available to a wide range of stakeholders, including academia, business

leaders, government policymakers, business analysts, and individuals. By providing a public platform for sustainability assessment and analysis, the THRIVE framework and its associated tools empower business leaders to make informed decisions that benefit the environment, society, and their business. Government policymakers can use the tools to forecast the effects of regulatory actions, while business analysts can use them to guide enterprise strategies. The tool also provides individuals with the ability to encourage competition for greater global shared value creation and collaborative partnerships for people, planet, and prosperity and thus are an aid to business' wanting to excel above their competition.

The THRIVE framework and its associated tool are available under a creative commons license, published in academic journals (Fedeli 2018), as well as freely available on the THRIVE Project website (https://ThrivabilityMatters.Earth). Accessible to a wide range of people, they help ensure a positive impact on the development of sustainable (business) practices. The framework's holistic and multi-capital approach, combined with its strong sustainability stance, make it unique in the field, and provide a valuable resource for those seeking to promote sustainable business practices.

1.10. The THRIVE Project

It would be hard to write about this research endeavour without referencing the THRIVE Project. The THRIVE Project, an international not-for-profit, for-impact organisation had its birth from within the many pages of this thesis. Over time it grew along with it, taking shape slowly but surely from early 2019 through the tumultuous times of COVID up until now. The organisation wasn't always as grandiose as it is now, but the vision was always to make impact on this scale – to change the world for the better through research, education, and advocacy.

Its core mission is to deliver providence and prosperity by illuminating the way forward towards integrating thrivability within the fabric of society and the environmental ecosystem of the planet. Its vision is to live in a world where all life-forms co-exist in harmony and solidarity

with each other, in the pursuit of global shared value creation and prosperity. To this end we have informed the sciences, have developed tools and techniques, educated many, from consumers through to scholars, and provoked several others into taking action for the better. Whilst researching and developing this initiative I was able to meet many great people and learn about the science of thrivability, learn how to mobilize and empower individuals within organisations to exercise informed leadership through various unorthodox approaches such as the collaborative flat structure model (a sociocracy) as used at THRIVE Project (worthy of a dissertation in of itself).

1.10.1. Background

The THRIVE Project, a visionary initiative officially launched in 2019, aims to promote "thrivability" as a new paradigm (Mackenzie & Knipe 2006) for humanity's future. Thrivability refers to a state in which all life flourishes in balance with the Earth's ecosystem and its finite resources. The project recognizes the interconnections between economic, social, and environmental factors, and the importance of addressing the root causes of societal and environmental problems, rather than merely treating their symptoms. The seeds of this project were planted 15 years earlier, back in 2004, when it was observed firsthand many of the issue plaguing the populous and the nations of our world.

The mission of the THRIVE Project is to catalyse a global movement towards a thrivable future by inspiring individuals, communities, and organisations to adopt a holistic and interdisciplinary approach to societal progress. The project provides a framework for action that is based on four pillars: regenerative culture, holistic health, equitable economies, and thriving ecosystems. These pillars provide a comprehensive and interrelated approach to creating a thrivable future, recognising that cultural values and beliefs, health and well-being, equitable distribution of wealth and resources, and the preservation of the Earth's ecosystems are all essential components of a sustainable and equitable future.

The THRIVE Project engages in a variety of activities to support its mission. This includes providing educational materials and resources to individuals, communities, and organisations on how to transition towards a thrivable future. The project also offers workshops, training programs, webinars, and podcasts, to help build capacity and knowledge in areas such as regenerative agriculture, renewable energy, community-based health initiatives, smart communities, circular economy, ocean governance, and in solutions to climate change, biodiversity loss, and ocean acidification to name a few.

The organisation operates across three arms, engaging in research, education, and advocacy work to advance its vision and mission. It collaborates with a wide range of experts and practitioners from various fields, including earth and space science, environmental science, economics, sociology, and the humanities, to develop innovative solutions and best practices for creating a thrivable future. The organisation also works with policy makers and government agencies to promote policies and regulations that support the transition towards a future that benefits us all.

1.10.2. Community collaboration

One of the key features of the THRIVE Project is its emphasis on community-based action and collaboration. The project recognizes the importance of local and decentralised initiatives in creating a thrivable future and works to support and connect communities around the world who are working towards this goal. The project also seeks to build a global network of experts and practitioners who can collaborate and share knowledge and best practices. It also has a unique structure, unlike typical organisations built on hierarchies, The THRIVE Project uses a collaborative structure (sociocracy) with swarms of volunteer thrivers coming together in tasks and teams leading various initiative. This ensures that individual thrivers have the responsibility for bringing to completion the tasks they embark on. It encourages cooperation and

collaboration between team members towards the shared vision and the common goal of doing good to do well (O'Tooie 1991).

The THRIVE Project, working with a series of professional researchers, software developers, data analyst, publishers, marketers, writers, and visual artist develop collaterals, training, and other materials providing insight into the THRIVE Framework and Platform. This provides confirmation and further validation for many of the principles employed in the exploration, design, and development of the same. Furthermore, the THRIVE Framework and Platform was showcase for UN RISD and other UN affiliated research groups from Jan 2020, and has received great support and acclaim. Respected sustainability critic Bill Baue from r3.0 who worked on the UN RISD "*Thresholds of Transformation*" report said about the THRIVE Framework that it "*has been spotlighted as a key data platform for further disseminating implementation of the indicators!*". Some of the public commentaries are included in ***Appendix C: The THRIVE Project***. Also note that the report cites Anders Bjørn (Bjørn et al. 2017), a member of the THRIVE Advisory Board and Academic Alliance partner r3.0 as part of the pilot study on indicators towards sustainable development. In fact, recent 2023 workshops on the United Nations SDPI (Thresholds of Transformations: *Authentic Sustainability Assessment*) incorporates much of what the THRIVE Framework has been espousing for the last four years.

1.10.3. Innovation

The THRIVE Project also promotes the use of innovative technologies and approaches in the transition towards a thrivable future. For example, the project supports the development of regenerative agriculture practices, which aim to restore soil health and promote sustainable food production. Regenerative agriculture practices have been shown to improve soil fertility, increase yields, and reduce the need for synthetic fertilizers and pesticides (Sanyal & Wolthuizen 2021). The project also promotes the use of alternative currencies and financial systems that prioritize community well-being over corporate profits.

Alternative currencies and financial systems, such as community currencies and time banking, have been shown to increase social capital and community resilience, while reducing inequality and promoting local economic development (Fitzpatrick et al. 2022).

Another example, as part of the THRIVE Project smart communities outreach initiative, we have conducted a full lifecycle assessment of household dwellings for embodied carbon to ascertain that a sustainable property constructed with sustainable principles in mind is no more costly than one without this forethought in mind. In fact, sustainable constructions have shown to reduce embodied carbon by as much as 40% (***Appendix B: The THRIVE Platform***). Additionally, THRIVE Project examined the seafood industry, building upon the insights from the research done here in this thesis and expanding it to include segmentations between different sub areas of the fisheries. The recent "*Animal sentience and the need for greater animal protection laws*" whitepaper is also inspired by the THRIVE Framework. Furthermore, the organisation has developed educational materials in the form of audio visuals and interactive tools examining fast-fashion, household recycling, smart buying, reducing water/energy usage, and more. All these activities were inspired by the theory, tools, and technique developed at THRIVE Project leveraging the THRIVE framework and embedded within the written, spoken, and visual content produced and delivered daily to the thousands of followers around the world.

Lastly, as part of the THRIVE Project and the work undertaken during this thesis on sustainable business models, the author was successful in winning a grant in mid-2023 from the Brisbane City Council to travel to Dubai (UAE), Amsterdam & Maastricht (Netherlands), Brussels (Belgium), Bangkok (Thailand), and Singapore (Singapore) to liaise with, present and negotiate for an International New Business Model Conference to be developed/brought back to Australia. Whilst talks are still in progress, it is looking promising with a Thrivability Matters branded

set of workshops and conferences kicking off from 2025 and in the lead up to the Brisbane Olympics 2032.

1.10.4. Transformation

Ultimately, the THRIVE Project represents a bold and visionary initiative that aims to inspire and support a global movement towards a thrivable future. Its holistic and interdisciplinary approach to societal progress, combined with its focus on community-based action and collaboration, makes it a valuable resource for individuals, communities, and organisations who are seeking to create a more sustainable and equitable world. Its emphasis on redesign for regenerative and resilient economies, and transformation towards thriving ecosystems provides a comprehensive, and interconnected framework for action, and its promotion of innovative technologies and approaches offers practical solutions for creating a thrivable future.

As the world faces an increasing array of complex and interconnected challenges, such as climate change, social inequality, and environmental degradation, it is essential that we adopt a holistic and interdisciplinary approach to progress. The THRIVE Project provides a visionary and actionable model for doing so, and its work to catalyse a global movement towards a thrivable future is more important than ever. From a project that started within these pages, THRIVE Project has gone on to become a major player on an international scale, often asked to partake at major events and provide critical input into issues related to sustainability measurement and measuring impact where it matters most.

For further information about the THRIVE Project, please refer to ***Appendix C: The THRIVE Project***. Below is our social map (***Table 1.1***), providing an insight into the culture and impact the organisation is having on the world as it stands today. Further performance measures can be learnt from ***Table 1.2***, with additional details available in ***Appendix C: The THRIVE Project***.

This study has certainly pushed me, the author, beyond anything imagined. My research has taken me to many corners of the Earth, has

made me meet many new similarly minded folks, stretched my imagination, and open me up to so many new learnings, and ultimately allowed me to become better informed as to how to make the world a better place. Now, I pass this knowledge on, sharing with similar minded folks set on a similar course – on the trajectory towards thrivability.



Table 1.1. *The THRIVE Project Social Map, showing the areas of the world where the organisation operates.*

The outcome from my involvement in this research has been beyond an academic doctorate, above a commercial project, and more than an international organisation, with the THRIVE Project now operating as a worldwide community and movement whose imperative is to foster collaboration and innovation towards a thrivable future. With over 25,000 followers across 177 countries, we are a force to be reckon with. Collaborating within a wider community of 2500+ similar minded organisations worldwide we are making a difference that matters.

I have always inspired folks to be the change they want to see in this world, and to leave the place in a better state than the way they found it. I also have encouraged folks to be of value to others rather than simply looking to be successful in one-self (outward perspective vs inward

perspective). Lastly, I ask folks to aim to strive to thrive, always looking to do better and delivering more value than the time before, learning and building upon the wisdom passed down to us by others. Thrivability Matters, so do keep on thriving.

1.11. The Review Process

Initial thoughts around the review process came from discussion with industry leaders and academics from around the world. Several trips to Europe, Asia, and the Middle East planted the seeds of this study's understanding and eventual approach. Details on this process follows.

1.11.1. Integrative literature review

Early thoughts were to conduct a systematic literature review or scoping review (Stål 2018a). However, given the trans-disciplinary nature of the study, common terms do not imply common or even compatible meaning. A comprehensive review was then discussed with supervisors and other experts. Ultimately, given the multi-disciplinary nature of the subject matter at hand, the wide scope, and that only one researcher is involved, an integrative literature review was undertaken as outlined in ***Figure 1.4***.

An integrative literature review is a research method that involves reviewing, critiquing, and synthesising existing literature to generate new

THRIVE Project (activities conducted)	Datum (number / hours)
Audio-visuals	237 / hrs
Webinars	26 / 10:02hrs
Podcasts	19 / 12:17hrs
Trainings	780 / 975hrs
Research	71 / 7,099 hrs
Development	22 / 3,101 hrs
Presentations (Training & Events)	49 / 800 hrs

Marketing (Marketing, Production, Writing)	93 / 5,582 hrs
Leading (Leading, Supporting, Recruiting)	109 / 1,499 hrs
Software Development (LADDER)	4 / 14,000+ hrs
Contributors	344 / 21,193 hrs
	# Number
Blogs	347 / 340.4Kb
Countries	42
Languages	9
Time zones	61
Followers	25,327
Locations	**177 countries**

Table 1.2. THRIVE Project looker database. Snapshot as of 31/12/2022.

knowledge about a topic (Torraco 2005). It is particularly useful for emerging topics where a new framework and perspective that challenges the existing knowledge base is sought. This method involves a critical analysis of the literature, identifying strengths, key contributions, deficiencies, omissions, inaccuracies, and other problematic elements and aspects. The integrative literature review process typically involves the development of a new conceptual model or framework that posits new relationships and perspectives, leading to new questions, and/or agenda for further research. While this method has its shortcomings, with careful consideration of the literature selection and analysis process, it can provide a valuable contribution to the field. Throughout this study, the logic and conceptual reasoning used during the research process are explained, and the insights gained towards the proposed framework or model are sign-posted throughout the review, as seen in INSIGHT (R00).

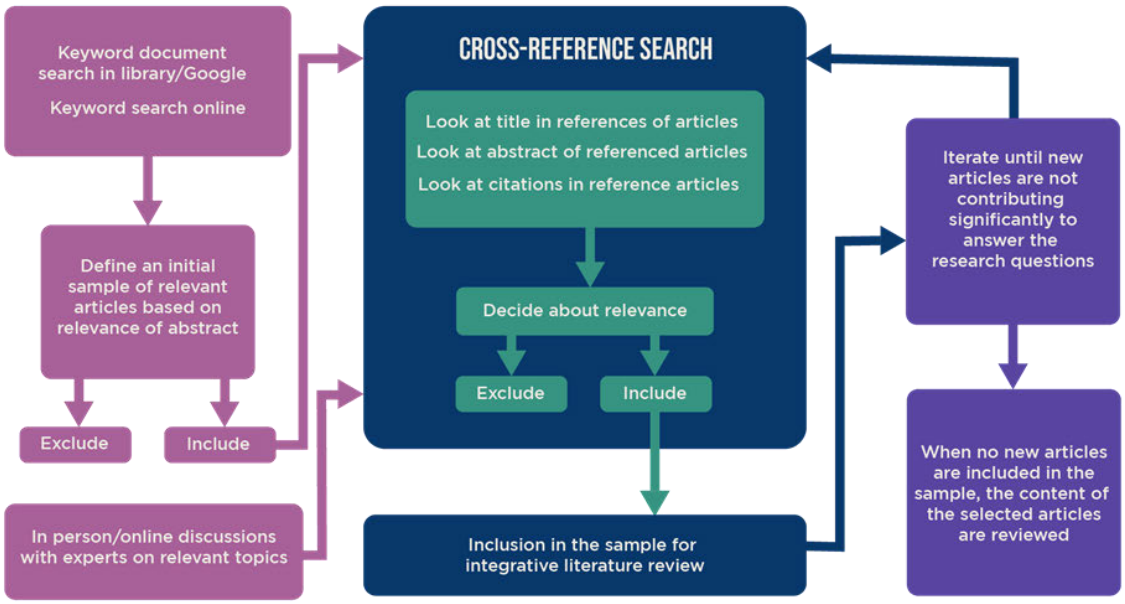


Figure 1.4. *Outline of the integrative literature review process undertaken in his study.*

One of the key advantages of the integrative literature review method is that it provides a comprehensive synthesis of existing literature on a given topic. This approach enables practitioner researchers to identify and address gaps in the literature, and to develop a more complete and nuanced understanding of the topic in question (Fraenkel et al. 1993). It is important to note that the integrative literature review method is not without limitations, including the risk of bias in the selection and interpretation of literature. To mitigate this risk, a rigorous, balanced, and transparent approach to the selection and analysis of literature was used, with clear articulation of the strengths and weaknesses of the chosen approach (Grant & Booth 2009). Aspects of the critical review process which add to its strength, includes deep immersion by the researcher in both the literature, and in consultation with respected authors in the field worldwide.

Informed by the natural and social sciences, this study develops a guiding theory, invoking a strongly sustainable stance, engaging a systems view point (Bansal & Song 2017), based on the fact that we have exactly one planet Earth with finite resources. Developing a framework and Artificial Intelligence (AI) model provides the means to process the

vast datasets available to develop the forward guidance necessary to place society onto the trajectory towards thrivability. As recently reported by John Elkington in his March 2nd 2024, Newsletter, an emergent property of generative AI-enabled neural nets is the integration of triple bottom line thinking – thrivability and flourishing - into world modelling.

Thrivability is about enduring into the future, and whilst there are many ways civilisation as we know it could become extinct, through asteroid strikes, super-volcanoes, contentious nuclear warfare (nuclear apocalypse), epidemics/infestations, or overbearing AI, actions concerning climate change, biodiversity loss, pollution and contamination, and a series of related woes, remain the most profoundly debated (Petranek 2021). Many studies and most practical applications in the field of sustainability assessment assumes endless resources and growth, however, as any good physicist will tell you, the second law of thermodynamics prohibits this to endure (Wiener 2019).

1.11.2. Mapping tools used

During the research a variety of tools were used to help discover, analyse, and catalogue findings. For example, research rabbit allowed me to find all relevant references, access abstracts and visualize papers, and discover networks among collaborators. This tool is highly interactive with sample snapshots shown in ***Figure 1.5*** and ***Figure 1.6***. In the first figure it shows 50 key papers, and 101 authors arranged in a network graph where the connections between the authors indicates collaborations and the size of the circle when highlighted indicates relevance (not visible in the snapshot). Total number of citations is well over 235,000. In the second figure we see collaborations with Christoph Zott, with around 60 publications and over 14,000 citations. In ***Figure 1.7*** we have another example, using the Litmaps tool, and a word cloud for this study is shown in ***Figure 1.8***.

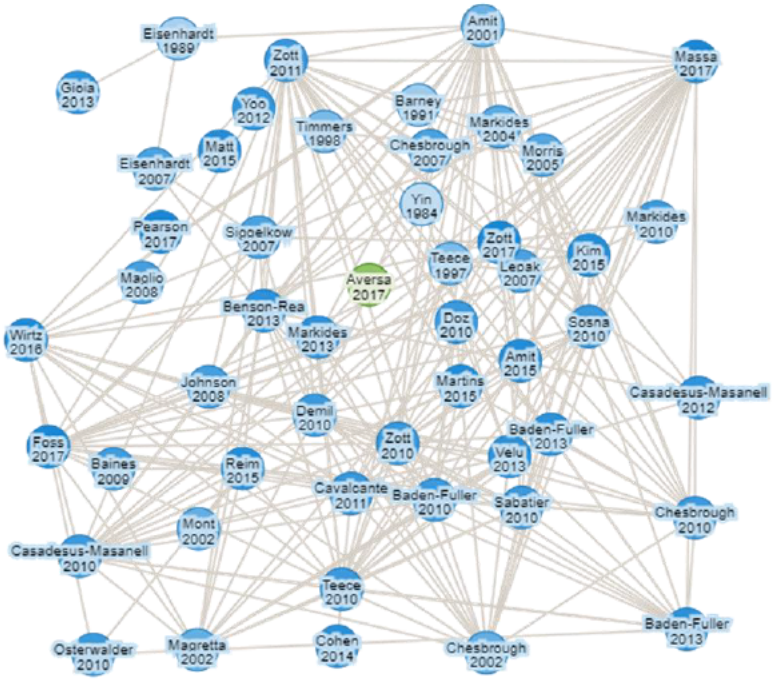


Figure 1.5. Literature map for "business models", "business strategy", and "innovation", as discovered during the literature review.

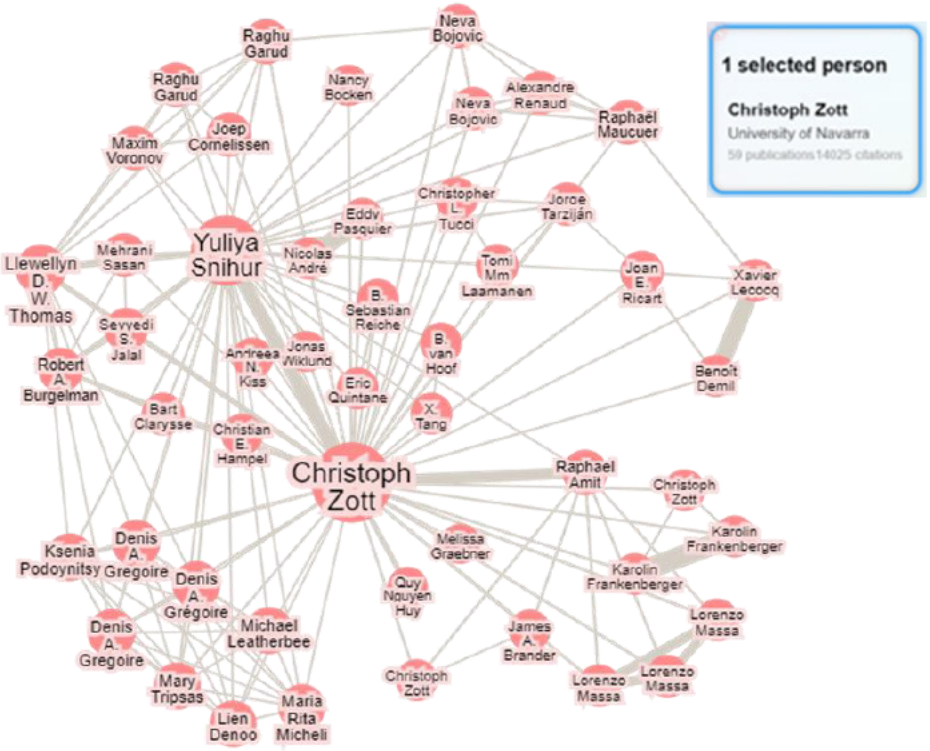


Figure 1.6. *Diagram showing collaborations between Christoph Zott and various other researchers.*

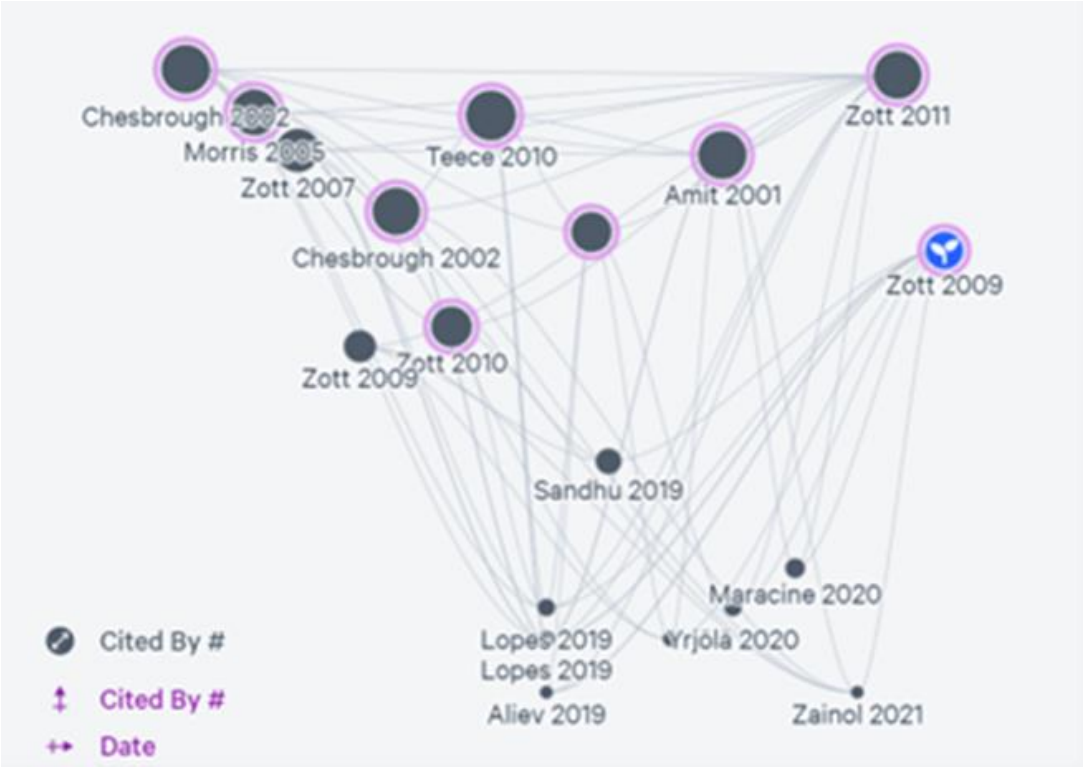


Figure 1.7. *Literature map based on the article: Designing Your Future Business Model: An Activity System Perspective.*



Figure 1.8. *Word cloud extracted from this study.*

1.11.3. Terminology and scope

As revealed throughout the integrative literature review and referenced in this dissertation, the terms business, firm, organisation, enterprise, group, institution, or company, have been used interchangeably as so they appear in the literature. However, as this study reveals, the super-ordinate levels of community, city, country (or region), continent, and cosmos can equally benefit from the findings herein (Kissinger et al. 2011; Fang, Heijungs, Duan, et al. 2015; Steinhöfel et al. 2017). Furthermore, "we" is used in several places so as to refer to the reader and the author, and more broadly society at large as the issues being discussed are relevant to us all.

The next few sections will introduce and reveal several insights that the literature deems necessary for the assessment of the innovation of an entity (e.g., business) model with respect to their sustainability impact. These insights form the conceptual basis of the study, and thus underlying assumptions, which are then explored further, and appear highlight in a boxed area like shown below.

INSIGHT (R00): Sample insight as listed in this literature review.

1.12. Conclusion

This chapter exposes the premise, scope, and approach to this study. It looks at the why, how, and what will be examined and the practical and theoretical significance of the findings. Key concepts and the research questions are shared as well as expected outputs. The role of the author is also shared to provide further context to the usefulness of the approach and outcome from the study.

This thesis follows the publication schema by Gregor and Hevner (2013), with the conceptual framework for the THRIVE Framework (the output of this study) first shared at the end of the literature review. This was done to ensure appropriate emphasis is placed on this part of the thesis as it is largely a conceptual study. The structure is as follows:

1. Introduction: This section provides an overview of the topic, including the nature of the issues being investigated, the scope, research questions, findings, and its significance. It also details my journey and some of my learnings.

2. Literature Review: A significant effort was placed on researching the topic broadly, this chapter constitutes the biggest part of the thesis. Specifically, many sources were considered, beyond journal articles. These include conference proceedings, authoritative websites, meetings with experts and taking part in workshops. Much time was spent by the author in contacting and reaching out to those most influential in the field, leading the way with the latest science. Over the term of the research, prior to COVID-19, trips were made abroad to over thirteen countries to meet and take part in discussions with seminal authors in Bulgaria, Netherlands, Belgium, Germany, Singapore, Thailand, the middle East and elsewhere.

3. Conceptual Framework: This is where key components of the study started to come together, and principally unveiled in the novel artefact known as the 12 Foundational Focus Factors (12FFF). Early understandings and discussions were shared at the Third International New Business Model Conference held in Sofia Bulgaria and published in the Journal of Accountancy and Business.

4. Methodology: Several methodologies were considered in the early days of this study including a systematic literature review, bricolage, and a qualitative only analysis, and a Delphi study. In the first year and a half the approach was changed a few times until the design science research approach was discovered and applied. Online and face to face discussions with key scholars in this field confirmed the appropriateness of my approach (Antony Upward, in Berlin, and Rotterdam). This resolve was further cemented when my supervisors and I discussed this at length, given the nature of the investigation.

5. Artefact Description: This chapter builds on the conceptual model and describes the artefact being the THRIVE Framework composed of the

12 foundational focus factors, and the instantiation being the THRIVE Platform (software tool). Each aspect is introduced and described in detail. Additional resources are available in the ***Appendix B: The THRIVE Platform*** which include links to walkthrough videos, extended tables, charts and the online THRIVE Platform software itself.

6. Evaluation: This is a summary of the evaluation undertaken in late 2020, early 2021 of the artefacts. The evaluation involved a critical analysis of the various aspects of the framework and the instantiation (software) as undertaken by a group of experts who volunteered at random to take part in this process. This included a cross section of individuals from consultants through to academics, business leaders and the like. Even though the evaluators came from different walks of life, they all understood the field and had varied interest and therefore offered a variety of views of the artefact.

7. Discussion: Here I take a closer look at each of the 12 foundational focus factors in light of the evaluation in the previous chapter. Looking to combine common trains of thought and to highlight differences and the reasons for these. The idea is to see where there are areas of consensus among the experts whilst at the same time acknowledging areas of discord. This can serve the purpose of future investigations and ongoing development and refinement of the 12 foundational focus factors.

8. Conclusions: This chapter serves to bring together all the elements before it, from the introduction through to the literature review, the conceptual framework and methodology, and then onto the description of the artefact, evaluation, and discussion. Serving as a summary, it provides a concise round up of the investigation and concludes with future areas of research.

CHAPTER 2: LITERATURE REVIEW

2.1. Background

This study investigates the nexus of business model innovation, strategy, and sustainability (Robèrt 2003; White & Lenssen 2009; Lloret 2016; Waage & Anderson 2017; Sullivan et al. 2018; Cao & Zeng 2019; Ioannou & Serafeim 2019). Prior work in this field reveals that there is no well accepted definition of a business model, nor that all sustainability assessments are treated equally (Lüdeke-Freund & Dembek 2017). As a new integrative field of endeavour this is not so surprising. We shall look at prior work that is deemed relevant to this study, including theories, empirical research, and findings or reports from practice.

With the growing body of scientific evidence suggesting that human activities largely responsible for the deterioration of Earth's systems (Thomas et al. 2004; Rockstrom 2009; Intergovernmental Panel on Climate Change 2023), this study embodies an imperative chasing a moving target. By 2042, it is expected that the world population will grow to 9 billion, the global economy will triple, and pollution and waste will double, leading to a risk of catastrophic global warming if carbon concentration in the atmosphere are not reduced drastically (OECD 2023). For DSR work in the social and environmental sphere (Brocke & Seidel 2012), the prior literature surveyed would need to include any prior design theory or knowledge relating to the class of problems to be addressed, including artefacts that have already been developed to solve similar problems (e.g., exaptations). With this in mind, we progress through the literature review.

The structure of this chapter is to a) review the categorisation of business (entity) models, b) consider current approaches to the measurement of performance, and c) finally disclose the gap in the literature (***Figure 2.1***). We kick this chapter off with an integrative literature review, culminating in a call for an investigation into business model innovation for sustainability.

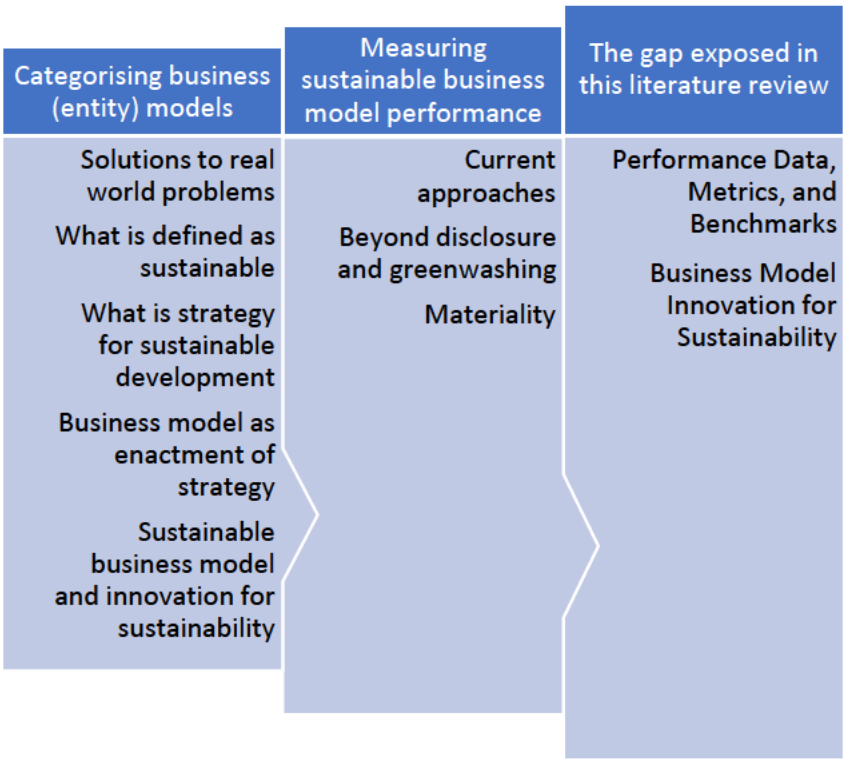


Figure 2.1. *Chapter 2 LITERATURE REVIEW chapter layout.*

2.2. Categorising business (entity) models

Historically the link between business models and sustainability performance has been intrinsic and implicit at the conceptual level (Roome & Louche 2015) with most approaches concerned with the internal business logic (Evans, Vladimirova, et al. 2017). These approaches consider how value is created, delivered, captured and destroyed (Yang, Evans, et al. 2017). Rethinking a business model is seen as a source of competitive advantage (Massa et al. 2017). Business models are dynamic (Roome & Louche 2015) and scalable (Täuscher & Abdelkafi 2018), with several studies showing that there is a positive and statistically significant relationship between sustainability performance and financial performance (UN Environmental Program 2014) with sustainability playing a role internally and externally (Rauter et al. 2017).

The dynamics of how business models change over time through internal innovation and external competitive pressures, drives interest in the identification and categorisation of each of these entity model types (Spieth & Schneider 2016). Lambert and Montemari (2017) have

proposed that practitioners and academics alike, will find value beyond mere disclosure, with the business model used to extract key performance and risk indicators determining how sustainable an entity may be (Lambert & Montemari 2017). Furthermore, Rosati (2018) cites the need for frameworks and tools to manage and assess the sustainability effects of business models (Schaltegger, Hansen, et al. 2016; Lüdeke-Freund et al. 2017). This study will start its exploration by identifying what constitutes a sustainable business (entity) model.

Table 2.1 summarises the key concepts uncovered during the investigation in the categorising of business (entity) models. These will next be explored in more detail.

2.2.1. Solutions to real world problems

2.2.1.1. We live in VUCA times

For civilisation to thrive on Earth, we must transition to a strongly sustainable economy (Broman & Robèrt 2017; Oppenheim et al. 2017; Elkington 2018). The challenges posed by a volatile, uncertain, complex, and ambiguous (VUCA) environment have become increasingly pressing for leaders, policymakers, and consumers in recent years. As Millar et al. (2018) noted, technological disruption, globalisation, and changing economic and political contexts have all contributed to the complexity and unpredictability of the business environment. In response, organisations must develop innovative management practices that foster agility, collaboration, resilience, and adaptability. As reported by Schick et al. (2017), we see how far human well-beings heavily depend on the functionality of ecosystems which are known to suffer from a wide range of stresses and threats of varying criticality. Experts rate impacts of global climate change as most critical. In attempts to achieve ecosystem-based sustainable development, conservationist have been led to seek greater cooperative management and to strive for more risk-robust and adaptive strategies by advocating for active risk management. VUCA is thus both an outcome of disruptive innovation and a driver of it (Millar et al. 2018).

Topic	Details
Conceptual Link	The link between business models and sustainability performance has been intrinsic and implicit at the conceptual level (Osterwalder et al., 2005; Zott and Amit, 2010).
Business Logic	Most approaches focus on the internal business logic, including how value is created, delivered, captured, and destroyed (Amit and Zott, 2001; Teece, 2010; Bocken et al., 2014).
Competitive Advantage	Rethinking a business model is seen as a source of competitive advantage (Teece, 2010).
Dynamic and Scalable Models	Business models are dynamic and scalable, with studies showing a positive relationship between sustainability performance and financial performance (Eccles et al., 2014; Orsato, 2006; Schaltegger et al., 2016).
Internal and External Role	Sustainability plays a role both internally and externally in business models (Dyllick and Muff, 2016).
Change Dynamics	The dynamics of how business models change over time through internal innovation and external competitive pressures drive interest in the identification and categorisation of entity model types (Schaltegger et al., 2016).
Value Beyond Disclosure	Beyond mere disclosure, the business model extracts key performance and risk indicators determining how sustainable an entity may be (Eccles et al., 2014).
Frameworks and Tools	There is a need for frameworks and tools to manage and assess the sustainability effects of business models (Stubbs and Cocklin, 2008; Lüdeke-Freund, 2010; Schaltegger et al., 2012).
Sustainable Entity Models	Sustainable entity models go beyond mere sustainability improvements and are anchored in radical innovation (Bocken et al., 2014).
VUCA Environment	Organisations must develop innovative management practices to foster agility, collaboration, resilience, and adaptability in response to a volatile, uncertain, complex, and ambiguous (VUCA) environment (Bennett and Lemoine, 2014; Sullivan et al., 2017).
Need for Systemic Change	Traditional business models are seen as contributing to ecological degradation, necessitating rapid systemic change in business systems (Rockström et al., 2009; Raworth, 2017).
Strong Sustainability Approach	The study emphasises a strongly sustainable approach focusing on quantitatively assessing sustainable impacts within normative performance ranges (Dyllick and Hockerts, 2002).
Use of THRIVE Platform	The THRIVE Platform software tool is used to visualise and simulate sustainability impacts, offering insights into the different outcomes from various methodologies (THRIVE Project, 2024).
12 Foundational Focus Factors	The 12 Foundational Focus Factors include systems thinking, finite resources, complex wicked problems, entity models, materiality, integral thinking, science-based targets, context-based metrics, and more (THRIVE Project, 2024).
Objective Assessments	Context-based metrics ensure objective assessments of impacts relative to science-based thresholds and allocations (THRIVE Project, 2024).
Moving Towards Thrivability	The study aims to set the foundations for moving individuals, businesses, and society towards strong sustainability and thrivability (THRIVE Project, 2024).

Table 2.1. *Categorising Business (Entity) Models.*

Patnaik (2020) emphasizes that one of the key aspects of fostering innovation in a VUCA environment is developing a culture of innovation within communities such as organisations. This requires a shift away from a culture of risk aversion and towards a culture that values creativity, experimentation, and learning. Patnaik argues that this can be achieved by encouraging collaboration and the formation of cross-functional teams, providing opportunities for employees to share ideas, and promoting a culture of continuous learning and improvement. Patnaik (2020) also emphasizes the importance of developing the necessary skills and capabilities to support innovation in a VUCA environment. This includes building a diverse workforce with a range of skills and perspectives, investing in training and development programs, and fostering a culture of experimentation and risk-taking.

INSIGHT (R01): Given VUCA times, the need for worldwide cooperation and collaboration amongst organisations, governments, and academia is needed, with risk management also playing a part.

In addition to developing a culture of innovation, Millar et al. (2018) identify four key management innovation practices that, pursued together, can help organisations adapt to a VUCA environment. The first is agile management, which involves the ability to respond quickly and flexibly to changes in the market or emerging technologies. The second is collaborative management, which focuses on building partnerships and networks with other organisations. The third is resilience management, which involves developing the ability to anticipate and manage risks. The fourth is adaptive management, which involves the ability to learn and change in response to the environment. Thus, the challenges posed by a VUCA environment require organisations to adopt innovative management practices that promote agility, collaboration, resilience, and adaptability. As Patnaik (2020) notes, this requires a shift towards a culture of innovation that values creativity, experimentation, and learning. By

adopting these practices and developing the necessary skills and capabilities, organisations can better cope with the challenges of a VUCA environment and increase their competitive advantage.

Although beyond the scope of this study, some would argue that degrowth (Schneider et al. 2010) is the path forward, whereas others would favour green growth policies (Fitzpatrick et al. 2022). What we do know is that unending economic growth is physically impossible given the laws of thermodynamics, and that coupled with feedback loops we are already seeing ever increasing VUCA actions in the environment, society, and our very political and economic institutions (Wiener 2019). In fact, there is no empirical evidence supporting the existence of a decoupling of economic growth from environmental pressures and all evidence thus far based on past attempts suggests that such decoupling appears unlikely to happen in the future (Parrique et al. 2019).

INSIGHT (R02): There is a need for innovative management, instilling a culture of innovation toward building resilience to avoid the worst in feedback loops in tackling VUCA times.

In order to avoid the worst from VUCA and feedback loops, we invoke the precautionary principle which demands a holistic (Dao et al. 2011) systems thinking approach (Redclift 1998; Holmberg & Robèrt 2000; Williams et al. 2017). In the delivery of systemic change (Broman et al. 2017; Robèrt & Broman 2017), we can leverage on the framework for strategic sustainable development (FSSD) (Robèrt 2003). Porter and Kramer (2006) acknowledge that addressing sustainability issues is critical to the long-term existence and thriving of enterprises, with radical innovations (Nidumolu et al. 2009; Adams et al. 2015) at the heart of addressing the complex wicked problems faced by humanity (Levin et al. 2012; Kurucz et al. 2017; Foss & Saebi 2018a). The capturing and monitoring of real performance over time (Malhotra et al. 2013; Foss & Saebi 2018a), together with the identification of common principles and

processes associated with resilience across disciplines serves as the basis for effecting systemic change (Ungar 2018).

INSIGHT (R03): The need to take a precautionary approach to sustainability building on the FSSD. Radical innovations at the heart of addressing the wicked complex problems faced by humanity.

Systemically resolving these challenges, requires a first principle design (Holmberg & Robèrt 2000), predicated on an ecological macro-economic approach (Ekins 2003), and strong sustainability (Upward & Jones 2016; Landrum 2017; Stål 2018b; Bonnedahl & Heikkurinen 2019), spanning the economic, social, and environmental pillars (Elkington 1997). A first principled approach has shown resilience in the face of chaos, with Baden-Fuller and Winter (2008) identifying two methods to replication in these cases. In certain circumstances, replication by principles can be as speedy and cost effective (Aspara et al. 2010) as replication with templates, and deliver results of comparable quality, with the additional benefit that replication efforts can be a source or incubator, as well as an application area, for dynamic capabilities in an organisation. They point out that the use of technological rules (Joan E. van Aken 2004) as a first principled approach best suits in areas of adaptation and where the understanding is reasonably accurate at the macro level.

It is expected that field testing of the generated model will produce grounded technological rules (Joan E. van Aken 2004) leveraging first-principles for use in the management sciences, and for implementing management control systems for integration into an enterprises' sustainability strategy (Cao & Zeng 2019), thus addressing the volatile, uncertain, complex, and rapidly changing external environment (Intergovernmental Panel on Climate Change 2014; UN Environmental Program 2015a; Intergovernmental Panel on Climate Change 2018; 2019).

INSIGHT (R04): The need to take a first-principles approach to sustainability to ensure resilience in the face of VUCA. Replication is seen as the best approach when adapting technological rules, and generally accurate at the macro level.

2.2.1.2. Design tools versus evaluation tools

The literature review identified several approaches at determining how best to conceptualize a business model and how best to evaluate its impact on society and the environment at large. To identify solutions to real world problems, several key assumptions by prevailing authors may need to be challenged. One of those considerations is how assessment of business model performance is carried out: ex-ante or ex-post (Steinhöfel et al. 2017).

Many of the well-established design tools such as the business model canvas (BMC) (Osterwalder & Pigneur 2010) and flourishing business canvas (FBC) rely on the former; what we have broadly considered business model design tools, as they are helpful during the proto-strategy stage. In the case of the latter, it specifies that "*subject to confirmation by appropriate descriptive science, many of these conceptual contributions may turn out to also be theoretical in nature, e.g. identifying necessary and sufficient definitions of strongly sustainable business and business models*" (Upward 2013). This means that whilst efforts can be made which are seen as moving towards sustainability (by design), the true measure can only be confirmed empirically by descriptive sciences ex-post.

In my search for better business model assessment methods, I came across the work of Mateu and March-Chorda (2016), who notes that previous studies on ex-ante assessment, based on the definition by Teece (2010), did not consider sustainability or the impact of sustainability performance on the business model. This is a critical limitation, given the growing importance of sustainability in today's business landscape. The usefulness of a business model can only be evaluated ex-post, after it has

been implemented and its consequences have been observed. In this approach, the success of a business model is measured in terms of the profits or other performance indicators obtained by the company. However, this method has two methodological limitations: firstly, it can only be applied to fully or well-implemented business models, and we can never have an ex-post assessment of yet to be or non-implemented business models; and secondly, ex-post assessment can only be obtained years after the implementation, when the implications have already occurred and been recorded.

To address these limitations, Amit and Zott (2001) proposed an ex-ante assessment method. This approach involves evaluating the business model before its implementation, considering its potential to create value and achieve sustainable competitive advantage. The method focuses on analysing the business model components, such as the value proposition, revenue model, and key resources, and assessing how these components fit together and support the overall business model. There is little in the way of ex-post methods with the ex-ante assessment method, such as the one proposed by Amit and Zott (2001), offering a more proactive and potentially more comprehensive way to evaluate the potential of a business model than mere design tools. By considering sustainability and the empirical impact of sustainability performance ex-post, these methods can help ensure that business models are not only profitable but also sustainable and contribute to long-term value creation.

INSIGHT (R05): Ex-post techniques to measure sustainability performance are lacking. Most approaches to date concentrate on ex-ante assessment based on recognised practices that are simply deemed improvements towards sustainability.

2.2.1.3. The study of business model components

Another common approach seen in the literature details business models constructed from business logic components. A few different component approaches were discovered during this investigation (Clauss

2016). A range of examined components from models based on business strategy, resource-based theory, strategic network theory, cooperative strategies, and transaction-based economics have guided the selection of business model components (Morris et al. 2005) resulting in an inside-view on a wide array of components being recognised in the literature (Lambert 2012).

One such approach is the SUST-BMA by Lüdeke-Freund et al. (2017) which aims to identify how sustainable business models may create, deliver, and capture ecological, social, and economic value through sustainability innovations. In their study, the business model is seen as a mediating device, bringing together the five key business model logics of financial, marketing, production, capability & resources, and context logic as illustrated in ***Figure 2.2***. Here the business model concept demonstrates systemic linkages across several logics which can be captured, described, understood, and shared. A business model is the result of a combination of these logics. Worth noting is that most performance assessment approach, such as those by GRI (cf. Fedeli & Glinik 2021) and others are organisation-wide, and thus constitute a very different unit of analysis than the business model. As a case in point, in further differentiating these approaches we see that whereas the GRI framework is focused on [numerator] "impacts", the business model is focused on "value(s)" (Lüdeke-Freund et al. 2015). This study asserts there is usefulness and utility in obtaining an a-posteriori assessment of an entities' adopted model(s) using a black-box outside-in approach. As such, there is no need to examine the components in of themselves, just the outcome and impacts of the chosen combination of business model(s) on society and the environment (i.e., the outside world) (Lüdeke-Freund 2019).

INSIGHT (R06): An outside-in a-posteriori black-box approach can provide empirical quantitative results which is focussed on measuring value.

2.2.1.4. Keystone actors

Keystone actors, much like keystone species, have a disproportionate influence on the structure and function of their ecosystem. In the Anthropocene, keystone actors are an increasingly important feature of the human-dominated world with high relevance for sustainable management of natural resources and the environment (Osterblom et al. 2015). There is mounting evidence that similar keystone actors exist in other sectors also (*Ibid*.).

INSIGHT (R07): The examination of the impact of keystone actors is a useful and exemplary way to tackle the sustainability of the environment and natural world.



***Figure 2.2**. Highlight of the key five business logics, reproduced from Lüdeke-Freund et al. (2017).*

2.2.2. What is defined as sustainable

At this point it is worth clarifying two distinct types of approaches to sustainability. "*Strong sustainability*" is explicitly informed by current natural science observations about the importance of certain stocks of

"*critical natural capital*" to sustain "*basic life support functions*". It refers to the notion that economic development should not come at the expense of the natural environment and that the preservation of natural resources and ecosystems is crucial for long-term human well-being. It demands an understanding of the "*macro-economy as a sub-system of the finite ecosystem*" informed by the natural sciences. With this holonic understanding we have these economic systems operating separately and as nested relationship within the biophysical and social systems (Victor 2018). Whereas "*weak sustainability can be interpreted as an extension to neoclassical economics*" where such containing systems are not considered (Neumayer 2010a; Pelenc 2015) (***Figure 2.3***). Under the weak approach one could trade the last gallon of water on Earth with an ingot of gold or a donation to the local fire department or even acquire carbon credits and still be seen as sustainable. In fact, carbon credits are a uniquely pliable way to obfuscate one's way towards achieving sustainable outcomes (Emma Borjigin-Wang 2024).

MAIN DIFFERENCES BETWEEN WEAK AND STRONG SUSTAINABILITY

	STRONG SUSTAINABILITY	WEAK SUSTAINABILITY
KEY IDEA	The substitutability of natural capital by other types of capital is severely limited	Natural capital and other types of capitals (manufactured etc.) are perfectly substitutable
CONSEQUENCES	Certain human actions can entail irreversible consequences	Technological innovation and monetary compensation for environmental degradation
SUSTAINABILITY ISSUE	Conserving the irreplaceable stocks of critical natural capital for the sake of future generations	The total value of the aggregate stock of capital should be at least maintained or ideally increased for future generations
KEY CONCEPT	Critical natural capital	Optimal allocation of scarce resources
DEFINITIONS OF THRESHOLDS AND ENVIRONMENTAL NORMS	Scientific knowledge as input for public deliberation (procedural rationality)	Technical/Scientific approach for determining thresholds and norms (instrumental rationality)

Figure 2.3. *Main differences between weak and strong sustainability.*

According to Upward and Jones (2016) and Willard (2009), a successful strongly sustainable business is one that is fully engaged in the sustainable value network of the broader economy. This approach is characterised by the compatibility of business success with relevant scientific knowledge, including natural, social, economic, management, and psychological science. Upward and Jones (2016) refer to such businesses as "*flourishing enterprises*" and "*future-fit businesses*", which are informed by the prevailing scientific knowledge and committed to sustainability. It emphasizes the integration of sustainability into all aspects of the business, including operations, governance, and stakeholder engagement. By considering the broader circular economy (Geissdoerfer et al. 2017) and sustainable value network, businesses can identify and prioritize opportunities to reduce their environmental impact, increase their social contributions, and enhance their economic value. This requires a commitment to ongoing learning and adaptation, as well as a willingness to collaborate with other stakeholders in the value network (Willard 2009; Upward & Jones 2016). For enterprises, for example, this means extending the paradigm of corporate sustainability beyond the business case and into the realm of ecological science and strong sustainability (Landrum 2017).

INSIGHT (R08): Integrating a scientifically informed strong sustainability approach is necessary in a finite world of unknowns operating within the sustainable value network.

2.2.2.1. Definition of business model (BM)

As demonstrated in ***Figure 1.5***, there are many definitions of business model inter alia with several similarities and many divergences too. I will discuss some of the more applicable definitions here with a view to highlighting some of the key areas of inclusion in any thorough analysis of business models. My aim here is not to converge upon, but rather to illuminate some of the key characteristics exhibited by business models

with a view to include these, and thus provide a comprehensive approach in the final analysis.

We start with Linder and Cantrell (2000), who noted the emergence of influential works in the strategy and innovation domains. They suggest that the definition of a business model highlights functions that are mainly discussed by scholars of strategy and innovation, which include creating, delivering, and capturing value. They also argue that when people use the term "business model", they are often referring to three different types of things: components of business models, real operating business models, and change models. Components of business models refer to the pieces that make up a business model but do not constitute a complete model (more on this later). An operating business model, on the other hand, represents the organisation's overall core logic for creating value. Finally, change models describe how an organisation adapts to a dynamic environment. This provides a useful framework for understanding the various elements that comprise a business model and the ways in which they are discussed in the literature. Additionally, (Rappa 2001), sees business models as intellectual property and therefore an organisation’s asset.

INSIGHT (R09): A BM represents an organisation’s core logic for creating value and is mostly emerging from scholarly research in the field of strategy and innovation.

Chesbrough and Rosenbloom (2002) provided an "*operational definition*" of a business model, outlining its key functions, including defining the value proposition, identifying the target market, designing the value chain, estimating the cost structure and profit potential, determining the firm's position within the value network, and formulating a competitive strategy. According to this definition, a business model is a company's approach to generating revenue and ensuring its sustainability. It specifies where the company is situated in the value chain and outlines how it makes money. The initial business model can be

seen as a proto-strategy or a preliminary hypothesis for delivering value to the customer, rather than a fully elaborated plan of action. Entrepreneurial insight into both technology and the market are required to identify and implement a new or different business model. Later, Chesbrough and Rosenbloom promoted the Business Model Canvas (BMC) by Osterwalder and Pigneur (2010) as a potentially useful conceptual tool for innovating business models strategically.

INSIGHT (R10): Organisations, governments, and academia initial BM serves as a proto-strategy, testing an hypothesis until it is implemented successfully.

Teece (2010) posits that the business model is a critical element that lies between a firm's input resources and market outcomes. It embodies the organisational and financial architecture of the business, and its primary function is to define the way a firm delivers value to customers, attracts them to pay for the value, and converts those payments into profit. The creation of a successful business model does not guarantee a competitive advantage as imitation can be easy. To attain sustained profits, a differentiated and hard-to-imitate yet effective and efficient business model is crucial. Unlike business strategy, the business model is a conceptual model of a business, and it is more generic. However, the analysis of business models in conjunction with strategy is necessary to secure competitive advantage resulting from new business model design. Entrepreneurs and managers must be well-positioned and adaptable to succeed in creating a viable business model, as the best model is rarely apparent early on. The design of good business models is an art that requires evaluation against the present state of the business ecosystem and how it could evolve.

INSIGHT (R11): BM is conceptual and ought to be hard to imitate to provide a competitive advantage. BM is more generic than strategy and is thought of as art, requiring evaluation against incumbent models.

According to Casadesus-Masanell and Ricart (2010), a business model can be defined as "the logic of the firm, the way it operates and how it creates value for its stakeholders," which is similar to the definition provided by Baden-Fuller and Winter (2008). However, the authors suggest that developing a business model is more of an art than a science. They note that when a firm's business model links/connects to another firm's business model, it can lead to consequences for both organisations. Therefore, feedback to the rest of the system is determined not only by the focal firm's choices, but also by the choices of the other firm. Furthermore, they argue that although not every organisation has a strategy, a firm's business model reflects its realised strategy. The authors note that a business model is a highly complex entity that can only be represented through abstractions, with the business model being the direct result of its strategy. When discussing a real, objective business model, one is actually working with its representation.

INSIGHT (R12): First-hand recognition that a firm does not operate in isolation, and that there are feedback loops. Developing BMs is seen as an art and an abstract representation or reflection of its realised strategy.

Magretta (2002) argues that a successful business model represents a superior way compared to the existing alternatives. In this sense, creating a business model can be likened to writing a new story. Magretta notes that the process of business modelling is analogous to the scientific method, where a hypothesis is developed and tested in action, then revised as necessary. While some may use the terms interchangeably, a business model is not equivalent to a strategy. Nonetheless, all viable organisations are founded on a solid business model, regardless of whether their founders or managers conceptualize their operations in those terms. Business models serve to describe how the components of a business are integrated as a system, yet they do not consider a crucial aspect of performance: competition.

According to Magretta, a business model is essentially a narrative that elucidates how enterprises operate (Magretta 2002). It is a story that depicts how a company creates and captures value for its customers. The business model should identify the value proposition of the company, the target customer segments, the channels through which the company interacts with customers, the key activities and resources that support the business, and the revenue streams that generate profits. A business model represents an overall system that brings together all these elements, and if well-designed, it results in a sustainable competitive advantage.

INSIGHT (R13): Compared to strategy, BM does not factor in competition. Akin to the scientific method, a BM is about a narrative, developing a hypothesis and testing it in action.

Osterwalder and Pigneur (2010) propose a business model design approach that centres on "how an organisation creates, delivers, and captures value", referred to as the Business Model Canvas (BMC or Canvas). Business model innovation (BMI) is a novel and useful change in how enterprises or fields operate towards value imperatives. The authors identify patterns for BM similarities interpreted among five selected business concepts using the BMC approach, noting that organisations may incorporate several patterns simultaneously.

Regarding strategy, Osterwalder and Pigneur (2010) suggest utilising the BMC perspective, particularly with regards to strategic theory. This includes considering the competitive environment (Porter & Kramer 2011), internal and external evaluation factors (Andrews 1971), market space innovation (Kim & Mauborgne 1999), and managing multiple BMs within organisations (Goold et al. 1994). The authors suggest that the Canvas could be a potentially useful conceptual device for the strategic task of BM innovation.

INSIGHT (R14): The BMC adopts BMI practices to identify (multiple) patterns used for designing a BM that creates, delivers, and captures economic value. As a strategic conceptual device, it leads to novel and useful changes in how enterprises operate towards value imperatives.

We come to Zott et al. (2011) who have noted that there is no consensus among scholars regarding the definition of a business model, despite its significant attention from both academics and practitioners. However, they have identified four areas of agreement among scholars, including the business model as a new unit of analysis, the importance of a system-level approach to explain how firms conduct business, the emphasis on system-level approach to explaining firm activities, and the business model's role in explaining value creation. Although the business model is often studied without a clear definition, it is widely acknowledged as a combination of several elements, including but not limited to value proposition, revenue model, and network of relationships.

The work of Afuah (2004) and Afuah and Tucci (2001) has been considered conceptual, but some authors have conducted empirical analyses. For instance, Zott and Amit (2007) have explored the performance implications of business model design in entrepreneurial firms. The business model is viewed as a crucial element of a comprehensive framework for systemic change. In the technology and innovation management field, the business model is perceived as a mechanism that links a firm's innovative technology to customer needs and/or other firm resources. Zott et al. (2011) notes that the definition of business model remains a subject of debate among scholars, and that empirical analyses are being conducted to explore the performance implications of business model design in entrepreneurial firms.

INSIGHT (R15): The BM is a new unit of analysis and seen as part of a comprehensive framework for systemic change, capturing a systems-level approach to how a firm conducts business.

Recent literature has discussed many limitations of existing works on measuring sustainable development at both local, national and international levels (Frugoli et al. 2015; Hák et al. 2016; Klopp & Petretta 2017), with leading frameworks such as the United Nations sustainable development goals (UN SDGs) spreading across 17 goals, 169 targets, and 247 indicators providing diluted guidance at best (Costanza et al. 1997). Measuring what matters most requires skilfully identifying aspects of a strongly sustainable and thriving future (Fedeli 2018).

2.2.2.2. Why should we care: business as usual?

We live in a world of finite resources, with ever increasing threats to humanity's long-term survival posed by ever increasing levels of poverty, water and food shortages, toxic pollution, depleting natural resources, loss of biodiversity, and deteriorating unfavourable climate (O'Neill et al. 2010; Steffen et al. 2011; Ghisellini et al. 2016). Notably, human induced climate disruption is integrally related to the evolution of global capitalism over the last 200 years of industrial development. During this time, we have seen rising CO_2 concentrations (GHG) (Faria & Labutong 2015) in the atmosphere from the pre-industrial 280ppm to now more than 420ppm as we are set for the Earth's temperature to increase by more than 2^{o} C by the turn of the century (Intergovernmental Panel on Climate Change 2014; Steffen et al. 2015). Capitalism coupled with globalisation of economic activity and expansion of consumption, driven by consumerism, has brought our continual "*take-make-use-dispose*" approach to our societal needs (Daly 1992; Ness 2008; Webster 2015; Evans, Fernando, et al. 2017), to diminish our natural resources, such as forest and oceans, thus severely jeopardising their ability to act as carbon sinks (Steffen et al. 2006). Man-made or not (Cook et al. 2013), one thing is for certain: "*business as usual*" revolving around our escalating reliance on fossil fuel energy: coal, oil and gas, is not sustainable and an urgent solution to our crisis is needed (Haanaes et al. 2011; Robèrt et al. 2013; Bocken 2014; WBCSD 2017a). Scope 1, 2 and 3 emissions (footprints) need tracking as well as scope 4 handprints (Norris 2015).

INSIGHT (R16): We live in a world of finite resources. Our economic activities and global actions sparked by consumerism are depleting natural resources including our carbon sinks.

Thus, what is the importance of sustainability for humanity? Organisations relying on each other and ultimately natural and human resources, play a most vital role, by providing society with the goods and services we use and consume through the value chain (Willard 2009; Clinton & Whisnant 2014). Improvements at every point along the value chain are paramount; however, disruptive innovation, particularly at the business model level are the most rewarding (Lindgardt et al. 2009; Breiby & Wanberg 2011; Schaltegger et al. 2012). Some organisations still assume that there is no self-benefit in doing more for the common good than that which is mandated (i.e., by compliance) as required by politically imposed regulation and legislation, and that such behaviour would only harm their competitiveness (Willard et al. 2013). However, contrary to the prisoner's dilemma mind-set, Robèrt and Broman (2017) argue that a large part of the self-benefit of proactivity for sustainability is direct, whereby promoting the common good or shared value through voluntary collaboration between proactive businesses and policy makers in worthwhile in advancing legislation for strategic sustainable development thereby supporting society's transition towards sustainability.

Examples of such policies seen as conducive towards the economy, and society at large, and for the greater good, are derived from emerging principles of sustainability. These include the circular economy, just transitions, ecological resilience and systems thinking, net-zero and carbon neutrality, nature-based solutions, alignment to the SDGs, regenerative economics, and indigenous knowledge integration. Case in point is the EU's Biodiversity Strategy 2030 nature-based solution,

promoting reforestation and wetland restoration; or ecological resilience brought about by the Paris Agreement, urging adaptive ecosystem-based approaches to climate shocks. On the Net-Zero front we have the UK's legally binding target to reach net-zero emissions by 2050 and New Zealand's Wellbeing Budget prioritizing regeneration and social well-being over GDP. There is the UNFCCC's just transition principles to secure job protection during decarbonization, and the EU's Circular Economy Action Plan targeting waste reduction and product lifecycle management. A list of some of these sample initiatives and emerging principles is to be found in ***Table 2.2***.

Emerging Principle	Definition/Principle	Sample Policy Example	Reference
Circular Economy	Transitioning from a linear "take-make-dispose" model to circular systems focused on recycling and reuse.	The EU's Circular Economy Action Plan targets waste reduction and product lifecycle management.	European Commission. (2020). *A new Circular Economy Action Plan.* Retrieved from europa.eu.
Just Transition	Ensuring equitable and inclusive sustainability transitions that protect vulnerable communities.	The UNFCCC includes just transition principles to secure job protection during decarbonization.	United Nations Framework Convention on Climate Change (UNFCCC). (2021). *Just Transition of the Workforce.* Retrieved from unfccc.int.
Ecological Resilience & Systems Thinking	Building resilience by understanding ecosystems as interconnected and complex systems.	The Paris Agreement urges adaptive, ecosystem-based approaches to climate shocks.	United Nations. (2015). *Paris Agreement.* Retrieved from un.org European Commission. (2020). *EU Biodiversity Strategy for 2030.* Retrieved from ec.europa.eu.

Emerging Principle	Definition/Principle	Sample Policy Example	Reference
Net Zero & Carbon Neutrality	Setting stringent goals to achieve carbon neutrality and reduce greenhouse gas emissions.	The UK's legally binding target to reach net-zero emissions by 2050 with supporting frameworks.	UK Government. (2019). *The Climate Change Act 2008 (2050 Target Amendment).* Retrieved from gov.uk.
Nature-Based Solutions	Using natural processes and ecosystems to address societal challenges like climate change and water management.	The EU Biodiversity Strategy for 2030 promotes reforestation and wetland restoration.	European Commission. (2020). *EU Biodiversity Strategy for 2030.* Retrieved from ec.europa.eu.
Sustainable Development Goals (SDGs) Alignment	Embedding the SDGs as a framework for comprehensive sustainability in national policies.	Australia's National Strategy for Ecologically Sustainable Development aligns with SDGs.	Department of Agriculture, Water, and the Environment. (1992). *National Strategy for Ecologically Sustainable Development.* Retrieved from environment.gov.au.
Regenerative Economics	Moving beyond sustainability towards systems that actively regenerate and restore ecological health.	New Zealand's Wellbeing Budget prioritizes regeneration and social well-being over GDP.	New Zealand Government. (2019). *Wellbeing Budget.* Retrieved from treasury.govt.nz.
Indigenous Knowledge Integration	Incorporating traditional ecological knowledge and Indigenous practices in sustainability frameworks.	Canada's IPCA initiative integrates Indigenous stewardship into national conservation efforts.	Government of Canada. (2020). *Indigenous Protected and Conserved Areas (IPCAs).* Retrieved from canada.ca.

Table 2.2. Sample policy review of emerging principles of sustainability.

Collaborations are seen as an essential way for organisations working with industry peers, suppliers, consumers and the government can make progress towards sustainable development by combining their knowledge and expertise (Sandow & Allen 2005; Moggi et al. 2021). These collaborations - often across multiple disciplines – are becoming more common and are characterised by the process of "*hybridisation*" in which corporations work with key stakeholders (government, political actors, public, consumers, and NGOs) to achieve environmental sustainability (Busch & Shrivastava 2011). Hybridisation offers the possibility of a deeper engagement between corporate and stakeholder interests, but caution is necessary as it has the potential to corrupt traditional boundaries between different sectors and has a biased availability towards large established companies. Therefore, whilst the process of hybridisation offers opportunities for transforming organisations towards sustainability, the potential corrupting influence on political systems is also to be considered (Shrivastava 1995).

INSIGHT (R17): Disruptive innovation, particularly of one's BM is the most rewarding. Entities do not work in isolation but are at the mercy of the ecosystem supporting them including other industry competitors and regulatory bodies. Collaborations is key to environmental sustainability.

Sustainable development – a term emerging from the UN commissioned Brundtland report of 1987 (Kiron et al. 2017) – is defined as the ability to "meet the needs of the present without compromising the ability of future generations to meet their own needs" (UN Environmental Program 2015a); and thus predicates, the long-term viability of this planet to be largely determined by the actions we, as a society, take to ensure future generations do not fall prey to our neglect. A strategic business approach to society and the environment, based on 'systems thinking' (von Bertalanffy 1968; Pourdehnad & Bharathy 2004; Evans, Fernando, et al. 2017), is necessary to tackle these 'super wicked'

problems (Breuer & Lüdeke-Freund 2016) whereby leading businesses will recognize this as an opportunity, and see it as an imperative to become part of the solution (Haanaes et al. 2011; Webster 2015; Kourula et al. 2017).

INSIGHT (R18): Systems thinking approach is necessary to implicate interconnectedness and address super-wicked problems.

Super wicked problems are ones that are defined as complex problems involving many variables (Lazarus 2008) and where the interdependencies between the various elements requires sophisticated modelling to more truly understand the impacts . It is where changes in one aspect of a system can have repercussions (or domino effect) in many other areas, and where tensions between the natural and social sciences manifest themselves (Jerneck et al. 2011). This is where applying design thinking and reflexivity by the researcher is useful, going beyond identifying system knowledge and developing normative and transformative knowledge (Von Wehrden et al. 2017). Through combining design thinking and sustainable business models (Shapira et al. 2017) by integrating design thinking into the innovation process (Martin 2009) we can create additional forms of value and include formerly underserved stakeholders (Geissdoerfer et al. 2016).

The world faces complex and interconnected issues, such as climate change, that are characterised as "*super wicked problems*" (Levin et al. 2012). These problems have four key features: a limited amount of time to solve them, those who cause the problems are also seeking to solve them, a lack of central authority, and irrational policy responses that discount the future. In the face of these challenges, values-based innovation can play a critical role in helping organisations effectively tackle complex and wicked problems by aligning their efforts with their core values and mission. Seiler et al. (2022) argue that a customised combination of values-based and evidence-based innovation management

elements can enhance a company's culture (Warrick 2017) of innovation and improve its idea generation process. This approach to innovation management considers the unique values and goals of the organisation, while also relying on evidence and data to guide decision making. By combining values-based and evidence-based elements, organisations can ensure that their innovative efforts are not only effective, but also aligned with their values and goals. In fact, values-based innovation has been shown to be the crucial starting point for systemic sustainability innovations in values-based networks and business models (Breuer & Lüdeke-Freund 2017).

INSIGHT (R19): Values-based innovation help organisations deal with complex and wicked problems and in dealing with systemic sustainability innovations in values-based networks and business models, even improving culture. Modelling is useful in addressing super wicked problems.

Moreover, despite the complexities of the integration of the disciplines within the domain space, it has been shown that sustainability isn't the burden on the bottom line that many executives believe it to be, but rather represents a competitive opportunity to excel (Ball 2006; Nidumolu et al. 2009; Adams et al. 2012; Kiron et al. 2017; Varadarajan 2017).

2.2.2.3. Normative Definition of "success"

We are now reminded that we need to be explicit about the normative. Whilst this is a matter of axiology, of values (Upward 2017), the conceptual field of business models, studied without an explicit normative definition of "success" is fraught with danger, and makes the whole investigation rather meaningless. Zott et al. (2011) remarks how often there is a lack of clarity on this term, stating that the "*business model is not a value proposition, a revenue model, or a network of relationships by itself; it is all of these elements together*". It is a new unit of analysis, offering a systemic perspective on how to "*do business*", encompassing boundary-spanning activities (i.e., activities performed by

the enterprise and others), focusing on value creation as well as value capture. These themes are interconnected and mutually reinforcing, whereby more than mere strategy, the business model is introduced as part of a comprehensive framework for thinking about systemic change. Zott et al. (2011) suggests that this type of conceptual consolidation suggests the research field of business models is moving towards maturity.

In the case of "success" as it applies to business models, we therefore consider business models that lead to sustainable development. In the next section we'll examine what strategies may lead us there.

INSIGHT (R20): Expressing the normative is essential if we are to achieve the desired outcome. Note that a BM stretches beyond the boundary of an enterprise.

2.2.3. What is strategy for sustainable development

Seminal author Mintzberg (2007) essentially defines strategy as *patterns* in action, occupying a place along the strategy continuum between deliberately formulated a priori and emergently formed a posteriori as they evolve, guided by decision-making behaviour. Porter and Kramer (2006) sees strategy as *position*, and Drucker (1995) in '*Theory of the business*' sees it as *perspective.* Whether perspectives, position, or patterns, for a business to be seen as sustainable it needs to demonstrate a logic as to how it goes about its business in line with the objectives of achieving sustainable development. Thus, for simplicity, we identify those sustainable business *patterns*, exhibited by organisations within the sustainable development paradigm, as those that are restorative and regenerative by design, and aiming at keeping products, components, and materials at their highest utility and value at all times (Lewandowski 2016). Thus, operating within the external environment, or the wider circular economy (CE) (Geissdoerfer et al. 2017), we are seeking to understand which organisations empirically demonstrate a business model pattern (BMP) leading to sustainability. As an ecological

economist, seminal author, Herman Daly, has argued for a holistic approach whereby economic growth and environmental protection are not necessarily incompatible, but rather can be mutually reinforcing if managed properly, and advocates for a steady-state economy that aims to maintain a stable level of resource consumption and waste generation within the carrying capacity of our ecosystem. His views re-enforces long-term thinking and planning (Daly 1995). Lazlo et al. (Hill et al. 2022) in *From Sustainability to Thrivability: Transforming Systems with Purpose*, state that the "*true potential of regeneration and thrivability [is] to create the conditions for flourishing*" providing the necessary and sufficient foundations required to achieve sustainable development.

INSIGHT (R21): See BMs as patterns in action. Take a long-term view, holistic approach to sustainable development, with consumption and waste generation within carrying capacities.

2.2.3.1. Organisations are co-dependents

Pfeffer and Salancik (2003) argue that organisations are not self-contained, but rather must embrace a contingency approach to management and consider the effect of globalisation of business, rapid technological and product innovation, product and customer diversity, as well as dealing with variations local, state, and federal laws and regulations among others in adapting their organisational structures, managerial practices, communication systems, hiring and training methods, and products or services to differing cultural values, expectations, and preferences to be most effective in different environments (Ashton et al. 1995). Thus, they argue, management's initial task is to uncover the complex interrelationship between task, people and the organisation, and interpret correctly the environment, seen as a function of fundamental changes in the relationship of production to consumption; to include the market and technological situation in terms of its instability or rate of change, and then design the

management system appropriate to those conditions (Burns & Stalker 1961). The literature shows that academics and practitioners are increasingly discussing the relationship between business models, innovation and sustainability (Boons et al. 2013; Bocken 2014)(Wells 2015; Pedersen et al. 2018) as boundary spanning activities (Breuer et al. 2018).

INSIGHT (R22): Organisations are not self-contained and thus must consider how it is affected by, and its effect are, on other organisations across boundaries and the ecosystem around it.

Sustainable business strategies and their corresponding business models, and sustainable business model (SBM) patterns are instrumental to success, whereby operating within the context of the circular economy (CE) (Morioka et al. 2016; Geissdoerfer et al. 2017; Smol et al. 2017; WBCSD 2017a), each interdependent organisation must define its core strategy leading to business growth, a strong competitive position, and strong financial, social and environmental performance, often characterised as the triple bottom line (Elkington 1997). We find that the circular economy (CE) promises to de-link prosperity from resource consumption growth (Climate Counts 2013; European Academies Science Advisory Council EASAC 2016; McKinsey 2017), going beyond incremental efficiency gains to deliver transformative change (Preston 2012; Ellen McArthur Foundation 2015) by – much alike in the natural world - closing the loop on energy and material flows (Haas et al. 2015; Antikainen et al. 2017), and thus necessarily taking us towards, but questionably insufficiently close enough to sustainable value creation and sustainability (O'Neill et al. 2010).

INSIGHT (R23): Business models are identified as a pattern acting as a factor in the interdependencies between organisations.

2.2.3.2. Business as Usual

In Bocken et al. (2014), the authors lament how with rising global population, accelerating global development and associated increasing resource use and environmental impacts, that *business as usual* cannot endure. To instil a sustainable future, they develop a research agenda towards sustainable business models predicated on categories, identifying a set of eight archetypes. Recognising the need to transition away from business as usual and towards sustainable value creation, Evans, Fernando, et al. (2017) using an example from the manufacturing industry, articulate how to go from concept through to implementation. Sustainable value creation is at the juncture of systems thinking (Williams et al. 2017), systems-based innovation (Melville 2010; Watson et al. 2010), and sustainability-oriented innovation (Adams et al. 2015; Lüdeke-Freund et al. 2017), and operates within the greater 'system of systems' (Ackoff 1971; Elliot 2011). Sustainable value is defined as value that incorporates economic, social, and environmental benefits conceptualised as value forms (***Figure 2.4***). Incorporating the natural environment and society is essential in deriving business models aimed at sustainability (Haigh & Griffiths 2009). The value network is a set of roles and interactions in which entities engage in based on their different needs, hence they are tailored propositions to create value for each of the participants in the network. A clear understanding of an entities' role within a value network (***Figure 2.5***) could enable it to innovate towards new sustainable business model (Evans, Vladimirova, et al. 2017).

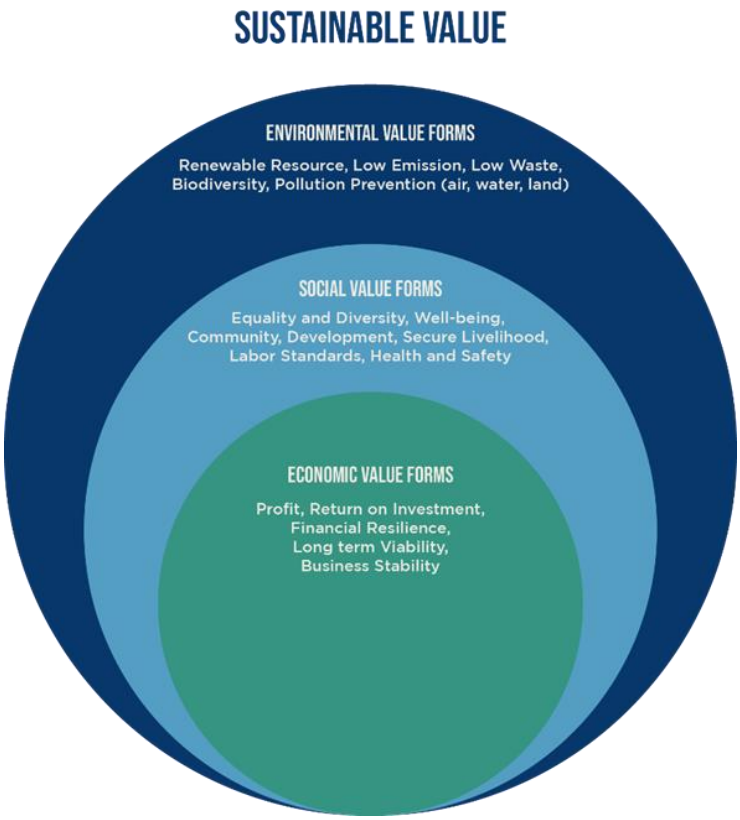


Figure 2.4. *Sustainable value model forms developed by the author for this study.*

According to Boons et al. (2013), the economic performance of sustainable innovation on business models is a critical consideration, given the link between the individual firm and the larger production and consumption system within which it operates. As sustainable development requires radical and systemic innovations, the concept of business models can serve as a valuable framework for envisioning and implementing sustainable innovations. In fact, building on the concept of business models can facilitate the creation and study of sustainable innovations. It is worth noting that sustainable innovation does not necessarily pose a direct challenge to the current economic logic, which typically prioritizes growth, even if it is "green growth". This observation is consistent with the current debate on degrowth, which considers alternative economic models that prioritize sustainability over growth (Schneider et al. 2010). Nonetheless, the concept of business models remains a valuable tool for firms looking to engage with sustainability issues in their operations and supply chains.

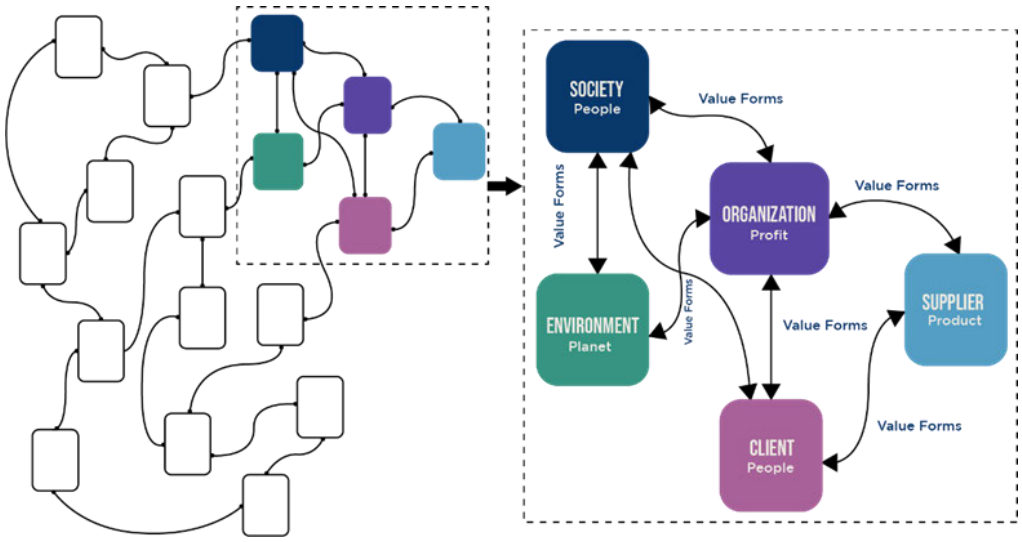


Figure 2.5. *Sustainable value network and model as adapted from Evans et al. (2017).*

INSIGHT (R24): The sustainable value network model and their value forms provide the link between an individual firm and the larger production and consumption system. Sustainable value creation is at the juncture of systems thinking and sustainability-oriented innovation.

2.2.3.3. Sustainable value network

The sustainable value network provides the backdrop upon which all activities take place, from the individual level through to the corporate, government and nation-wide level. In this respect each level is nested or linked to the next and is where one can see the world from a top-level view (super-ordinate holonic structure). The ability for each level to provide regenerative capacity is what makes it sustainable. We see the concept of sustainability, as developed by Wahl (2016) in "*Designing Regenerative Cultures*", involving the maintenance of the underlying pattern of health, resilience, and adaptability that supports the flourishing of life on this planet. The author posits that a regenerative culture should support healthy personal development and facilitate a shift from an ego-centric to a cosmos-centric perspective of self, requiring a critical examination of the role culture and education play in shaping our worldview and values. He further highlights the need for a comprehensive analysis of modern societal, organisational, ideological, and cultural

issues, and offers potential solutions to these problems through subjects such as finance, agriculture, design, ecology, economy, sustainability, organisations, and society. He proposes a way of understanding the current polycrisis and offers a path towards a better future, emphasising the importance of moving away from patterns of thinking and believing towards practices in education, design, and community living.

INSIGHT (R25): Systems thinking, leading to envisage a society by design that is restorative and regenerative.

Häyhä et al. (2016) in their study, present a framework linking the biophysical, socio-economic, and ethical aspects of sustainability across scales, aimed at providing a consistent approach for translating planetary boundaries into national-level fair shares. This framework aligns with the concept of planetary boundaries articulated by Rockström et al. (2009) (***Figure 2.6***), which outlines the essential conditions necessary for the Earth system to maintain stability and preserve ecosystem resilience and human well-being. AI architectures and codesign approaches for Earth system predictability showcase AI-enabled model-data integration with promise at improving predictions associated with climate change (Levin et al. 2012), perturbations, and extreme events. This in turn enhances Earth system models, observations, and theory using state-of-the art and futuristic computational infrastructure (Mudunuru et al. 2024). Examples of footprint measures as they apply to planetary boundaries can be seen in ***Figure 2.7***.

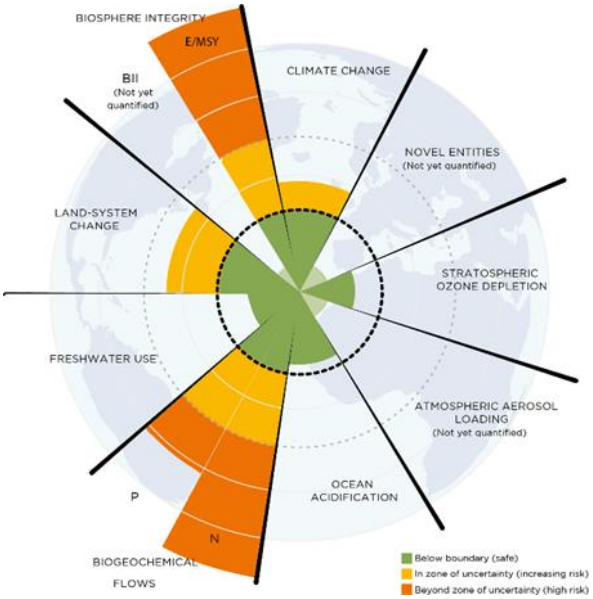


Figure 2.6. *Planetary boundaries reproduced from the Stockholm Resilience Center (Steffen et al. 2015).*

Planetary boundaries	Footprints
Climate change	Carbon Footprint (Wiedmann and Minx, 2008), Ecological Footprint (Wackernagel et al., 1999)
Ocean acidification	Carbon Footprint (Wiedmann and Minx, 2008)
Stratospheric ozone depletion	Chemical Footprint (Sala and Goralczyk, 2013)
Chemical pollution (novel entities)	Chemical Footprint (Sala and Goralczyk, 2013)
Nitrogen cycle	Nitrogen Footprint (Leach et al., 2012), Gray Water Footprint (Hoekstra and Mekonnen, 2012)
Phosphorus cycle	Phosphorus Footprint (Wang et al., 2011), Gray Water Footprint (Hoekstra and Mekonnen, 2012)
Biodiversity loss	Biodiversity Footprint (Lenzen et al., 2012)
Land system change	Land Use Footprint (Weinzettel et al., 2013), Ecological Footprint (Wackernagel et al., 1999)
Fresh water use	Blue and Green Water Footprint (Hoekstra and Mekonnen, 2012)
Atmospheric aerosol loading	PM10 Footprint (Moran et al., 2013)

Figure 2.7. *Examples of footprint measures relative to various planetary boundaries as cited by Fang et al. (2015a, b).*

INSIGHT (R26): Scale-linking leading to multiple levels of regenerative capacities.

Borucke et al. (2012) emphasize the importance of metrics in tracking human demand for and availability of the biosphere's regenerative and waste absorptive capacity. The Ecological Footprint analysis reveals that, as of now, humanity demands the equivalent of 1.8 planets' worth of resources, leading to "*global overshoot*" and depletion of ecological capital and accumulation of waste (***Figure 2.8***). The authors argue that the Earth's regenerative capacity constitutes the limiting factor

for the human economy when demand exceeds the biosphere's capacity to renew. However, Giampietro and Saltelli criticize the Ecological Footprint metric, asserting that it has serious methodological flaws (Galli et al. 2016). One of the main issues with the Ecological Footprint is its violation of semantic rules. They criticize the Ecological Footprint for equating "agricultural productivity" with "biocapacity," as agricultural productivity is presently boosted by reliance on non-renewable fossil energy and monocultures, which carry an ecological impact not captured by the Ecological Footprint accounting. The Ecological Footprint also misleads on energy security by ignoring that several planets would be needed to generate agro-biofuel matching present energy consumption, as it considers only the requirement of land for absorbing CO_2 and not for producing fuels.

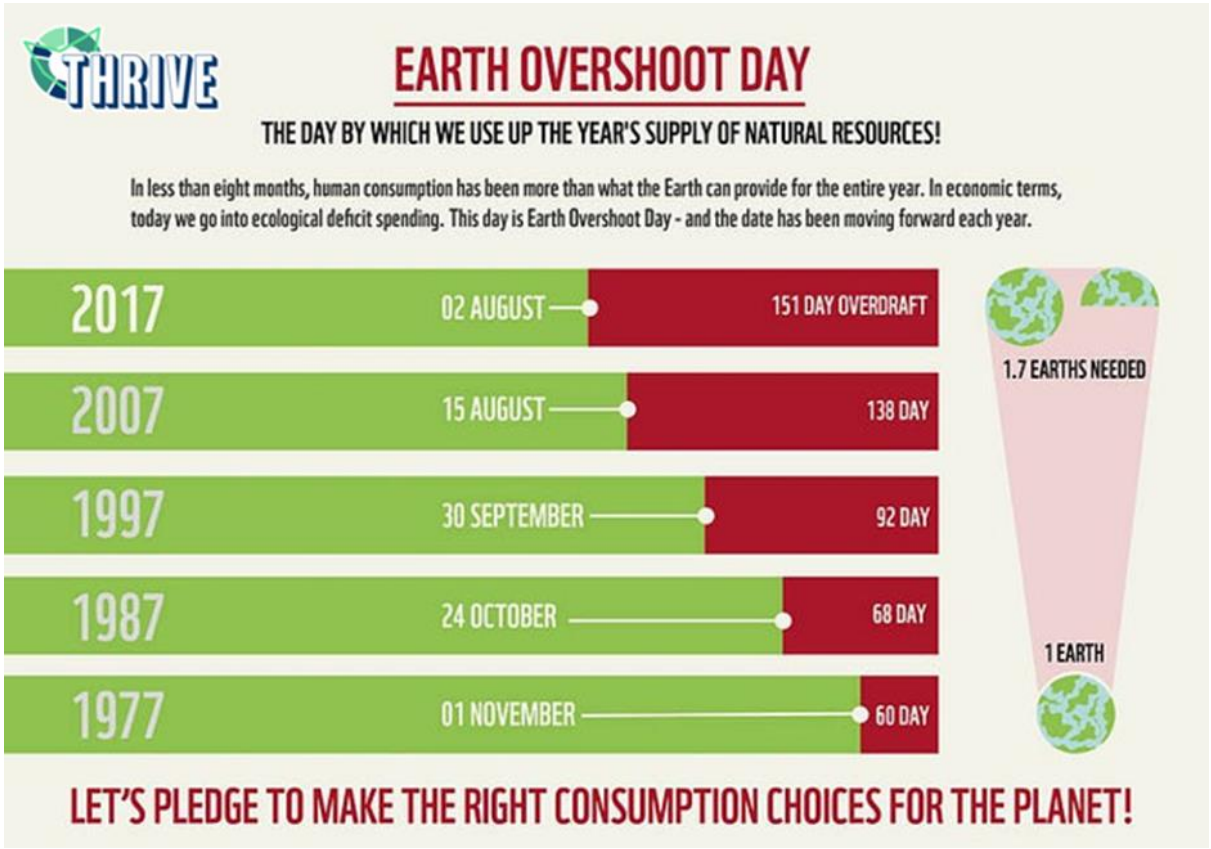


Figure 2.8. *Earth Overshoot Day illustrating showing how humanity have used more than our fair share. Reproduced from Thrivability Matters Newsletter 2021.*

2.2.3.4. Ecological footprints

Overall, the Ecological Footprint's assesses what is happening today, rather than what is sustainable, and thus makes a disservice to the ecological community. It violates common sense rules because altered ecological systems do not necessarily result in an increase in biocapacity. The dimensional inconsistency of the proposed equations, where flows of CO_2 are offset by stocks of land, is also problematic. So too is its continuous shift of quantitative assessments across scales making its quantitative output very fragile due to cumulated uncertainty in the conversion factors and rounding of values. Lastly, and perhaps most importantly, the Ecological Footprint neglects scales, as some societies can import "ghost land" because other societies export it. This type of accounting generates a "zero-sum game" at the global level. Finally, the Ecological Footprint ignores that a given forest area can absorb emissions only during growth, and additional forest area is needed when the forest becomes mature. Therefore, the assessment of land demand should not be given in "number of hectares" but as "a quantity of hectares which is a function of time". Thus, the Ecological Footprint's ambition to reach the bottom-line with a single number, such as in its "Earth Overshoot Day" campaign, although noble, is overly simplistic (Ayres 2000; Richardson 2019).

INSIGHT (R27): The need to bring humanities footprint within regenerative and absorptive capacities. The EF approach to “global overshoot” is simplistic by assessing what is happening today, rather than what is sustainable, ignoring scales, and contains numerous quantitative and congruency errors.

Lin, Wackernagel, Galli, Goldfinger, and Lazarus in Galli et al. (2016) argue that Ecological Footprint Accounting and the main output, the National Footprint Accounts, are unique in three ways. Firstly, consumption (Ecological Footprint) can be compared to a biophysical budget limitation (biocapacity). Secondly, data is aggregated to a single comparable unit of biocapacity (gha). Thirdly, time series of flows are

provided (1961-2011). The authors also make an important distinction between accounts and composite indices. Accounts add components together using a common unit of measure, whereas composite indices aggregate data across different domains that may not have equivalent units and subjectively assign weights to determine their relative value (Munda 2005b). Thus, composite indices are a richer, more accurate and methodical way of aggregation, as they provide an easy way to understand a complex concept more easily in the form of a sole number that encompasses a plethora of indicators (Saltelli 2007). They are thought of well suited in capturing complex multi-dimensional systems made up of numerous components, making it easier to understand the parts as well as the whole. The concept of composite indicators (Saisana & Tarantola 2002) is interdisciplinary in nature and features the use of aggregation and weighting factors, making them particularly suited in measuring well-being, as we see with the Human Development Index (HDI) (Greco et al. 2018).

INSIGHT (R28): Composite indices are well suited in measuring well-being and in capturing impacts in complex multi-dimensional trans-disciplinary systems that aggregate data across different domains.

In "*Our Ecological Footprint: Reducing Human Impact on the Earth*" by Wackernagel and Rees (1998) the idea of ecological footprints is explored and how human activities are placing unsustainable pressure on the Earth's natural resources and ecosystems. It is argued that the planet's carrying capacity is exceeded by the global ecological footprint, leading to depletion of resources and environmental problems. The authors further suggest that a shift is needed towards sustainable living and development practices, promoting ecological integrity and social equity, as well as strategies such as reducing energy and material consumption, using renewable energy sources, and adopting more efficient technologies and production processes. Emphasis is placed on the

need for global cooperation and collective action to address the systemic challenges of ecological sustainability (Holmberg et al. 2012), which requires a change in values and priorities, and the development of new institutions and governance systems that prioritize ecological and social well-being over economic growth and profit.

INSIGHT (R29): The promotion of ecological integrity and social equity, as well as global cooperation and collective action through new institutions and governance systems prioritising ecological and social well-being over economic growth and profit.

Environmental footprints and planetary boundaries are complementary in nature with the planetary boundaries framework (Steffen et al. 2015) providing a set of consensus-based estimates of the global-scale regenerative and absorptive capacities, which enhances the policy relevance of environmental footprints. Conversely, well-grounded footprint models enable more accurate and reliable estimates of human pressure on the planet's environment and benefit the planetary boundaries framework. This study helps in establishing measurable parameters for footprints across various scales, and associated trade-offs, with an emphasis on harmonizing footprint and boundary metrics to inform practical policy targets for addressing global environmental unsustainability, through adaptation and mitigation measures. Integrating planetary boundaries enriches the discourse by providing consensus-driven assessments of global regenerative and absorptive capacities, whilst robust footprint models enhance estimations of human-induced environmental pressures (Fang, Heijungs & De Snoo 2015; Moshrefi et al. 2019).

The proposed framework advocates for the cohesive integration of social impacts, environmental footprints and planetary boundaries to guide more effective and relevant policy formulation and implementation. The development of measurable boundaries in relation to footprints at multiple scales and their trade-offs, as well as the harmonisation of the

footprint and boundary metrics (Laurent & Owsianiak 2017) in terms of environmental coverage and methodological approach is critical in setting practical and tangible policy targets for mitigating environmental unsustainability at a global level (Fang, Heijungs & De Snoo 2015; Moshrefi et al. 2019).

INSIGHT (R30): Environmental footprints and planetary boundaries are complementary and provide for the capturing of impacts at scales by incorporating harmonisation of the metrics. This forms the basis for mitigating sustainability (or a lack thereof) at the global level.

Wahl (2006) has further advocated for biomimicry and regenerative cultures and highlights the need to create a biomaterials-based circular economy that supports life. He stresses the importance of understanding why we are worth sustaining and encourages reflection on changes needed to create a better future, advocating for the rediscovery of common ground in human community. He argues that our conventional education system, promoting competition, is outdated and that collaboration skills must be nurtured to create regenerative economies that benefit all.

INSIGHT (R31): Important to implement circular economy models emulating biomimicry, invoking collaboration to develop synergies towards the greater good.

2.2.4. Business model as enactment of strategy

2.2.4.1. Business models (BMs)

The role of business models as a key driver of corporate success has been emphasised in academic literature. Martins et al. (2015) highlight the practical significance of business models in this regard. Similarly, Casadesus-Masanell and Ricart (2010) suggest that business models are likely to replace strategy as the starting point for gaining competitive advantage in the future. Thus, in the context of business

model innovation (BMI), the importance of evaluating business models is widely acknowledged.

The findings of Steinhöfel et al. (2017), who conducted a systematic literature review on the evaluation of business models, confirm the importance of evaluating business models as a crucial factor for successful innovation and adaptation. According to their study, organisations use business model evaluation as a tool for enhancing their BMs and driving innovation. These findings are aligned with those of Zott and Amit (2007), who emphasised the importance of novelty and efficiency in business model designs. Furthermore, the literature highlights the significance of business models in corporate success and the importance of evaluating business models in the context of business model innovation (Schaltegger et al. 2012; Pedersen et al. 2018). They conclude their research indicating a deeper need to understand the role of business models in driving corporate success and best practices for evaluating business models.

INSIGHT (R32): Need to better understand the role of BMs as it pertains to corporate success and how to evaluate BMs. BMs is a key driver for successful innovation, adaptation, and success.

Lee and Hong (2014) take a distinct approach by asserting that the collection of business model-related information is crucial for a company's success. To this end, they emphasize the use of automation tools in business model analysis and suggest the application of automated text mining techniques to annual reports to gather insights into competitors' business models, their evolution, and provide a comprehensive methodology for doing so. Kulins et al. (2016) carried out a study with 41 entrepreneurial firms to examine the correlation between specific business model design themes and financial success, as expressed by the firm's stock market value. This research falls under the super-ordinate level of portfolio management. Similarly, Werani et al. (2016) investigated the

connection between business model configurations and corporate success by examining 51 companies in the business-to-business market. The authors identified 14 business model configurations that result in above-average sales profitability.

INSIGHT (R33): Some studies suggest as valuable is the use of text mining automation tools on annual reports. Others analyse BM configurations as well as super-ordinate levels of portfolio.

	Technology-oriented	Organisation theory-oriented	Strategy-oriented
1975	• Konczal • Dottore		
1997	• Shaw • Timmers	• Treacy/Wiersema	
1999	• Bambury		
2000	• Amit/Zott • Wirtz • Erikson/Penker	• Linder/Cantrell	• Amit/Zott • Erikson/Penker
2001	• Amit/Zott • Petrovic et al • Applegate • Rappa • Gordijn/Ackermans • Rayport/Jaworski • Papakinia Kopoulos et al. • Weil/Vitalo		• Hamel
2002	• Bienstock et al • Hawkins • Dubboson-Torbay et al. • McGann/Lyytinen • Eisenmann • Osterwalder/Pigneur		• Betz • Chesbrough/Rosembloom • Magretta
2003	• Afuah/Tucci • Hedman/Kaling • Wang/Chang • Wirtz/Lihotzky		• Winter • Afuah • Mansfield
2005	• Rajala/Westerfund	• Keen/Qureshi • Tikkanen et al.	• Lehman/Ortega • Moris • Schafer • Schweizer
2007	• Haaker et al. • Rappa • Kalio et al. • Eriksson et al.	• Zott/Amit • Al-Debei et al. • Hurt	• Chesbrough • McPhillips/ Merlo • Debelak • Richardson • Lai/Weil • Zott/Amit • Johnson et al.
2009	• Andersson/Johannesson/Zdravkovic • Bjorkdahl • Tankhiwale • Clemons • Zott/Amit	• Osterwalder/Pigneur	• Kind/Nissen/Sargard
2011	• Gambardella/McGahan • Sosna/Trevinyo-Rodriguez/Velamuri • Wirtz/Schilke/Ulrich	• Balden-Fuller/Morgan	• Casesdesus-Masanel/Ricart • Teece • Demi/Lecoco • Smith/Binns/Tushman
2013	• Huaring	• Fielt	• Desyllas/Sako • França • Keen/Williams
2014	• O'Riordan et al.		
2016		• Wirtz et al. • Foss/Saebi	• Shaltegger et al.
2017		• Lambert/Montemari • Evans et al	• Yang et al. • França et al.
2018	• Täuscher/Abdelkafi	• Stål • Elliot et al. • Ritala et al.	• Braun et al.
2019	• Lee et al.		• Braun et al.
2020	• Toniolo et al. • Di Vaio et al.		• Fedeli/Lüdeke-Freund
2022	• Romeo/Capolupo		

Early phase | Formation phase | Differentiation phase | Maturation phase

Figure 2.9. *Key historical references and literature overview for the business model research field compiled by the author.*

2.2.4.2. Business models at scales

The concept of a business model has been the subject of much discussion in academic literature. Despite numerous attempts, there is

still no universally accepted definition of a business model. According to Steinhöfel et al. (2017), various approaches, methodologies, and tools exist for analysing business models, but most of them concentrate at the business level, such as Osterwalder and Pigneur (2010) who see a business model as a single entity for a company. However, some authors are starting to address the super-ordinate level, like Aversa et al. (2017) who views a business model as a portfolio tailored for different parts of the value chain. In her seminal work, Ostrom (2007) observes that scholars have long sought to develop simple, predictive models of social-ecological systems that can offer universal solutions to complex governance problems. However, this approach has proved to be challenging given the complex and multidimensional nature of social-ecological systems. To address this challenge, scholars have taken a step towards building a strong interdisciplinary science of complex, multilevel systems by organising variables in a nested, multitier framework. This method enables scholars to analyse how attributes of a resource system, the resource units generated by that system, the users of that system, and the governance system jointly affect and are affected by interactions and resulting outcomes achieved at a particular time and place across multiple levels.

INSIGHT (R34): Emphasis on scale-linking at the super-ordinate level across multiple tiers. Developing predictive models that work universally at scale at solving complex solutions.

Agrawal and Redford (2006) emphasize that social-ecological systems are complex, non-linear, and cross-scale systems that require a serious study of their changing and multivariable nature. To develop diagnostic methods to identify combinations of variables that can lead to sustainable outcomes, it is crucial to recognize and understand the complexity of social-ecological systems. Holling et al. (1998) propose that social-ecological systems are a single integrated system with crucial feedback

loops across temporal and spatial scales, and overexploitation of ecological systems often involves various contributing factors. Emergent properties that are not predictable from the original variables can result from the combination of different variables. To overcome the challenge of rigorous research with numerous variables, scholars suggest using a multitier conceptual framework, and agent-based models, combining remotely sensed and on-the-ground data, and qualitative conceptual analysis. Such advanced techniques can help build a comprehensive understanding of complex social-ecological systems and move beyond simple solutions to complex governance problems through triangulation and transformation (Mertens 2007).

INSIGHT (R35): Build strong trans-disciplinary approach to multitier conceptual framework to address complexity at scale. Be cognizant of feedback loops over temporal and spatial scales. Provide triangulation by combining qualitative conceptual analysis with on-the-ground data.

One major challenge in evaluating business models is the difficulty of measurement. This is partly due to the time frame between the development of a business model, its implementation, and its impact on company value. Despite the development of tools that aim to address this issue, there is still a lack of generalisation in the field. Some tools offer checklists or heuristics to resolve the challenges, but a comprehensive blueprint for business model development and implementation is still lacking. The most promising approaches for analysing, simulating, and innovating new business models seem to be those based on system theory and business dynamics, which aim to understand the interdependencies and reinforcing effects of resources, processes, and results. Market leaders often demonstrate a unique combination of these elements, highlighting the need for integrated approaches to business model analysis. Steinhöfel et al. (2017) conclude that whilst much work has been done in the field of business model evaluation, there is still

much room for improvement and further research is needed to develop a more comprehensive understanding of this complex and evolving concept.

INSIGHT (R36): Suggest integrated approach to BM analysis based on systems theory as measuring and evaluating BMs is difficult. More work needed in this area.

2.2.4.3. Business model patterns (BMPs)

According to Lüdeke-Freund, Bohnsack, et al. (2018), the development of a sustainable "*business model pattern language*" presents an opportunity for future research. The authors argue for the need for consolidation and highlight the significance of business model patterns in advancing the field of sustainable business model innovation. This is achieved by creating knowledge for action, which is knowledge that can be applied in practice to design more sustainable organisations. In contrast to traditional academic pursuits aimed at advancing theoretical knowledge, this approach prioritizes practical application. In ***Figure 2.10*** we can see a list of common definitions for business model pattern consolidated into this study.

SELECTED BUSINESS MODEL PATTERN DEFINITIONS

AUTHORS	GENERAL BUSINESS MODEL PATTERN DEFINITION
Abdelkafi et al., 2013, p. 14	"The relationship between a certain context or environment, a recurring problem and the core of its solution."
Osterwalder & Pigneur, 2009, p. 55	"Business models with similar characteristics, similar arrangements of business model Building Blocks, or similar behaviors."
Gassmann et al., 2014, p. 17	"A business model [pattern] is a specific configuration of the four main business model dimensions who-what-how-why that has proven successful."
Amshoff et al., 2015, p. 3	"Reusing solutions that are documented generally and abstractly in order to make them accessible and applicable to others."

Figure 2.10. *Business Model Pattern definition.*
Reproduced from Lüdeke-Freund, Carroux, et al. (2018).

Simon (1969) emphasizes the importance of knowledge for action in guiding practical decision-making. The concept of solution patterns occurring at different scales, as introduced by Lüdeke-Freund, Bohnsack, et al. (2018), reinforces the idea of super-ordinate patterns. A sustainable business model pattern describes the core solution to an ecological, social, or economic problem that arises during the process of value creation by an organisation. This pattern includes design principles, value-creating activities, and their arrangements necessary for a useful problem-solution combination. By combining multiple sustainable business model patterns, organisations can reduce forms of ecological, social, or economic value destruction or increase forms of ecological, social, or economic value creation, as argued by Bocken and Bogaert (2013), Upward and Jones (2016), and Yang, Vladimirova, et al. (2017). These authors have emphasised the importance of strong sustainability in achieving sustainability goals.

INSIGHT (R37): Organisations exhibit multiple BMPs working across enterprises and scales and in support of super-ordinate patterns.

2.2.4.4. Business Model Innovation (BMI)

Business Model Innovation (BMI) has received increasing attention in the academic and business communities as a means of creating and sustaining competitive advantage with several definitions on offer as indicated in ***Figure 2.11*** (Geissdoerfer et al. 2018). Business model innovation concerns itself with business transformation (Elliot 2011; Spieth & Schneider 2016) for sustainability, requiring developing organisational capabilities in knowledge management to ensure the adoption of sustainable business practices (Roxas & Chadee 2016). Thus, in this study, we have business model innovation referring to the creation and implementation of new or significantly improved business models that have the potential to generate new value propositions, revenue streams, or competitive positions (Chesbrough 2010; Breiby & Wanberg 2011;

Amit & Zott 2012). While innovation has traditionally been associated with product or process innovation, business model innovation recognizes the importance of the business model as a key determinant of a firm's success (Evans, Fernando, et al. 2017).

A business model refers to the way a firm creates, delivers, and captures value (Teece 2010; França et al. 2017). It encompasses all the activities a firm undertakes to generate revenue and create value for its stakeholders, such as customers, employees, and investors (Fielt et al. 2018). Therefore, business model innovation is a broader concept that encompasses both the creation of new business models and the improvement of existing ones (Massa & Tucci 2013). Much focus has been on business model generation with an emphasis on innovation towards sustainability by including strategies deemed as theoretically more sustainable (Breuer & Lüdeke-Freund 2017; Geissdoerfer et al. 2018; Karlsson et al. 2018). For example, a combination of sustainable business model patterns, should enable organisations to reduce forms of ecological, social, and/or economic value destruction in absolute terms (which could be considered as contributions to weak sustainability) or to increase forms of ecological, social, and/or economic value creation in absolute terms (which could be considered as contributions to strong sustainability) (Lüdeke-Freund, Bohnsack, et al. 2018) (cf. Bocken & Bogaert 2013; Upward & Jones 2016; Yang, Vladimirova, et al. 2017).

INSIGHT (R38): SBM are about transformation and alignment with strong sustainability (thus avoiding substitution of resources). The normative approach to business model innovation "success" is toward sustainability.

Business model innovation can take many forms and can involve a wide range of changes to a firm's business model (Lindgardt et al. 2009), including the creation of entirely new business models, such as those associated with the sharing economy or a subscription model (Clauss 2016; Foss & Saebi 2018b). Business model innovation itself is not a one-

time project, but an iterative process that must be anchored within every sustainable organisation (Osterwalder & Pigneur 2010). For example, a company might develop new revenue streams by offering new products or services, or by entering new markets (Kennedy & Haigh 2016). It might also involve changing the way a company creates value for its customers, such as by using new technologies, or by changing its organisational structure (Spieth et al. 2014).

SELECTED BUSINESS MODEL INNOVATION DEFINITIONS

SOURCE	DEFINITION
Mitchell and Coles, 2004	"By business model innovation, we mean business model replacements that provide product or service offerings to customers and end users that were not previously available. We also refer to the process of developing these novel replacements as business model innovation." (p. 17)
Labbé and Mazet, 2005	A business model innovation changes one or more dimensions of a business model (which are perceived by the authors as product-market combination, the architecture of the value creation, and the revenue model) so that a novel configuration of the elements is created and implemented. (pp. 897 f.)
Osterwalder and Pigneur, 2005	"Specifying a set of business model elements and building blocks, as well as their relationships to one another [...] a business model designer [...] can experiment with these blocks and create completely new business models, limited only by imagination and the pieces supplied." (p. 24)
Chesbrough, 2007	Business model innovation is to "advance [the] business model [...] from very basic (and not very valuable) models to far more advanced (and more valuable) models." (p.15)
Lindgardt et al., 2009	"Innovation becomes BMI [business model innovation] when two or more elements of a business model are reinvented to deliver value in a new way. [...] BMI can provide companies a way to break out of intense competition, under which product or process innovations are easily imitated". (p. 2)
Romero and Molina, 2009	"business models as definers of the value creation priorities in an organisation should be continuously reviewed in response to actual and possible changes in the perceived market conditions and evolve the enterprise strategy as the business environment and customers' needs change." (p. 3)
Chesbrough, 2010	Business model innovation "[1] Articulates the value proposition (i.e., the value created for users by an offering based on technology); [2] Identifies a market segment and specify the revenue generation mechanism (i.e., users to whom technology is useful and for what purpose); [3] Defines the structure of the value chain required to create and distribute the offering and complementary assets needed to support position in the chain; [4] Details the revenue mechanism(s) by which the firm will be paid for the offering; [5] Estimates the cost structure and profit potential (given value proposition and value chain structure); [7] Describes the position of the firm within the value network linking suppliers and customers (incl. identifying potential complementors and competitors); and [8] Formulates the competitive strategy by which the innovating firm will gain and hold advantage over rivals." (p. 355, citing Chesbrough and Rosenbloom, 2002)
Johnson, 2010	"[Seizing the white space] calls for the ability to innovate something more core than the core, to innovate the very theory of the business itself. I call that process business model innovation." (p. 13) "business model innovation is an iterative journey" (p. 114)
Geissdoerfer et al., 2016	"Business model innovation describes either a process of transformation from one business model to another within incumbent companies or after mergers and acquisitions, or the creation of entirely new business models in start-ups." (p. 1220)

***Figure 2.11**. Selected list of business model innovation definitions. Reproduced from (Geissdoerfer et al. 2018).*

The importance of business model innovation has been emphasised by several authors who have argued that it is becoming increasingly important for firms to innovate their business models to remain competitive in a rapidly changing business environment (Geissdoerfer et al. 2018). The increased pace of technological change and the growth of digitalisation are just two examples of the forces driving the need for business model innovation. In particular, the growth of the digital economy has created new opportunities for firms to create and deliver value in new and innovative ways (Breiby & Wanberg 2011). However, despite its growing importance, business model innovation can be a challenging and complex process, with several authors noting that firms may face significant barriers when attempting to innovate their business models (Chesbrough 2010). For example, established firms may struggle to change their existing business models due to the weight of their existing processes and infrastructure. They may also face resistance from stakeholders, such as employees, customers, or partners, who may be reluctant to change established ways of working (Spieth et al. 2014).

Despite these challenges, there is growing evidence to suggest that business model innovation can have a significant impact on a firm's performance and competitiveness (Chesbrough 2010; Breiby & Wanberg 2011; Amit & Zott 2012; Evans, Vladimirova, et al. 2017; Geissdoerfer et al. 2018). Several studies have shown that firms that successfully innovate their business models are more likely to be profitable and to have higher market valuations. Business model innovations have been shown to help firms improve their sustainability, by creating new revenue streams or reducing costs (Breiby & Wanberg 2011; Bocken & Bogaert 2013; Yang, Evans, et al. 2017).

INSIGHT (R39): BMI of existing BMs towards sustainability has been shown to deliver better performance, profitability, higher market capitalisation, improved competitiveness, and improved sustainability.

2.2.4.5. Strategic Business Model Innovation (SBMI)

Strategic Business Model Innovation (SBMI) is a process of redefining an organisation's core business model in response to changing market conditions or emerging opportunities (Teece 2012). Implementing SBMI can be challenging due to various barriers that organisations face. In a 2023 study by Kwasi Sampene et al. (2023), six barriers were identified:

- Institutional barriers: These barriers are related to the existing regulatory frameworks, policies, and cultural norms that govern an organisation's operations. Institutional barriers can make it difficult for organisations to adopt new business models that deviate from the status quo.
- Organisational barriers: These barriers refer to the internal factors that prevent an organisation from implementing SBMI, such as rigid structures, siloed departments, and a lack of collaboration among employees.
- Strategic barriers: These barriers arise from a misalignment between an organisation's strategic objectives and the proposed SBMI initiatives. Organisations need to ensure that their SBMI efforts align with their broader strategic goals to achieve success.
- Resource allocation barriers: These barriers relate to the limited resources that organisations have, such as time, money, and personnel. SBMI requires significant investments, and organisations must allocate resources effectively to achieve success.
- Technological barriers: These barriers are related to the use of technology in SBMI initiatives. Organisations may lack the necessary technological infrastructure or expertise to implement SBMI successfully.
- Financial barriers: These barriers arise from the financial constraints that organisations face. Implementing SBMI can be costly, and organisations may struggle to secure funding to support their initiatives.

Furthermore, the study identified several drivers that can help organisations overcome these barriers and successfully implement SBMI, including:

- Organisational learning: Organisations need to foster a culture of continuous learning to adapt to changing market conditions and emerging opportunities.
- Knowledge management: Effective knowledge management can help organisations capture and leverage the knowledge required to implement SBMI successfully.
- Dynamic capabilities: Organisations need to develop dynamic capabilities to respond to changing market conditions and emerging opportunities.
- Resource mobilisation: Organisations must mobilize resources effectively to support their SBMI initiatives.
- Innovative business activities: Organisations must be willing to engage in innovative business activities to achieve success in SBMI.
- Human resource development: Organisations need to invest in the development of their human resources to build the skills and expertise required for successful SBMI implementation.

With the 'strategy' being to become sustainable, SBMI promises to deliver innovations of the business model towards sustainability (Hawken et al. 1999; Malhotra et al. 2013; Melkonyan et al. 2017).

INSIGHT (R40): Through BMI, the aim by way of strategy is to produce an actual BM which is empirically measured to be (more) sustainable.

2.2.4.6. BMI leading to measurement

The field of business model innovation has received increasing attention in academic literature, with a growing focus on the measurement of the effects of the same. Spieth and Schneider (2016) provide a definition of business model innovation as a change that has an impact on at least one of the following dimensions: value offering, value

creation architecture, or revenue model logic. In their study they validate a measurement index for business model innovativeness through an examination of 200 German firms. In an O'Riordan et al. (2014) study, business model innovation is seen as a crucial priority for many organisations. Whilst companies have traditionally focused on product and service innovation, many are now turning towards business model innovation as an alternative or complement to traditional approaches. To support this decision-making process, O'Riordan et al. (2014) propose a prioritisation framework for ranking alternative business models, which utilizes benchmarks within the company's ecosystem. This framework can be used as an input towards developing an IT-based business model decision support system (Orlikowski & Iacono 2001), allowing for more informed decisions with potentially many other sectors added later.

INSIGHT (R41): Ranked benchmark of BMs based on framework to augment impacts. IT-based decision support system for BMs.

Brillinger (2018) proposes a methodology for identifying and analysing business model risk factors within value networks from the perspective of the business model owner. This approach considers the end customer, all actors involved in the value creation, all partners involved in value delivery, as well as value and revenue streams. By evaluating risks within the broader value network, organisations can better identify potential areas of weakness or disruption.

In assessing the performance of start-ups' business models, Batocchio et al. (2017) propose a method that combines the Business Model Canvas by Osterwalder and Pigneur (2010) with the Balanced Score Card by Kaplan and Norton (1996); (Hansen & Schaltegger 2014). This approach allows for the assessment of performance using a scorecard relative to the specific business model. By employing these techniques, organisations can evaluate the effectiveness of their business model

within value networks, and subsequently use business model innovation to make their existing models more sustainable.

INSIGHT (R42): Evaluating BM risks with respect to the sustainable value network. Use BMI to improve the same. Assess BM using a canvas and scorecard.

Clauss (2016) introduces a ten-tier measurement model for business model innovation and develops a measurement approach to assess the innovativeness of business models. Di Valentin et al. (2012) investigated the key performance indicators (KPIs) for value chain activities and their impact on business model elements. Heikkilä et al. (2016) aimed to create a repository of metrics that can guide business model analysis and highlight the challenges and opportunities of current or new business models. These studies highlight the importance of measuring business model innovation and provide various approaches and tools for doing so. The field of business model innovation measurement is still evolving, and there is ongoing research aimed at improving and refining existing methods. The development of effective and reliable measurement methods will be crucial for advancing our understanding of business model innovation and its impact on firms.

INSIGHT (R43): Measurement of BMI is an evolving field of research. Development of effective and reliable measurement methods is crucial to our understanding on the impacts on a firm.

2.2.4.7. BMI leading to business model patterns

Business model innovation is typically supported by design tools and can be effectively addressed using business model patterns. Abdelkafi and Täuscher (2015) highlight the importance of understanding the underlying structure of business model patterns in relation to value generation. They examined business models from a system dynamics perspective, which takes into account the economic, social, and environmental value proposition. In their study, they emphasised the importance of business

model innovation as a strategic approach for incorporating sustainability into organisational practices. According to their analysis, business model innovation is a key tool for leveraging sustainability in organisations (Abdelkafi & Täuscher 2015). Meanwhile, Romero et al. (2017) have compiled a catalogue of business model patterns that can be applied in the design and analysis of business models. This idea is further supported by scholarly literature on business model innovation, including studies by Massa et al. (2017), Wirtz et al. (2016), and Zott et al. (2011). The value and potential of business model patterns have been acknowledged by several authors, including Girotra and Netessine (2014), and Remane et al. (2017). The latter emphasised that "*90% of all business model innovations are a recombination of existing business model patterns*" (Remane et al. 2017). Therefore, the use of business model patterns provides an efficient way to undertake business model innovation by drawing upon aspects that have already been proven successful in other companies and industries.

INSIGHT (R44): Sustainable business model as a source of innovation. BMs as a (re)combination of BMPs. BMI can draw upon proven successful pattern combinations.

2.2.5. Sustainable business model (SBM) and innovation for sustainability (IfS)

2.2.5.1. Business model innovation for sustainability (BMIfS)

With sustainability an important factor for entities able to create, capture, and destroy value, organisations that adopt sustainable practices can improve their financial performance, enhance brand reputation, and increase customer loyalty through the creative novel application of new models (Yang, Vladimirova, et al. 2017). Sustainability can also lead to cost savings and new business opportunities, making it a source of competitive advantage. Morioka et al. (2016) support this view, pointing out that businesses that successfully address sustainability challenges can benefit from increased efficiency and innovation.

To turn sustainability into a competitive advantage, businesses need to develop sustainable business models. According to Abdelkafi and Täuscher (2015), a business model is a systemic representation of how a company creates, delivers, and captures value. A sustainable business model integrates sustainability into the value proposition and considers the impact of its operations on the environment and society. To design sustainable business models, companies need to understand the complex interplay of economic, environmental, and social factors. They suggest using system dynamics, a method for modelling complex systems, to analyse the interactions between these factors and design robust business models for sustainability.

Yang, Vladimirova, et al. (2017) also emphasize the importance of sustainability in innovation and suggest that companies should adopt a "*green innovation*" approach to sustainability, where sustainability is integrated into the innovation process. This can lead to the development of sustainable products, services, and processes, as well as increase the competitiveness of the enterprise, making sustainability a driver of innovation (Nidumolu et al. 2009; Varadarajan 2017). Organisations see sustainability as an important factor in their strategy, driving innovation, providing a respected source of value creation and competitive advantage for organisations that adopt sustainable business models, whereby they assess the interplay of economic, environmental, and social factors.

Strategy success, is encapsulated in the context of the sustainable value network (Donaldson & Preston 1995; Bocken et al. 2013; Tyl et al. 2015; Evans, Vladimirova, et al. 2017), whereby the competitive viability of an organisation is determined by its ability to integrate and transform itself, matching demand with production, harnessing the value of shared resources, and using its creativity to continuously innovate its product, processes, and most notably its business model (Preston 2012) to ensure longevity and long-term sustainability. As espoused by Hawley (1950), organisations engage in activities which have as their logical conclusion adjustment to the environment and can survive only to the extent that

they can seize the opportunity and develop the strategy to acquire, maintain and transform these resources (Pfeffer & Salancik 2003) for the greater good. Business models are the conceptual design of organisational structures to enact an opportunity (Amit & Zott 2012) and most often found to be the single best source of competitive advantage (Breiby & Wanberg 2011; Boons & Lüdeke-Freund 2013; Pansera & Randles 2013; Kiron et al. 2017; Prasad & Junni 2017; Varadarajan 2017).

INSIGHT (R45): BM is a systemic representation of how a company creates, delivers, and captures value. Adopt system dynamics to incorporate sustainability into the innovation process. BM seen as a source of competitive advantage beyond mere strategy.

2.2.5.2. Sustainable business models (SBMs)

Sustainable business models (SBMs) are defined as business models that create competitive advantage through superior customer value while contributing to sustainable development of the organisation and society (Kiron et al. 2017; Lüdeke-Freund et al. 2017) (***Figure 2.13***). These sustainable business models, have emerged from the field of business model innovation; however, *how exactly does innovation at the business model level lead to successful sustainable business outcomes?* Business models describe the business logic (Magretta 2002) defining how value is created, delivered and captured (Teece 2017); and innovation is the process for introducing new ideas, workflows, methodologies, models, services, products or technologies to meet human needs within planetary boundaries or limits (Clinton & Whisnant 2014; Frugoli et al. 2015).

Sustainability risks are business risks (Hansen et al. 2009); and therefore, business model innovation is seen as a risk minimisation technique (Girotra & Netessine 2014), that creates new value propositions, and related value delivery and value capture systems, in order to generate superior value (Richardson 2014) by reinventing or re-assembling (Sandow & Allen 2005) two or more elements of a business model (Gassmann et al. 2014; Ohnesorge 2017) to deliver value in a new

way that directly affects the sustainable value network (Schumpeter 1939; Berends et al. 2016; Evans, Fernando, et al. 2017). Innovation for sustainability translates business models into business model innovation (Chesbrough & Rosenbloom 2002; Baldassarre et al. 2017) for sustainability (BMIfS)(Morioka et al. 2016; Rauter et al. 2017) or more succinctly (business model) Innovation for Sustainability (IfS) (Pansera & Randles 2013). Thus, business model innovation has been found to simultaneously create and capture social and economic value (Kennedy & Haigh 2016) and, if systematically cultivated, sufficiently supported, and explicitly managed, deliver sustainable competitive advantages for the organisation that is both challenging to execute and difficult to imitate (Lindgardt et al. 2009).

Thus, with reference to ***Figure 2.12***, we can see that innovations of the business model in relation to sustainable outcomes give rise to:

1. (a-priori) Business model design tools (such as the BM canvas and the FB canvas); and
2. (a-posteriori) Sustainability-Oriented Innovation (SOI) or Sustainable Business Models.

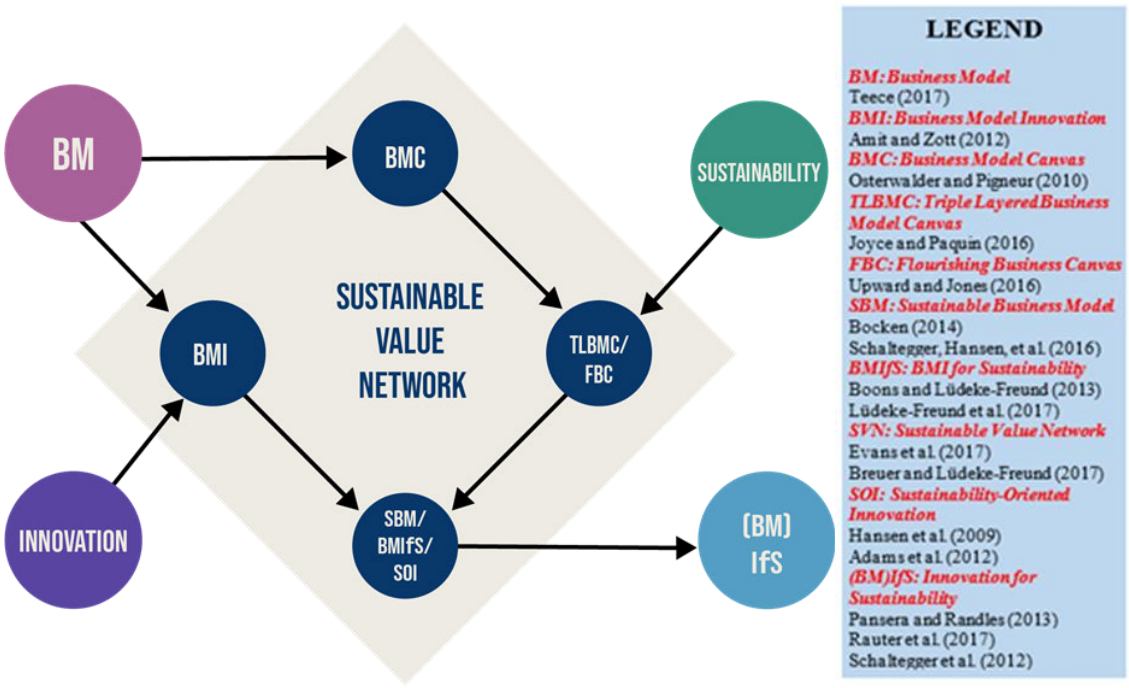


Figure 2.12. *The evolution of the business model concept, linking Innovation to Sustainability across the Sustainable Value Network, as devised, and illustrated by the author.*

SELECTED SUSTAINABLE BUSINESS MODEL DEFINITIONS

SOURCE	DEFINITION
Stubbs and Cocklin 2008	A sustainable business model is "a model where sustainability concepts shape the driving force of the firm and its decision making [so that] the dominant neoclassical model of the firm is transformed, rather than supplemented, by social and environmental priorities." (p. 103)
Birkin et al., 2009a, 2009b	Sustainable business models are "new business models for sustainable development [that] are operating and appraising their performances within the four classes of information identified in the cloverleaf account of sustainable development (namely mass balance, life-cycle impacts, stakeholders and ecological resilience), [and] these operations are [...] integrated by a comprehensive new understanding that [...] could have more to do with societal and value issues than technical and managerial ones. In this way, some companies specifically did report that their decisions are based upon issues wider than traditional economics, accounting or market theory." (2009b, p. 288)
Garetti and Taisch, 2012	Sustainable business models "have a global market perspective, taking into account the development of new industrialised countries as well as the need for more sustainable products and services." (p. 88)
Schaltegger et al., 2012	Sustainable business models "create customer and social value by integrating social, environmental, and business activities" (p. 112)
Bocken et al., 2013	"Sustainable business models seek to go beyond delivering economic value and include a consideration of other forms of value for a broader range of stakeholders." (p. 484)
Boons and Lüdeke-Freund, 2013	A sustainable business model is different from a conventional one through four propositions, "1. The value proposition provides measurable ecological and/or social value in concert with economic value [...] 2. The supply chain involves suppliers who take responsibility towards their own as well as the focal company's stakeholders [...] 3. The customer interface motivates customers to take responsibility for their consumption as well as for the focal company's stakeholders. [...] 4. The financial model reflects an appropriate distribution of economic costs and benefits among actors involved in the business model and accounts for the company's ecological and social impacts" (p. 13)
Wells, 2013	A business model for sustainability "would assists in the achievement of sustainability [by] following major principles [...] for sustainability" which Wells defines as 1) resource efficiency, 2) social relevance, 3) localisation and engagement, 4) longevity, 5) ethical sourcing, and 6) work enrichement. (p. 65)
Bocken et al., 2014	"A sustainable business model aligns interests of all stakeholder groups, and explicitly considers the environment and society as key stakeholders." (p. 44)
Evans et al., 2014	A sustainable busines model "is the holistic value logic that encompasses economic, environmental and social goals while aligning the interests of all stakeholder groups" (p. 9)
Upward and Jones, 2015	A (strongly) sustainable business model " is the definition by which an enterprise determines the appropriate inputs, resource flows, and value decisions and its role in ecosystems, [in a way that] sustainability measures [which] are those indicators that assess the outputs and effetcs of business model decisions [...] might be claimed as successfuly sustainable." (p.98)
Abdelkafi and Tauscher, 2016)	Sustainable business models, "incorporate sustainability as an integral part of the company's value proposition and value creation logic. As such, BMfS [Business models for Sustainability] provide value to the customer and to the natural environment and/or society." (p. 75)
Evans et al., 2017	Sustainable business models are described with five propositions, "1. Sustainable value incorporates economic, social and environmental benefits conceptualised as value forms. 2. Sustainable business models require a system of sustainable value flows among multiple stakeholders including the natural environment and society as primary stakeholders. 3. Sustainable business models require a value network with a new purpose, design and governance. 4. Sustainable business model require a systemic consideration of stakeholder interests and responsibilities for mutual value creation. 5. Internalizing externalities through product-service systems enables innovation towards sustainable business models." (p. 5ff)
Dentchev et al., 2018	with helpful tools for "describing, analyzing, managing, and communicating (i) a company's sustainable value proposition to its customers, and all other stakeholders, (ii) how it creates and delivers this value, (iii) and how it captures economic value while maintaining or regenerating natural, social, and economic capital beyond its organizational boundaries.'"

Figure 2.13. *List of notable sustainable business model definitions by seminal authors examined by the author of this study. Extended from Geissdoerfer et al. (2018).*

We therefore see the evolution of the business model, with sustainability as the outcome driven by innovation, as business model innovation for Sustainability (BMIfS) or simply innovation for sustainability (Varadarajan 2017). Thus whilst 'by design' the BMC/FBC can construct business models deemed to be sustainable, the real test of the same comes at the a-posteriori stage when those entities are measured and assessed in terms of their *real* actual impact on society and the environment. Empirically measured impacts across the three pillars of the economy, society, and environment are the only true measure of strong sustainability on a finite planet (Costanza et al. 2009).

INSIGHT (R46): Innovation for sustainability translates BMs into BMI for sustainability (BMIfS). Akin to strategy, these have shown to deliver competitive advantage. Empirically measured impacts are the only true measure of strong sustainability on a finite planet. BMI seen as a risk minimisation technique.

Some enterprises have shown competitiveness by simply externalising true costs (i.e., water and air pollution, poor working conditions/inequality, collective bargaining/unions, health and safety risk, cross border financial liquidity etc) and thereby maintain a price advantage at the community's expense. The foray into emerging markets was an element in the evolution of capitalism (Schumpeter 1939), and has become a mechanism for multi-national enterprises to externalize and lower production costs, often at the expense of the local foreign communities through social exploitation and environmental abuse. Thus, for example, taking advantage of minimal regulatory requirements is a hallmark of unsustainability; achieving increased competitiveness through cost reductions and by avoiding environmental and social regulatory requirements through the establishment of back-end operations in emerging countries (Schaltegger et al. 2012).

Senge et al. (2019) assert that a comprehensive sustainability strategy for enterprises under the framework of natural capitalism requires four fundamental shifts. These shifts are interdependent and

entail both constraints and synergies with respect to one another. Furthermore, the authors contend that saving resources is not only feasible but also advantageous for the environment and cost-effective. Additionally, eliminating waste in production can lead to savings in both resources and costs. Moreover, transitioning to leasing models shifts the focus to providing satisfaction with minimal material throughput and waste in the entire economic system. These measures are necessary to ensure the availability of resources in the future and to prevent the reputation of environmental irresponsibility. On the other hand, increasing environmental stewardship can enhance market potential due to growing consumer awareness and interest.

Now let's consider indicators of growth and how we may contract growth through degrowth and green growth opportunities in our pursuit of sustainable development. These may be implemented via government installed legislative or regulatory practices or via industry boards and associations. A fitting place to start with, relevant to economies at large is with the gross domestic product (GDP).

INSIGHT (R47): Capitalism driven by industrialisation, emerging markets, competition, and cost reductions through externalisation.

2.2.5.3. Gross Domestic Product (GDP)

It has long been known that gross domestic product (GDP) is not a reliable indicator of progress (Costanza et al. 2009). Originally devised by Simon Kuznets in the 1930's he warned against its use as a measure of welfare. *Economist Moses Abramovitz* further questioned whether GDP accurately measures a society's overall well-being in the 1960s. In June 1978 writing in Britain's The Economic Journal, Irving B. Kravis, Alan W. Heston, and Robert Summers compiled the first estimates of GDP per capita worldwide, with figures for more than 100 countries. In 1990, the United Nations launched the Human Development Index (HDI), which measures such factors as education, gender equality, and health. In

2006, China creates a new index for "green GDP" — a measure of national economic output that takes environmental factors into consideration.

Furthermore, although Gross Domestic Product (GDP) is a commonly used measure of a country's economic progress and development, according to Arrow et al. (1995), GDP is not a reliable indicator of progress, particularly in terms of measuring human well-being and sustainability. One reason for this is that GDP only considers economic activity that is monetised and exchanged in the market and does not capture non-market activities or the depletion of natural resources. This means that GDP growth can occur at the expense of environmental degradation and the depletion of natural resources, which can ultimately harm human well-being in the long term. Additionally, GDP does not account for income distribution and inequality, which can have significant implications for social well-being and overall progress. Furthermore, GDP does not reflect the value of unpaid work, such as caregiving and housework, which is essential for social reproduction and the functioning of the economy.

INSIGHT (R48): Capitalism has been responsible for much of the 'great divide'. The pursuit of endless growth, coupled with GDP as a measure of 'success', has delivered a skewed perception of well-being. Newer measures of well-being and sustainability are needed that also capture non-economic factors.

Some scientists argue that the alternative to forever ending capitalism is degrowth, others argue for green growth. Either way, endless growth is not feasible on a finite planet with finite resources. A nuanced approach is sustainable degrowth, defined as an equitable downscaling of production and consumption that increases human well-being and enhances ecological conditions at the local and global level in the short and long term (Schneider et al. 2010; Fitzpatrick et al. 2022).

2.2.5.4. Degrowth or Green Growth

The global economy is currently built on the premise of growth, with the assumption that firms, industries, and nations must increase

production annually, regardless of its necessity. This dynamic is fuelling climate change and ecological breakdown, with high-income economies, corporations, and wealthy individuals mainly responsible for this issue. They consume energy and materials at unsustainable rates, resulting in many industrialised countries struggling to maintain economic growth due to economic convulsions caused by the COVID-19 pandemic, Russia's invasion of Ukraine, resource scarcities, and stagnating productivity improvements (Hickel et al. 2022).

Governments are thus faced with a difficult situation, as their attempts to stimulate growth clash with objectives to improve human well-being and reduce environmental damage. Ecological economics researchers propose a different approach, namely degrowth. According to prominent ecological economist Tim Jackson (2009), wealthy economies should abandon GDP growth as a goal, scale down destructive and unnecessary forms of production to reduce energy and material use, and focus economic activity on securing human needs and well-being. This approach has gained traction in recent years and can enable rapid decarbonisation and halt ecological breakdown while enhancing social outcomes. It also frees up energy and materials for low- and middle-income countries where growth may still be necessary for development.

Degrowth is a strategy that aims to stabilize economies and achieve social and ecological goals, as opposed to recession, which is chaotic and socially destabilising. Recent reports by the IPCC (Intergovernmental Panel on Climate Change 2018) and IPBES (IPBES 2023) suggest that degrowth policies should be considered to address climate breakdown and biodiversity loss. Such policies include scaling down destructive sectors like fossil fuels, mass-produced meat and dairy, fast fashion, advertising, cars, and aviation, while improving public services such as healthcare, education, housing, transportation, and renewable energy. Universal public services can deliver strong social outcomes without high levels of resource use, thus ending planned obsolescence and reducing the purchasing power of the wealthy, all necessary steps towards achieving a

degrowth model. Furthermore, although growth does not necessarily lead to collapse, it is worth noting that collapse follows growth only if the growth has led to overshoot, thus an expansion in demands on the planet's sources and sinks above levels that can be sustained (Meadows et al. 1972; Turner 2008).

INSIGHT (R49): A combination of degrowth and/or green growth is necessary to stay within the natural regenerative and absorptive capacities.

2.2.5.5. Sustainable Development

In a degrowth scenario, a green jobs guarantee – for example - is a proposal that provides training and employment for urgent social and ecological objectives, such as renewable energy installation and ecosystem regeneration, according to Hickel and Slamersak (2022). Thus, a just transition for workers in declining industries could provide for programs that develop and implement solutions to tackle the regenerative and absorptive capacity of our infrastructure, combined with a universal income policy. Reducing working time, through measures such as lowering the retirement age or adopting a four-day workweek, would also lower carbon emissions and stabilize employment as less-necessary production declines. Furthermore, to enable sustainable development, it is also essential to cancel unpayable debts of low-income and middle-income countries and address unequal economic structures.

INSIGHT (R50): A global imperative has emerged, instilling a need for global systemic transformation.

Herman Daly, a leading ecological economist, has argued that sustainable development requires a steady-state economy that operates within ecological limits, rather than a growth-oriented economy that seeks to maximize GDP. Alongside O'Neill et al. (2010), they advocate for a "steady-state" economy that operates at a sustainable level, maintaining a stable population and resource use. Furthermore, Costanza (1992)

argues that sustainable development requires maintaining natural stocks and that growth cannot be sustained indefinitely on a finite planet, whereby measures such as GDP at best conflate growth and development. These ideas have had a significant impact on the field of sustainable development, under the motif of "ecological economics", which seeks to integrate economic principles with the principles of ecology (Rees 2000). To achieve sustainable development, it is believed that we need to fundamentally rethink our economic systems and adopt a new economic paradigm that prioritizes ecological sustainability and social justice. Herman Daly's (1995) contributions have led to the development of new economic models that incorporate ecological principles, such as the concept of the "circular economy", which continues to shape the way we think about economic and environmental sustainability (Ghisellini et al. 2016).

INSIGHT (R51): GDP is not a suitable indicator of sustainable development. Building on ecological economics, society will need to transition to a steady-state economy.

Whilst some see sustainable development as an oxymoron (as they believe in the steady-state economy), others see the need to think globally and act locally, implementing the very solutions illuminated by the research in the field, by living a minimalist lifestyle, lobbying governments, and sharing their knowledge with others. In fact, whole movements have formed (Extinction Rebellion, Fridays for Future, Climate Justice Alliance, and several others), predicated on the importance and urgency around globally tackling these existential threats.

2.2.5.6. Globalisation and Decolonialisation

At the nexus of politics, power, resource management, and sustainability, lies a complex web of interconnected challenges that require interdisciplinary and intersectional approaches to address. Emanating from globalisation is the legacy of colonialism, as discussed by Hickel and Slamersak (2022), perpetuating inequality and exploitation,

with wealthy nations still extracting resources from poorer nations in a neo-colonial relationship. This ongoing situation emphasizes the need for a deeper understanding of historical and current power dynamics in addressing issues of sustainability. In a report by an Independent Group of Scientists appointed by the UN Secretary-General paper, titled "*The Future is Now*", it too emphasizes the importance of context and history in any sustainable development effort (Messerli et al. 2019). There, it is argued, that the global south is not a homogeneous entity, and that a more nuanced understanding is needed to achieve sustainability goals. The paper highlights the importance of listening to and working with local indigenous communities to address sustainability challenges. Kates et al. (2001) points to the need to foster problem-driven interdisciplinary research to progress in sustainability science through the development of capacities and global operational observation and reporting systems across all scales from local to global (***Figure 2.14***).

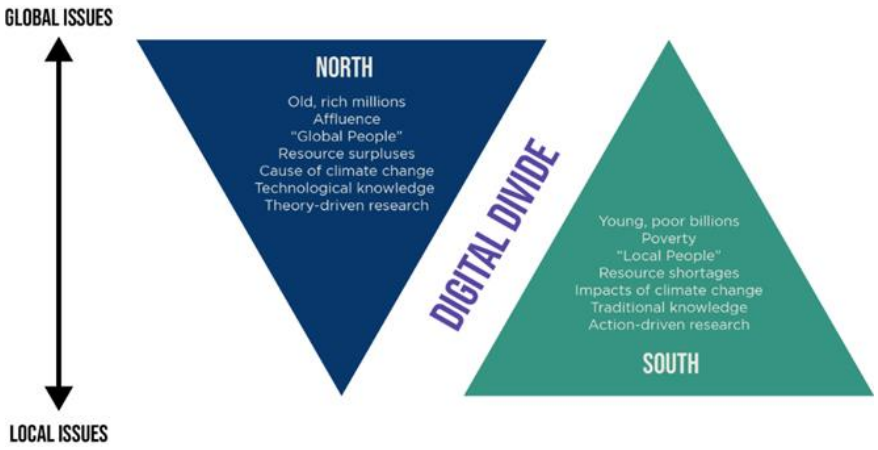


Figure 2.14. *Sustainability science within a divided world. Adapted from Kates et al. (2001).*

Recognising we have just one world and a finite set of resources, Ostrom (2007) challenges Hardin's notion in his paper "*Tragedy of the commons*" by further emphasising the importance of community-based management in achieving sustainable resource use. Ostrom argues that communities can and do manage common resources sustainably through collective action and shared governance. She advocates for modelling and

scale-linking as a means to better understand complex systems that are greater than the sum of their parts – i.e. by adopting a systems view (Ackoff 1971). This is particularly relevant to the concept of addressing sustainability challenges (Frischmann et al. 2019). Ostrom emphasizes the importance of community-based management and shared governance in achieving sustainable outcomes. It has also been argued that building a positive reputation for sustainable design can help overcome market failures and promote sustainable outcomes. This is highlighted in Krause and Parkman (2023's) paper on the reputational commons whereby they considers the importance of reputational incentives in promoting sustainable design practices. Moreover, with the hegemony of the West largely overusing their fair share for decades since the mid-1900s, often at the expense of the global south, it is no wonder curtailing growth and imposing fair use policies on the global south is seen as hypocritical.

Lastly, worth mentioning, is the author's collaborative efforts with r3.0 and colleagues in addressing the neo-colonial structures that have exacerbated the digital divide between "the have" and "have nots". Working with leading organisations such as Project Drawdown, the United Nations (UN), Future Fit Foundation (FFF), World Benchmarking Alliance (WBA), Flourishing Enterprise Institute (FEI), Taskforce on Inequality-related Financial Disclosures (TIFD), the Predistribution Initiative (PI), and the Integrated Multi-Capital Performance Research Center (IMPRC), a first report has been delivered on how the scope of thresholds and allocations is to intentionally encompass decoloniality more comprehensively and holistically by addressing a range of interwoven challenges covered in depth in r3.0 and colleagues (2024) report.

INSIGHT (R52): Colonialism persists till this day, creating social division, while the commons are being exploited and destroyed. An interdisciplinary approach, working with local communities and collective action globally, is seen as the best way to address these complex sustainability challenges.

2.2.5.7. Disruptive (Radical) Innovation

Innovations that make a meaningful difference are often those that venture into "*uncharted waters*". Leveraging globalisation, latest technology, and competitive advantage, new breakthroughs are possible in customer service, logistics, marketing, and manufacturing, to name a few. Many innovative solutions are driven by vast datasets, whereby there is an awareness of what consumers want and how products and services may be most effectively delivered (Romeo & Capolupo 2022). In today's world, where organisations are striving to become more environmentally sustainable, sensemaking of data plays a crucial role. Sensemaking is the process of creating meaning out of ambiguous and complex information, and it is necessary for organisations to make informed decisions that are in line with their sustainability goals (Seidel et al., 2017). The use of information systems (IS) is critical in supporting sensemaking practices in environmental sustainability transformations (Butler, 2011; Elliot, 2011; Melville, 2010).

INSIGHT (R53): Sense-making plays an important role in understanding the market and in delivering products and services to consumers with sustainability in mind.

Seidel et al. (2017) conducted a design science research study that developed a set of design principles for IS that supports organisational sensemaking in innovative environmental sustainability transformations. Their study highlights the importance of experiencing disruptive ambiguity, which can lead to (radical) disruptive innovation. The use of disruptive innovation can help organisations to break through their current limitations and adopt more sustainable practices (Christensen 2005). In his book *"The Innovator's Dilemma*" Clayton M. Christensen (2005) describes two types of innovation: sustaining and disruptive. Sustaining innovation involves making gradual improvements to existing products or services to meet customer demands, while disruptive innovation entails developing new products or services that initially serve

a niche market but eventually disrupt the existing market. Disruptive innovation is often challenging to manage within the existing business model and typically requires a different set of skills, processes, and business models to navigate successfully (Lindgardt et al. 2009).

As articulated earlier, the world is facing many challenges. Amidst these global difficulties VUCA is seen as both an outcome of disruptive innovation and a driver of it (Millar et al. 2018). This is even more so at the business model level where the outcome is found as the most rewarding (Lindgardt et al. 2009; Breiby & Wanberg 2011; Schaltegger et al. 2012). Disruptive change is not just innovative but often affects the underlying fabric of society as we know it, transforming whole industries (Vecchiato 2015). As consumerism drives (eternal) growth and competitiveness drives efficiency, sustainability-oriented business model innovation or (business model) Innovation for Sustainability have shown to be the most promising and impactful (Adams et al. 2015; Lüdeke-Freund et al. 2017; Breuer et al. 2018).

INSIGHT (R54): Disruptive innovation whilst difficult to manage has shown to be the most impactful and rewarding.

Tools developed to evaluate these disruptive innovations, such as the SUST BMA (Hansen et al. 2009), show that the advantages of using the business model concept lie in how the systemic linkages across several logics can be captured, described, understood, and shared within the greater sustainable value network (Evans, Vladimirova, et al. 2017). These tools provide a-priori opportunities to implement best innovative practices towards sustainability, however, ultimately, the outcome of these disruptions need to be assessed for their relative merits in bringing an entity closer to being more sustainable (Bansal, P. 2019) and meeting the steady-state economy challenge (O'Neill et al. 2010). Hansen et al. (2009) note that organisations carrying out sustainability assessments and taking sustainability seriously eventually reach a point where they

need to change their business model to become more sustainable (Bisgaard et al. 2012; cf. Beltramello et al. 2013; Kiron et al. 2013).

For these innovations to be effective the literature has shown we need a trans-disciplinary approach whereby entities, such as companies, are being benchmarked against industry peers using data-driven and statistical techniques. Elliot (2011) showcases the same in their detailed study of 80 firms and states that all companies can be benchmarked this way across any industry segment. Dao et al. (2011) argues for an inter-disciplinary and holistic approach across the whole value chain and sees the leveraging of IT as key to organisations' development of sustainability capabilities that helps them survive and thrive. Moreover, their study shows that the integration of IT resources with other internal and external resources along the value chain enables firms to develop sustainability capabilities. Integrating several firm resources and different management perspectives on sustainability, coupled with distinct types of IT resources contributes differently to a firms' sustainability strategy.

INSIGHT (R55): For disruptive innovation to be effective we need a holistic and trans-disciplinary approach that factors in the supply and delivery chain, allowing for the benchmarking of any enterprise, industry, or sector. IT is an important enabler of a firm's sustainability strategy.

2.2.5.8. Sustainability-Oriented BMI

The role of information technology (IT) as an enabler of a firm's sustainability strategy is becoming increasingly recognised, as technology can be used to accelerate the transition of entities towards sustainability (Malhotra et al. 2013). Considering the growing number of environmental and social challenges that the world is facing, the importance of sustainable business models (SBMs) is becoming more apparent. To make the transition from traditional business models ("*business as usual*") to sustainable ones, organisations need to focus on implementing business model innovation (BMI) strategies that are aligned with sustainability principles (Bocken & Bogaert 2013).

Academics and practitioners have long been discussing the relationship between business models, innovation, and sustainability (Boons & Lüdeke-Freund 2013; Wells 2013; Bocken et al. 2014; Pedersen et al. 2018), with a focus on extending the conceptualisation of these three approaches from customers to stakeholders, from monetary to multiple forms of value, from a single business to a network perspective, and from a purely organisational or stakeholder view to an embedded systems view (Breuer et al. 2018; Bansal, T. 2019). While these principles and criteria are not necessarily novel, their consolidation, consistency, and comprehensiveness offer a solid theoretical foundation to advance sustainability-orientation in business modelling and models.

Developing sustainable business models is an iterative process that requires entities to create new industries that did not previously exist, pivot to new industries or sectors, and transform products to services. For many organisations, this requires conducting a thorough analysis of their current business model and identifying areas where they can make changes to become more sustainable. This may involve examining the environmental impact of their operations, assessing their supply chain practices, or identifying opportunities for resource efficiency (Joyce & Paquin 2016). By understanding the areas where they can make the biggest impact, organisations can focus their efforts on the most critical sustainability issues. It is imperative for organisations to prioritize sustainability in their business models to address the current environmental and social challenges while remaining competitive in a rapidly changing business environment (Kurucz et al. 2017).

Developing a sustainable business model involves design that considers the environmental, social, and economic impacts of an organisation's activities. Key components of a sustainable business model include reducing waste, minimising energy use, and promoting social responsibility throughout the supply chain. Implementing new sustainable business models involves monitoring key performance indicators (KPIs) related to sustainability, such as greenhouse gas emissions, water usage,

and waste reduction. By tracking these metrics, organisations can assess the effectiveness of their (sustainable) business model and identify areas where they need to make further improvements or innovations (Blackburn 2007; Spieth & Schneider 2016; Witell et al. 2016).

Communicating the sustainable business model to stakeholders, including customers, suppliers, investors, and employees, is crucial. This involves developing a clear and compelling sustainability strategy that outlines the organisation's commitments, goals, and progress. It also involves engaging with stakeholders and seeking their input and feedback to ensure that the organisation is meeting their needs and expectations. Continuous improvement of the sustainable business model is necessary to remain competitive in a rapidly changing business environment. This involves maintaining a culture of innovation and continuous improvement and being open to new ideas and approaches (Carroux 2017; Fellmann et al. 2018; Lüdeke-Freund et al. 2019).

Developing solutions to transition from business model innovation (BMI) for measurement and business model innovation (BMI) for patterns to sustainable business models (SBM) requires a comprehensive understanding of the vast array of business models (Dentchev et al. 2018). Scholars have proposed various frameworks and models to facilitate this transition, including business model innovation for sustainable business models (Morioka et al. 2016; Evans, Vladimirova, et al. 2017; Lüdeke-Freund, Bohnsack, et al. 2018; Ritala et al. 2018) and sustainable business model measurement (Hansen et al. 2009; Pansera & Randles 2013; Adams et al. 2015; Schaltegger, Lüdeke-Freund, et al. 2016; Lüdeke-Freund et al. 2017; Varadarajan 2017; Breuer et al. 2018).

INSIGHT (R56): Bring disruptive innovation to global systemic transformation requires tracking metrics and effectiveness and iterative continuous improvements of the BM. Technology plays a vital role as organisations prioritize transitioning towards sustainability as part of their business model innovations.

The importance of sustainable business models has become increasingly apparent in the face of growing environmental and social challenges. To make the transition from traditional business models to sustainable ones, organisations need to focus on implementing business model innovation strategies that are aligned with sustainability principles. Current transformation systems will require intensive collaboration of actors, programs, and initiatives within and across whole systems (Waddock et al. 2022). This involves conducting a thorough analysis of the current business model, developing a sustainable business model that incorporates sustainability principles into the operations, implementing the new sustainable business model and assessing its effectiveness, communicating the new sustainable business model to stakeholders, and continuously improving the same. This requires consolidation, consistency, and comprehensiveness of principles and criteria to advance sustainability orientation in business modelling and models. Given the vast array of business models, developing solutions to transition from BMI for measurement and BMI for patterns to SBM requires careful consideration of various factors such as the context, the organisation's goals, and stakeholders' interests.

A successful sustainable business is not only profit-normative but also positively socially and environmentally driven and impactful (Schaltegger & Burritt 2005). The ontology of business models that establishes the necessary and sufficient constructs to represent any enterprise’s business model that might be claimed as successfully sustainable is best illustrated by those developed with the Flourishing Business Canvas (FBC) (Upward & Jones 2016). Adopting a values-based approach, sustainable business models (SBM) may be mapped to the Flourishing Business Canvas (FBC), thereby demonstrating the necessary and sufficient conditions to achieve sustainability (Upward 2013). Furthermore, by categorising business models based on SBM patterns (Lüdeke-Freund et al. 2017), one could identify which patterns give rise

to certain levels of sustainable outcomes and thereby underscore the strategy that links innovation with business sustainability.

INSIGHT (R57): Sustainable business implies empirically profit-normative, socially, and environmentally impactful. The nexus of strategy and innovation could yield the understanding necessary as to which business models are positively sustainable.

2.2.5.9. Integral Thinking

Integral thinking can be defined as a holistic approach to problem-solving and decision-making that considers multiple perspectives and dimensions of a situation. It seeks to integrate different perspectives and disciplines to create a more comprehensive understanding of complex issues. Integral thinking is a multi-perspective approach that seeks to consider multiple dimensions of a complex issue or system (Riedy 2007) and synthesizes them into a comprehensive, holistic understanding with an emphasis on the importance of understanding the interconnectedness of systems and the need to consider multiple perspectives in decision-making (Gudelunas & Waldman 2012). In the context of sustainable business models, this means considering the environmental, social, and economic impacts of business operations and the ways in which they are interrelated. For example, a sustainable business model might aim to reduce greenhouse gas emissions using renewable energy sources, but it must also consider the social and economic impacts of these changes, such as the costs and benefits to employees, customers, and other stakeholders (Steger 2017).

One example way in which integral thinking can be applied to sustainable business models is using life cycle assessment (LCA), a methodology for evaluating the environmental impacts of products and services throughout their life cycle. LCA considers the entire life cycle of a product, from raw material extraction to disposal, and considers the environmental impacts of each stage. By using an integral approach, LCA can also consider the social and economic impacts of a product or service,

such as the impacts on local communities or the costs and benefits to different stakeholders. In recent years, it has gained attention as a framework for addressing complex issues, such as sustainability and sustainable business models. This approach is particularly relevant to sustainability impact measurement, which requires consideration of multiple dimensions of environmental, social, and economic impacts. For example, triple bottom line accounting and integrated reporting are approaches to sustainability which aim to integrate the impact of efforts across the three pillars of sustainability (De Villiers et al. 2014; Stacchezzini et al. 2016). Whilst supported by the likes of the United Nations (Lydenberg et al. 2010; UN Environmental Program 2015b), several question how accurate and integrated such reports are (Lai et al. 2016; Gibassier et al. 2017) and effective in commanding change (Stubbs & Higgins 2014).

Overall, integral thinking offers a valuable framework for understanding and addressing the complex challenges of sustainability and sustainable business models. By considering multiple perspectives and dimensions, it helps businesses identify opportunities for improvement and develop more comprehensive and effective sustainability strategies. In applying integral thinking, some see sustainability as an extension of innovation (Thurm 2016), and a necessary outcome of innovating the business model towards sustainability.

INSIGHT (R58): Integral thinking connects the complex challenges of sustainability with sustainable business models, helping entities develop effective sustainability strategies. Integral thinking is a holistic and multi-dimensional approach to complexity whereby sustainability is an extension of innovation.

2.2.5.10. Leadership

Some business leaders, industry and governments alike do not see sustainability as a problem that affects them, nor think they have the ability to do something about it (Cook et al. 2013). Whilst some pacific

nations are literally ‘going under’ due to global warming (UNEP 2014; Duhaime-Ross 2016), we need to realize that we are a symbiotic part of the natural world and that a global collective collaborative effort is necessary to ensure our human legacy continues (Senge 2008). Sustainability is more than just an economic, environmental, or social justice issue — it's all of those at once — perhaps the biggest challenge humanity has ever faced, and we are going to have to work together to solve it (Ghisellini et al. 2016; Evans, Vladimirova, et al. 2017).

A successful transition by all organisations to sustainability would mean a resolution on all 17 of the United Nations Sustainable Development Goals (SDGs) (Casey & Marijs 2017). Ambitions are high, and expectations have been set such that by 2050 many of the world’s worst problems may have been avoided, averted, or annulled (UN Environmental Program 2015b). However, there are no guarantees without the cooperation of enterprise and government alike, particularly among those greenwashing their efforts (Najam et al. 2000) by posing as friends of the environment whilst, in actuality, socially and environmentally destroying it. Genuine efforts are required to address and off-set or diminish these risks with successful innovators focusing on opportunity creation — looking at market share, potential efficiencies, competitive advantages, and innovation rather than risk, reputation, and regulatory compliance (Kiron et al. 2017). Additionally, decision support systems, coupled with AI have demonstrated how the transformative power of information systems can be leveraged to create an ecologically sustainable society, whereby leaders can embrace environmental sustainability in their core principles and foster changes that reduce the environmental impact of our community (Watson et al. 2010). AI has been reported as the most important enabler for developing sustainable business models among organisations (Di Vaio et al. 2020; Toniolo et al. 2020). In addition, a Bansal (2003) on individual motivations in values-based organisations towards environmental issues was inconclusive on motives, although there is much anecdotal evidence that individuals are

more and more likely to want to work for organisations who value "*doing good to do well*" (Upward 2017).

INSIGHT (R59): Leaders see their organisation and actions not part of the problem. Solutions require a global collective collaborative effort by all at every level. Leaders can use (AI-enabled) information systems to foster change by including sustainability within their core organisational principles.

2.3. Measuring sustainable business models performance

Quantitatively measuring the performance of entities such as businesses has been a challenge (Elliot 2011). Whilst qualitative measures abound, quantitative measures that are uniform and congruent do not (Clauss 2016). It seems that a wide array of numeric quantitative indicators may be necessary (Moldan et al. 2012). In fact, the need for relevant indicators at higher scales such as the SDGs, and a relevant all-encompassing framework is widely accepted (Hák et al. 2016). This study starts by reviewing current typologies as summarised in ***Table 2.3***.

2.3.1. Current approaches

Initially, this study was aimed at assessing sustainability impacts based on empirically available public data (cf. Rekker et al. 2023). An evaluation of current sources turned out to be an underwhelming experience to say the least, with experts met along the way having a similar experience to share in finding accurate, reliable data. In fact, to this day, a study that links (entity) strategy to quantitative sustainability impact data is yet to surface (Fedeli & Glinik 2021), with many questioning to downright rejecting self-published quantitative results from major entities as half-truth efforts in greenwashing. ***Figure 2.15*** details a comparison between approaches to measuring sustainable impact developed by the author and colleague. Today there are more than 600 approaches and unlike in traditional financial accounting, sustainability reporting doesn't (yet) operate with the same transparency, consistency, and interoperability. Given the plethora of standards, methods, ratings,

Topic	Details
Conceptual Link	The concept of sustainable business models encompasses various dimensions, focusing on integrating sustainability into core business strategies (Allenby & Richards, 1994; Boons & Lüdeke-Freund, 2013).
Business Model Innovation	Sustainable business models require innovative approaches that transform traditional business operations to incorporate environmental and social considerations (Breuer et al., 2018; Schaltegger et al., 2016).
Frameworks and Theories	Various frameworks and theories have been proposed to conceptualize and implement sustainable business models (Stubbs & Cocklin, 2008; Geissdoerfer et al., 2017).
Circular Economy	The circular economy model is highlighted as a key approach for achieving sustainability, focusing on resource efficiency and waste minimization (Geissdoerfer et al., 2017).
Value Proposition	Sustainable business models emphasize creating shared value for multiple stakeholders, including customers, society, and the environment (Richardson, 2008; Porter & Kramer, 2011).
Strategic Change	Achieving sustainability often necessitates strategic changes in business models, aligning them with long-term sustainability goals (Schaltegger & Wagner, 2011; Evans et al., 2017).
Performance Metrics	Implementing sustainability in business models involves developing new performance metrics to measure sustainability outcomes effectively (Teece, 2010; Zott et al., 2011).
Stakeholder Engagement	Engaging with stakeholders is crucial for the success of sustainable business models, ensuring that diverse perspectives are considered (Evans et al., 2017; Lüdeke-Freund, 2010).
Challenges and Barriers	Businesses face numerous challenges and barriers when adopting sustainable models, including financial, cultural, and operational hurdles (Wells & Seitz, 2005; Schaltegger et al., 2016).
Tools and Methodologies	Various tools and methodologies have been developed to support the transition to sustainable business models, such as the triple-layered business model canvas (Joyce & Paquin, 2016; Osterwalder et al., 2005).
Case Studies and Examples	Numerous case studies and examples illustrate the practical application of sustainable business models across different industries (Bocken et al., 2014; Magretta, 2002).
Research Directions	Future research is directed towards exploring new dimensions of sustainable business models and developing integrated frameworks that combine economic, environmental, and social aspects (Wirtz et al., 2016).
Systemic Approach	Adopting a systemic approach to sustainability in business models is emphasized, considering the interconnectedness of various business activities and their impacts (Bocken et al., 2014).

Table 2.3. Typology of Sustainable Business Models.

and approaches, there is a real need for consolidation for these to be effectively used for comparisons (Fedeli & Glinik 2021). In fact, in recent years we have seen some efforts towards reconciliation, amalgamation and interoperability between standards. The fundamental tenet of the various approaches on offer based on either single, double, or triple materiality represent a challenge hard to overcome (***Figure 2.18***).

Jacobs and Finney (2019) contend that achieving a comprehensive understanding and consensus within the business community, as well as among other stakeholders, is crucial for companies to effectively evaluate, circumvent, or regulate the risks of greenwashing or other sustainability-related business impacts. Furthermore, such measures are vital for companies to attain the full benefits of their authentic sustainability endeavours. Note that reporting entity performance relative to base year data is in no way an indication of the authentic sustainability of an entity as it fails to address global thresholds (Thurm & Baue 2018b).

	DATA OR METHOD OR PLATFORM PROVIDER	EXPLICIT SOURCES	PUBLIC DATA	PUBLIC METHODOLOGY	MULTI ENTRY LEVELS	INC ENTITY MODEL	PERSPECTIVE	UNIT OF ANALYSIS	CONTEXT BASED	DETERMINES IMPACT OR SUST SCORE	QUALITATIVE OR QUANTITATIVE	MULTITOPIC/ MULTI-CAPITAL TBL	TOPICS ALIGNED WITH STD/ TOPIC OR SELF DEFINED OR DISCLOSURE ONLY	REPORT/ PLATFORM
CLIMATE COUNTS	Data	N	Y	Y	Y	N	Consumer	Enterprise	Y	Y	QUAN	N	CO_2	Report
BP SOLAR CASE STUDY	Data[1]	Y	Y	Y	N	Y	Researcher	Business Model	N	N	QUAN	Y	Self-defined	Report
EXXONMOBIL INTEGRATED REPORT	Data[1]	Y	Y	Y	N	N	Corporate	Enterprise	N	N	QUAN	Y	TCFD	Report
GIIN: IMPACT INVESTING IN SEA	Data	Y	Y	Y	Y	N	Investor	Country/ Sector	N	N	QUAN	Y	Several	Report
WIKI RATE	Data & Platform	Y	Y	Y	Y	N	Consumer	Region/ Country/ Sector/ Enterprise	N	Y	QUAN	Y	Several	Platform
WBA: E.G, SEAFOOD STEWARDSHIP INDEX	Data & Method	N	Y	Y	Y	N	Investor/ Consumer	Sector/ Enterprise	Y	Y	QUAN	Y	SDG's	Report
CORPORATE KNIGHTS	Method & Data	N	Y	Y	Y	N	Investor/ Consumer	Enterptise/ City/Leaders	N	Y	QUAN	Y	Self-defined	Report
TRUEPRICE STUDY: E.G, COFFEE	Data	N	Y	N	Y	N	Consumer	Raw Material/ Country	N	N	QUAN	N	Self-defined	Report
CIS	Data & Method	Y	N	Y	N	Y	Corporate	Enterprise	N	N	QUAN	Y	Self-defined	Report
SVA STUDY: E.G, AUTOMOBILE	Data & Method	N	N	Y	N	N	Corporate	Enterprise	Y	Y	QUAN	Y	Self-defined	Report
IIRC <IR>	Method & Platform	N	Y	Y	N	Y	Shareholders /Investors	Enterprise	N	Y	QUAN	Y	Self-defined	Report
DJSI	Method & Platform	N	N	Y	N	N	Investors	Enterprise/Portfolio	N	Y	QUAN	N	ICB	Report
CSR HUB	Method & Platform	Y	Y	Y	N	N	Stakeholder	Enterprise/ Industries/ Countries	N	Y	QUAN	Y	Self-defined	Report
GRI REPORTS	Method & Platform	Y	Y	Y	N	N	Stakeholder	Enterprise	Y[3]	Y	QUAN	Y	GRI	Platform
FUTURE FIT	Method	N	N	Y	N	Y	Stakeholder	Enterprise	Y[4]	Y	QUAN	Y	FF	Report
MCS	Method	N	N	Y	N	N	Stakeholder	Enterprise	Y	Y	QUAN	Y	Self-defined	Report
SASB	Method	N	N	Y	N	Y	Shareholders /Investors	Enterprise/ Industry	N	Y	QUAN	Y	SASB	Report
CDP	Data & Method & Platform	Y	Y	Y	N	N	Consumer/ Researchers	Enterprise	Y	Y	QUAN	Y	CDP	Platform
SBTi	Method & Platform	Y	Y	Y	N	N	Stakeholder	Enterprise/ Industry	Y	N	QUAN	N	CDP	Platform
B CORP BIA	Method	N	N	Y	N	N	Stakeholder	Enterprise	N	Y	QUAN	Y	B Corp	Report
THRIVE PLATFORM	Platform	Y	Y	Y	Y	Y	Systems	Entity Model (nano to macro)	Y	Y	QUAN	Y	Multi-standards inc self-defined	Platform

Figure 2.15. *Study by Fedeli and Glinik (2021) on Assessing the sustainability performance of entities: A review and classification of tools, methods, and approaches.*

Cinquini et al. (2016) exposes the lack of a unique framework for non-financial business model disclosure and articulates that to implement best business practices there is a need to define general guidelines that can ensure an acceptable level of a standardised approach, thereby improving effectiveness and comparability. The study explores the nexus of business strategy, innovation, and change management, finding that there is a low association between the business model elements and a strong need for an adequate and clear interpretation and interaction with other corporate issues (e.g., mission, vision, governance model, strategic plan, etc.). This can significantly support users in understanding the crucial pivot of the value creation process of enterprises. Furthermore, by using the Business Model Background Paper for <IR> Framework (IIRC 2013; Eccles et al. 2015) one can communicate key concepts (content elements) of the business model, as well as outline the key elements of a business model that ought to be disclosed in an effective <IR>. It is important to note that <IR> is not about monetisation, and covers the key elements of inputs, business activities, outputs, and outcomes (Michalak et al. 2017). With over 27,280 company reports as of September 2023 (https://corporateregister.com/), and the inclusion in the European Directive, the representation of an enterprise business model's ability to create and preserve value in its Annual Reports, is seen as instrumental. Whilst in many countries the disclosure of a corporation's business model is not mandatory (the UK is a notable exception), many organisations do so as to appear legitimate in the eyes of society (Deegan 2006).

2.3.2. Beyond disclosure and greenwashing

Whilst many enterprises disclose some social and environmental information, not all detail their sustainability performance in terms of measurement metrics, nor include targets, nor disclose this information transparently in publicly available reports, nor describe how their methodology employed in their reporting process (Stubbs et al. 2013; Kumar 2014). Although some governments in the name of transparency

have made sustainability reporting mandatory (Lydenberg et al. 2010), uptake rests on stakeholders exerting pressure for better and more detailed disclosure from enterprises (Stubbs & Rogers 2013; UN Environmental Program 2015b).

In a Bjørn et al. (2017) study of 40,000 corporate responsibility reports from 2000-2014, it was found that a mere 5% of those reports even referred to ecological limits. In fact, only 31 companies explicitly used ecological limits to define targets for resource consumption, emissions reductions and/or stated a reason for adjusting their product portfolio, with only a few corporate reports dealing explicitly with the issue of allocating resource and emission rights within ecological limits amongst companies and other actors.

INSIGHT (R60): Corporate reports by and large are disclosures addressing basic compliance requirements. These reports often lack metrics, science-based targets, and in-context based measurement, making them unusable for comparisons. Notably, impacts are often self-referential (inward looking) or greenwashed to appear favourable.

2.3.2.1. XBRL for comparative reporting

In 1998 <XBRL> (eXtensible Business Reporting Language) was introduced as an open, platform independent, international standard for the timely, accurate, efficient, and cost-effective electronic storage, manipulation, repurposing, and communication of financial and business reporting data (Berger et al. 2007). <XBRL> is an XML extension (and iXBRL or inline XBRL is an XHTML extension) for financial reporting which lends itself to be used interactively in IS databases (Cordery et al. 2011). The current stable version, published in 2013, uses meta-tags or markup to communicate business information unambiguously and concisely.

Although uptake has been slow, due to a lack of government drive (Cordery et al. 2011), XBRL has been mandated and progressively rolled out in many countries, including much of Europe (Enachi & Andone 2015), USA and Australia. However, <XBRL> primarily concerns itself with financial data single materiality), and as such is not tri-impact, nor

integrated, nor multi-capital and thus falls short as it is weakly sustainable.

INSIGHT (R61): Standardisation of sustainability or integrated reports would provide a basis for fair comparison. Attempts to date have not provided the integrated and harmonised approach necessary.

2.3.2.2. Systems level impacts

Over the years, several efforts have been made to measure the impacts of corporate entities within science-based targets. The World Business Council for Sustainable Development's (WBCSD) One Planet Thinking model was developed as a means of translating planetary boundaries to a business context, with a focus on issues beyond climate change (WBCSD 2023). Today, the initiative has evolved into the One Planet Business for Biodiversity (OP2B), an international cross-sectoral business coalition with a focus on biodiversity in agriculture. The coalition's primary objective is to drive transformational systemic change, catalyse action to protect and restore cultivated and natural biodiversity within value chains, engage institutional and financial decision-makers, and develop and promote policy recommendations that promote nature-positive biodiversity. The coalition focuses on three key pillars: scaling up regenerative agriculture, enhancing cultivated biodiversity, and protecting high-value ecosystems.

The WBCSD and One Planet Thinking initiatives are currently at the forefront of considering issues beyond climate change, and they serve as important sources of inspiration. Rekker et al. (2022) and Bjørn et al. (2020) have operationalised ecological limits for use in life cycle assessment (LCA) indicators, which complements the approach taken by One Planet Thinking. The One Planet Business for Biodiversity initiative is a significant step towards incorporating biodiversity into corporate sustainability considerations, reflecting the growing recognition of the critical role of biodiversity in ensuring long-term planetary health. As

such, it represents a crucial opportunity for businesses to align their practices with the broader objectives of global sustainability.

INSIGHT (R62): The One Planet Thinking initiative is an attempt to bring systems level thinking to the corporate level, thus recognising the holonic and scale-linking nature of the world in relation to biodiversity.

2.3.3. Materiality: what is relevant

2.3.3.1. Single, double, and beyond

Over the years we have seen several attempts at standardisation with little success. There has been also a fair amount of industry consolidation following COVID-19 with the International Integrated Reporting Council (IIRC) joining forces with SASB (forming the VRF), the Climate Disclosure standards Board (CDSB) consolidated into the International Financial Reporting Standards (IFRS) Foundation, and most recently GRI in talks to merge with the Internationaal Sustainability Standards Board (ISSB) (an unlikely marriage given their very different position on materiality) (Eco-business 2023). The ISSB is focussed on single materiality or simply put, looking at financial risk to an organisation (outside-in). The Corporate Sustainability Reporting Directive (CSRD) and GRI on the other hand looks at double materiality (GRI 2023), meaning it also concerns itself with risk an organisation places on society and the environment (inside-out). Neither, however, consider triple materiality which takes a system view, considering impacts on the overall system, given its complex interconnected nature and planetary boundaries – i.e. factoring thresholds and allocations.

In Europe, the European Financial Reporting Advisory Group (EFRAG) has developed a proposed Corporate Sustainability Reporting Directive (CSRD) that takes a "double materiality approach" to sustainability reporting. This approach considers understanding the most significant impacts from business activities on society and the environment, regardless of any direct link to enterprise value, as an

essential first step in sustainability reporting. The CSRD aligns with the Global Reporting Initiative (GRI) and reflects a more European worldview that advocates for a framework for active intervention to mitigate negative impacts on society and the environment before they occur.

The CSRD requires public issuers to disclose their environmental and human rights due diligence processes, stakeholder engagement practices, and methods for understanding the most salient impacts from business activities. The CSRD proponents argue that a double materiality approach is necessary to proactively manage sustainability risks and opportunities. However, critics of this approach contend that it is too big a departure from the status quo investor-focused reporting frameworks, generating significant extra costs for public companies, distorting capital allocation, and eroding the voice of shareholders in corporate governance (CSRD 2023).

Opponents argue that decision-useful sustainability disclosure must go beyond financial materiality at an enterprise value level to inform effective management of systemic risks. Sesqui-materiality is an alternative approach that considers both "inside-out" impacts on society and the environment (negative externalities) and "outside-in" impacts (financial materiality) within the bounds of fiduciary duty to manage systemic, or beta, risk. Studies have shown that such risks are responsible for 75% - 94% of all portfolio returns (RiA 2023).

Overall, the debate on sustainability reporting revolves around whether sustainability disclosure should prioritize financial materiality or adopt a broader approach to include all significant impacts from business activities on society and the environment. However, single-, double-, and sesqui- are all insufficient for achieving true sustainability as they fail to take a strong sustainability stance, factoring in finite resources, and global thresholds. An example comparison for biodiversity is included in ***Figure 2.16***.

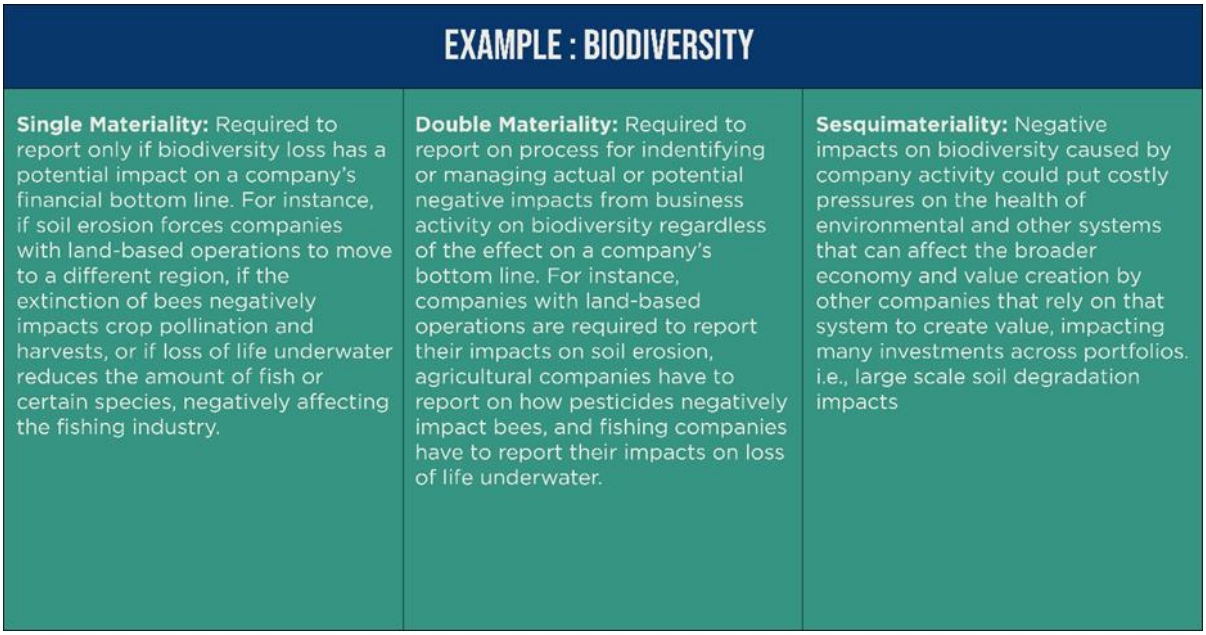


***Figure 2.16**. Biodiversity materiality comparison between single, double and sesqui materiality.*

Yet another, is dynamic materiality which refers to the notion that what is considered important to an organisation and its stakeholders is constantly changing, as demonstrated by recent global events. This implies that material issues that are currently deemed immaterial may become relevant in the future. To keep up with the evolving environmental, social, and governance (ESG) landscape, material issues should be treated as dynamic. By continuously monitoring sustainability impacts, risks, and opportunities, companies can ensure that their strategy remains relevant to their key external stakeholders. This approach ensures that companies can adapt to changing stakeholder expectations, stay ahead of emerging trends, and remain competitive in the market. An example of a materiality matrix is shown in ***Figure 2.17***.

INSIGHT (R63): Consolidation within the industry is necessary to provide uniformity and comparative measures between the plethora of approaches provided by standard setters. However, many take very different viewpoints and thus disagree on the basic premise of what is or is not material.



Figure 2.17. *Sample materiality matrix from Syngenta related to the 17 UN SDGs. Reproduced from https://syngenta.com.*

Finally, there are hundreds more approaches including integrated materiality. What we have seen, as of late, is a consolidation with several groups coming together, quoting 'interoperability' between the various standards (***Figure 2.18***). It is questionable, however, as to whether these promulgated standards are sufficient to inform a transition towards a truly sustainable future, with several critics pointing to inherent flaws in the assumptions in the standards, such as a lack of social floors (Shift), use of only single (ISSB) or double (GRI) materiality to name a few.

Recently, on July 31st, the IFRS has deployed the (ESRS) mandating more than 50,000 firms in the EU to comply. As stated by Dr Carol Adams, appointed Chair of the GRI's Global Sustainability Standards Board, if we are to avert the worst of the current pending crisis, frameworks, standards, and legislation, will explicitly require "*Changes in*

investment decision making, corporate strategies, and business models" (Adams 2018). She goes on to say that this is informed by rigorous qualitative research examining corporate behaviour in relation to reporting requirements. As stated in ESG Investor, "*There are no investment returns on a dead planet*" (Adams 2022).

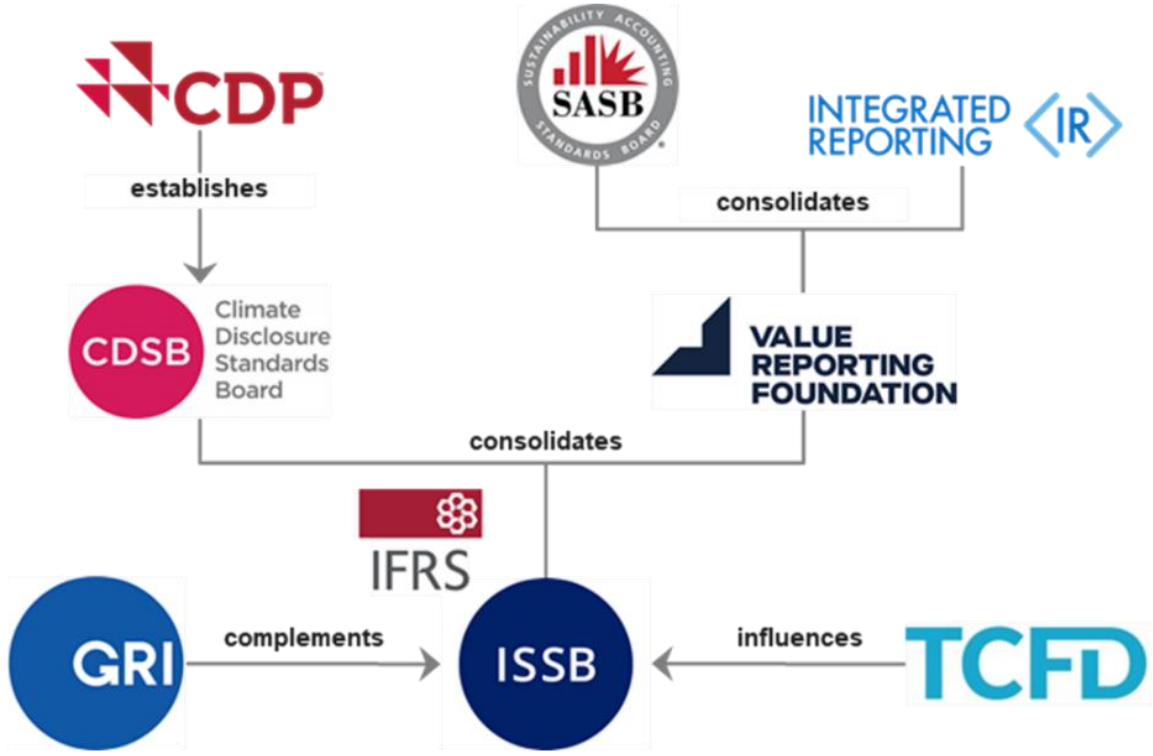


Figure 2.18. *Convergence of Voluntary Sustainability Disclosure Standards. Source: Kirkland & Ellis, May 2022.*

2.3.3.2. Triple or authentic materiality

In the UN RISD "*Thresholds of Transformations*" report, the concept of Sustainable Development Performance Indicators (SDPIs) is central to the Authentic Sustainability Assessment report (United Nations 2022b). These indicators measure the sustainability performance of businesses, non-profits, and other economic organisations using a new and improved approach. Unlike the old disclosure approach that relies on extracting infinite resources from a finite planet, SDPIs respect all planetary limits, whether social, economic, or environmental. Conventional disclosure involves comparing peers in the same industry or geography and

disclosing one's "good" performance in comparison to previous years. SDPIs, on the other hand, involve comparing companies against a scientifically established, context-based sustainability threshold. An organisation's sustainability performance is expressed in terms of its impact on vital assets, such as planetary limits and social thresholds, compared to sustainability standards.

The report shows how true sustainability can be assessed by comparing actual impacts with normative impacts. For example, an organisation reducing its water consumption by 35% or saving the most water compared to its competitors does not actually tell us anything about the sustainability of that water consumption. Instead, SDPIs recommend comparing water consumption to the capacity of ecosystems and to the actual water needs of living species. It is this balance between actual consumption and resource availability, considering ecosystem capacity, that will determine the true sustainability of an organisation. At its core, the report argues that "*current business practices are inauthentic and insufficient for achieving true sustainability*" (Baba & Kolli 2023).

Over time, businesses will be increasingly required to disclose their sustainability impacts. Around 50,000 large European companies, for instance, will be required to do so starting in 2024, following the enactment of the Corporate Sustainability Reporting Directive on 5th Jan 2023 (CSRD 2023). Stock markets are also moving in this direction, forcing publicly traded companies to disclose their sustainability performance in the United States and Canada. The widespread and concerted adoption of SDPIs around the world can foster authentic sustainability that will bring us closer to meeting the magnitude of the challenges ahead. The new indicators may be used to offer a trajectory towards achieving authentic sustainability (***Figure 2.19***).

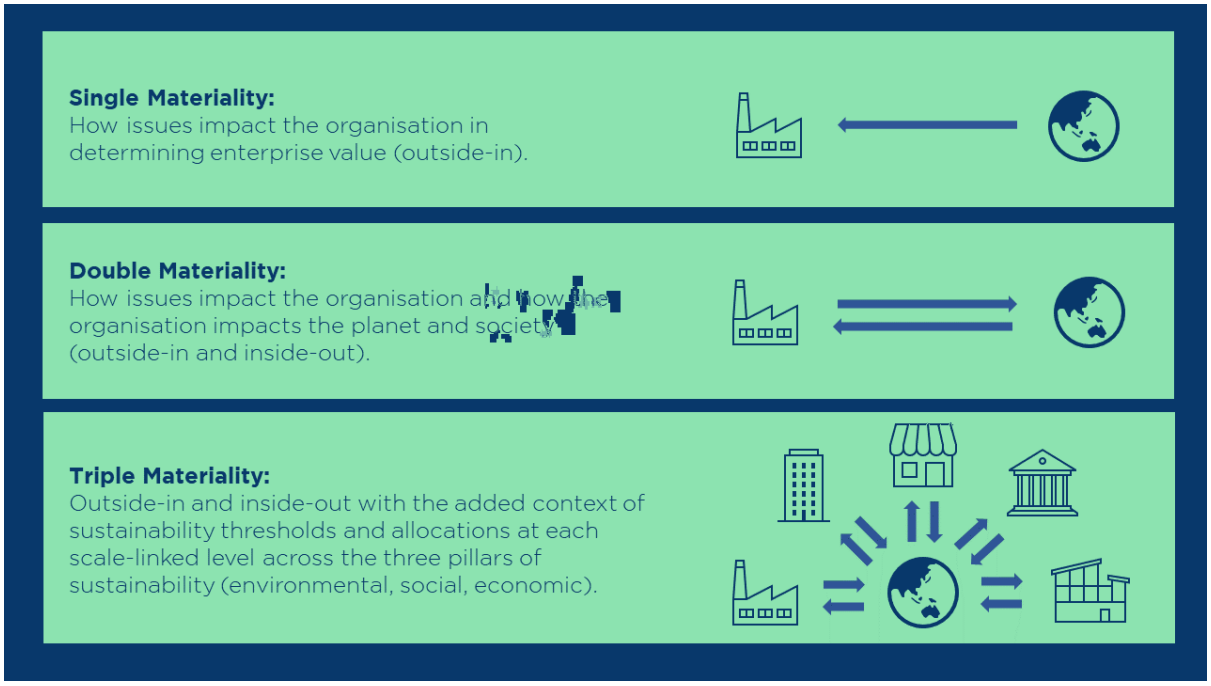


***Figure 2.19**. Single vs Double materiality. Triple or Authentic materiality combines both.*

However, it is early days and there is still a lot of confusion (Berg et al. 2019). ESG (outside-in) (Sustainlife 2023) is being conflated with sustainability (inside-out), cherry picking (only choosing favourable material topics) by some organisations, externalising of social and environmental costs, and there is still plenty of failure to disclose (UN Environmental Program 2015b; WBCSD 2017b), greenwashing, as well as outright fraud (Laufer 2003; Jacobs & Finney 2019).

INSIGHT (R64): Triple or authentic materiality measures sustainability performance relative to our regenerative and absorptive capacities. Many countries are requiring organisations to comply with various levels of standardisation, with the industry littered with often confusing requirements.

2.4. The gap exposed in this literature review

A review of the literature reveals gaps in several areas as identified and summarised in ***Table 2.4***. This study focuses on two distinct areas necessary to this investigation: Sustainability Performance Index (SPi) and Business (or generically Entity) Model Innovation for Sustainability (BMIfS).

Topic	Sub-topic	Current Understanding	Identified Gap	Relevance	Proposed Research Direction	References
Performance Data, Metrics, and Benchmarks	Context-based allocations	Various metrics and benchmarks exist for measuring sustainability performance based on context-specific allocations.	Lack of standardization in context-based allocation methods across different sectors and regions.	Standardizing context-based metrics can improve comparability and effectiveness of sustainability assessments.	Develop standardized methodologies for context-based allocations that can be applied across different sectors and regions.	Kiron et al., 2017; LeBlanc & DeRose, 2016; Fogelberg et al., 2017; IRIS, 2019; KPMG, 2020; Elkington, 1997; Porter & Kramer, 2011
Business Model Innovation for Sustainability (BMIfS)	Values-based innovation	Values-based innovation is recognized as crucial for sustainable business models.	Limited empirical studies on the impact of values-based innovation on long-term sustainability outcomes.	Empirical studies can provide insights into the effectiveness of values-based innovations and guide sustainable business practices.	Conduct longitudinal empirical studies to assess the long-term impact of values-based innovation on sustainability outcomes.	Fogelberg et al., 2017; IRIS, 2019; Breuer et al., 2018; Schaltegger et al., 2016; Stubbs & Cocklin, 2008
Systems Thinking	Management theory	Systems thinking is acknowledged as essential for addressing complex sustainability challenges.	Need for practical frameworks that integrate systems thinking into management practices.	Integrating systems thinking into management can enhance the ability of organizations to address complex sustainability issues effectively.	Develop and test practical frameworks that incorporate systems thinking into management practices, focusing on real-world applications.	KPMG, 2020; Fogelberg et al., 2017; Meadows, 2008; Senge, 2006
Sustainable Consumption and Production (SCP)	Lifecycle analysis	Lifecycle analysis is used to assess the environmental impacts of products and services.	Insufficient integration of social and economic dimensions in lifecycle analysis.	Comprehensive lifecycle analysis can provide a holistic view of sustainability impacts, considering environmental, social, and economic dimensions.	Develop methodologies for integrating social and economic dimensions into lifecycle analysis, ensuring a more holistic assessment of sustainability impacts.	LeBlanc & DeRose, 2016; KPMG, 2020; UNEP, 2011; Guinée et al., 2011
Policy Integration	Multi-level governance	Policy integration across different levels of governance is crucial for effective sustainability strategies.	Lack of coordination and coherence in sustainability policies across local, national, and international levels.	Improved policy integration can enhance the effectiveness of sustainability initiatives and ensure consistent implementation across different levels of governance.	Conduct research on best practices for multi-level governance and policy integration, identifying successful models and approaches.	IRIS, 2019; Fogelberg et al., 2017; Ostrom, 2010; Meadowcroft, 2007
Sustainable Finance	Impact investing	Impact investing aims to generate positive social and environmental impacts alongside financial returns.	Limited understanding of the long-term impacts and effectiveness of impact investing strategies.	Understanding the long-term impacts of impact investing can guide investors in making informed decisions and promoting sustainable finance practices.	Conduct longitudinal studies to evaluate the long-term impacts of impact investing, focusing on financial, social, and environmental outcomes.	Kiron et al., 2017; IRIS, 2019; Bugg-Levine & Emerson, 2011; Hebb, 2013
Digitalization and Sustainability	Smart technologies	Smart technologies can enhance sustainability by improving efficiency and reducing resource consumption.	Insufficient research on the potential negative impacts of digitalization on sustainability, such as increased e-waste and energy consumption.	Exploring the potential negative impacts of digitalization can inform the development of strategies to mitigate these effects and ensure the positive contributions of digitalization to sustainability.	Investigate the potential negative impacts of digitalization on sustainability and develop strategies to mitigate these effects, ensuring the positive contributions of smart technologies to sustainability.	KPMG, 2020; LeBlanc & DeRose, 2016; Hilty & Aebischer, 2015; Bocken et al., 2014

Table 2.4. Gap Analysis.

2.4.1. Performance Data, Metrics, and Benchmarks

2.4.1.1. Plethora of providers

The most prominent source of sustainability reporting is the non-profit GRI's Sustainable Development Database, holding the reports of 74% of the world's largest organisations (Kiron et al. 2017), predominantly harmonised with standards set by the OECD, and aligned with the Carbon Disclosure Project (CDP), and ISO 26000 among others (LeBlanc & DeRose 2016). Although sustainability reports are mandated in more than 80 countries, GRI reporting is voluntary, available publicly, freely and transparently from organisations worldwide conforming to the GRI Standards Framework (Fogelberg et al. 2017). Whilst choice of metrics is not specified, many organisations choose established sources such as IRIS+ (IRIS 2019), an initiative of Global Impact Investing Network (GIIN) since 2009, a non-profit organisation dedicated to increasing the scale and effectiveness of impact investing, by measuring the social, environmental and financial performance of an investment. Also noted in the Carrots & Sticks report by WBCSD's Reporting Exchange and UN Environmental Program among others, there is a need for alignment and harmonisation between the various providers with information overload and frustration exhibited by reporting organisations (KPMG 2020).

INSIGHT (R65): Reporting impacts is voluntary and suffers from a lack of alignment and harmonisation between the various rating/ranking/standards providers.

2.4.1.2. Fair shares – thresholds

More importantly, despite GRI's Sustainability Context Principle involving "*discussing the performance of the organisation in the context of the limits and demands placed on environmental or social resources at the sector, local, regional, or global level*", very few reports do so (McElroy et al. 2008). As such, context-free sustainability reports fail to

address the impact on vital natural, human, and social capital resources relative to norms, standards, or thresholds for which they apply, in order to be sustainable; and, critically, were the target of the 2011 'Enforce or Explain' Campaign against GRI. In fact, UN Environmental Program (2015b) report identified that context-based sustainability (CBS), i.e. placing sustainability reporting information within the context of environmental limitations identified by scientific evidence, is necessarily important to organisations, since only CBS makes it possible to measure, manage and report the performance of organisations against their duties and obligations to stakeholders thus enabling a more accurate reflection of an organisation's contribution to sustainable development (McElroy 2012). We see here norms as more than just rules or strategies but as the evolutionary adaptation of humankind itself, setting the standards for society to meet into the future (Loughmiller-Cardinal & Cardinal 2023).

Furthermore, it has been shown that following the GRI guidelines is not sufficient in answering the question as to how quickly an organisation is approaching sustainability as in many instances, for example, carbon emissions can be reduced alongside compromises in quality or simply offset by carbon-credits (McElroy 2012). Whilst organisations may report level and progress, they often do not compare these to industry standard benchmarks (Isaksson et al. 2009). Instead, Zhou et al. (2012) argues for composite indices that are comprehensive and proposes a method of calculation of indices and an aggregate composite index by applying sensitivity analysis to the results.

INSIGHT (R66): Reporting lacks contextualisation within thresholds, based on environmental limitations identified by scientific evidence. These impacts need to be measured relative to production benchmarks through aggregate composite indices.

A handful of frameworks exists as well as a myriad of self-assessment tools including the Multi Capital Scorecard's (MCS) True Sustainability Index (TSI) by McElroy using CBS metrics, through to the

comprehensive Future Fit Business Benchmark (F2B2) espoused by Kendall and Willard (2015) which incorporates a number of other frameworks, providing methods and tools for self-evaluation of sustainability performance and impact. In recent times, we have seen some of these approaches also modified and applied at the industry or bioregional level. Another promising approach, is that taken by WikiRate (*WikiRate* 2017), an open research platform, whereby community or designer assessed data is compiled into tables together with metrics and user-defined formulae for reporting. This allows comparison with benchmarks, such as the weakly-sustainable "Sustainable Value Assessment" or SVA method (Kuosmanen & Kuosmanen 2009) by Figge and Hahn (2005) or industry specific standards like the Higg Index, which together with weights provides equal footing and context towards cross-sector issues commonly identified by the context gap (Eccles 2012b).

2.4.1.3. Context-based – allocations

Placing performance information (e.g.: Sustainability Performance Index: SPi) in the broader biophysical, social, and economic context lies at the heart of sustainability reporting, and it is this lack of contextualisation and consistency of metrics across sectors which is the root of the context gap (i.e. missing science-based targets in the denominator) (Eccles 2012b). Context matters, and it is essential that the performance of an organisation is transparently viewed in the context of the limits and demands placed on economic, environmental, or social resources at a macro-level (von Bertalanffy 1968; UN Environmental Program 2015b). Furthermore, within the paradigm of strong sustainability, minimising burden-shifting requires all material topics to be tracked with stakeholders embracing context-based sustainability (CBS) approaches to data, and scientific evidence-based advocacy, in order to advance the achievement of a regenerative and inclusive economy (Lydenberg et al. 2010).

INSIGHT (R67): There is a myriad of self-assessment tools, open research platforms, assessment, and benchmarking tools available. It is important to address the context gap openly and transparently, where contextualisation and consistency of metrics is paramount (context matters). Embrace CBS.

However, benchmarking organisations on a worldwide basis is a massive project, far too big for any one group, be it government or organisation to measure, however, the ability to accurately assess within context and track sustainability is crucial for achieving the Sustainable Development Goals (SDG) (Compass 2015; UN Environmental Program 2015b). Indeed, political pressure is moving organisations to embrace the SDGs (SDG 2019). Currently an organisation embracing this endeavour is the World Benchmarking Alliance (WBA), a new global multi-stakeholder initiative developing and transparently providing public access to benchmarks via '*league tables*' (like medicine index), ranking organisations on their sustainability performance and contributions towards achieving the Sustainable Development Goals (SDGs) (OECD 2016). Just like traditional sports, it encourages competition and excellence among businesses aligning themselves with the SDGs. It is the result of the WBA's "*Better Business, Better World*" report, published in Jan 2017 outlining the $12 trillion economic opportunity for business in pursuing sustainable and inclusive business models, and the creation of 380 million jobs by 2030 (Oppenheim et al. 2017).

Criticism has arisen due to unclear sourcing of datasets acquired from third parties like the Carbon Disclosure Project (CDP). CDP's confidentiality constraints prevent them from disclosing these sources. However, the unavailability of these raw datasets hinders the ability to verify the contextual basis of the data. Context-based universal indicator would provide for comparability across industries as well as across scales such as between enterprises, or between countries (Tatiana Krylova et al. 2019). For fair comparisons, materiality must be uniform and universal.

INSIGHT (R68): WBA is attempting to benchmark organisations worldwide sector by sector. There have been doubts as source data sets are not made available publicly and transparently (despite stating the contrary). Need for a comparative uniform universal harmonised sustainability performance index.

2.4.1.4. The holonic view

In Costanza and Patten (1995) article - *Defining and predicting sustainability* – the authors emphasize the concept of sustainability as the persistence or surety of a system. They argue that sustainability can only be assessed after the fact, and therefore, it is essential to take a holonic view and examine systems and subsystems as hierarchically interconnected entities over a range of time and space scales, with a necessarily finite lifespan (Victor 2018). The nested hierarchy of systems over a range of time and space scales, is known as the meta-system, offering a useful framework for understanding sustainability and achieving a steady-state system that can be maintained indefinitely (Costanza et al. 2016). Regarding assessing sustainability, the authors assert that it can only be done retrospectively, and therefore, the focus should be on developing methods that enable us to predict which configurations will persist. Due to the vast uncertainties involved in the socio-economic system, it is crucial to adopt policies that are precautionary in nature, avoiding unnecessary risks with sustainability and not relying solely on hoped-for technological solutions for their success (Ekins et al. 2003). This, precautionary principle, is particularly important when dealing with large-scale socioeconomic systems (Holmberg & Robèrt 2000; Willard et al. 2013).

INSIGHT (R69): True sustainability impact may only be assessed after the fact (of taking some action), and the value comes from developing methods that enable us to predict which configurations will persist. Taking a holonic view, it is crucial to adopt policies that are precautionary in nature.

2.4.1.5. Abundance of approaches

There are hundreds of approaches and methods, ratings and rankings, standards and benchmarks, measuring systems available, all with their own assumptions as to what is most significant to include or exclude and associated methodologies (Vanclay 2004). Sustainability assessment is a recent framing of impact assessment which is an extension from social impact assessment and fundamentally requires a pluralistic approach (Bond et al. 2012). This means addressing an interdisciplinary field with a vast set of data points by circumventing the complexity of integrating several incongruent platforms across scales. This will allow for harmonisation across all approaches including those earlier cited examples of the SVA, GDP, EF, and HDI.

In their analysis, Mazzetti et al. (2022), indicate that the linkage between Earth Observation data and Earth Science models for environmental decision-making has significant local and global impacts, which can be facilitated by the ongoing digital transformation. This transformation presents an opportunity to transfer scientific knowledge into tools for informed environmental decision-making. The advancement of information technologies has made it possible to run complex models using large amounts of Earth Observation datasets. However, data and model interoperability remain limited to the syntactic level, which hinders the reusability of scientific processes and related workflows. For example, a proof-of-concept has been developed for assessing one of the indicators of the Sustainable Development Goals defined by the United Nations, highlighting the need for explicit indicators or indices in environmental policy agreements that should be addressed with policymakers. Additionally, some sustainability indicators may not be reliably quantifiable, and some indicators may serve as proxies for sustainability (Nicolăescu et al. 2015). To overcome this challenge, it is important to utilize improved technology to better predict the behaviour of complex systems and apply backcasting methodologies (Holmberg & Robèrt 2000).

INSIGHT (R70): Improve interoperability by transferring the pluralistic, interdisciplinary, scientific knowledge, into tools for informed environmental decision-making leveraging significant local and global impacts. Consider the use of proxies and technology to predict the behaviour of complex systems.

Gallopín (1996) proposes that situational indicators are a specific case of systems behaviour indicators. Sustainability assessment is a critical tool for decision-making that moves beyond the purely technical or scientific evaluation of a system. In sustainability assessment, external inputs such as values and boundaries are considered in the analysis, including the relevant sustainability framework (Sala et al. 2015). Russell et al. (2021) suggest that the use of AI and AGI can make sense of the numerous taxonomies related to materiality, targets, indicators, and goals. Meanwhile, Zhou et al. (2012) propose that the best scheme for producing composite indicators involves gradually aggregating sustainable development indicators into sustainability sub-indices and, eventually, to a composite sustainability index (Munda 2005a). Large regenerative models drive high predictability with associated difficulty in anticipating the consequences of specific model development and deployment. The AI community may consider the increase in chances of these models having a beneficial impact on policy when developing large generative models (Ganguli et al. 2022).

INSIGHT (R71): Leveraging AI, bake in the grounded, science-informed, technological rules, abstract the taxonomy and (agnostic) methodology, and transparently provide granular access to the vast Earth Observation datasets.

2.4.2. Business Model Innovation for Sustainability (BMIfS)

2.4.2.1. The new normal – Sustainable Business

The concept of "*business as usual*" has been widely recognised as unsustainable and incompatible with the survival of the human species (Bocken 2014). Nicolăescu et al. (2015) have demonstrated that

corporate performance can be improved by implementing sustainability initiatives. Neumayer (2010a) argues that sustainability should be considered the predominant lens through which all business operations should be evaluated in order to ensure their continued viability. Lambert and Davidson (2013) in '*Applications of the business model in studies of enterprise success, innovation and classification'* recognize the usefulness of the descriptive and analytical construct, that is the entity (business) model concept. They cite the business model as the basis for enterprise classification, performance, and entity (business) model innovation. Consequently, it is necessary for organisations to proactively transition from unsustainable practices to sustainable ones (Eriksson & Robèrt 1991; Ostrom 2008; Rockstrom 2009).

This transition requires a shift in perspective from a natural science/engineering-dominated approach to one that incorporates ecological/managerial considerations (Allen et al. 2003). Furthermore, organisations must move beyond purely intuitive approaches to problem-solving and embrace consciously designed problem-solving approaches (Simon 1969; Ackoff 1981; Robinson 1982; Broman et al. 2000). Legal and regulatory frameworks must also be updated to explicitly recognize the interdependence between organisations, the economy, society, and the environment (Richardson 2010). Finally, companies, researchers, practitioners, and state policy should focus on the use of scalable technologies, such as AI to further development of SBMs (Di Vaio et al. 2020).

INSIGHT (R72): There is a transition to being sustainable. There is no doubt that this will be the default modus operandi for all organisations (entities) into the future. AI will be a key catalyst in this transition.

2.4.2.2. Sustainability

Sustain*ability* as the word implies is the ability to sustain for the long-term and therefore is more than just an economic, environmental or

a social justice issue. Our transgressions as a society, brought on by consumerism and colonisation are well documented (Sultana 2023). Sustainability is a new evolving complex trans-disciplinary integrated field of study, intrinsically linked to innovation (Williams et al. 2017), leveraging on systems thinking (Pourdehnad & Bharathy 2004; Jones & Upward 2014) and embracing the fields of industrial ecology (IE), corporate responsibility (CR), environmental science, politics and economics; whereby our disregard for its implications has brought unheard of levels of suffering and destruction into this world (Hawken et al. 1999; Steffen et al. 2015). Gharajedaghi (2006) proposes the integration of two distinct schools of thought of systems thinking - Ackoff's interactive design and Forrester's systems dynamics - to develop a holistic approach to problem-solving towards addressing sustainability. This approach combines iteration of structure, function, and process with interactive design, resulting in the development of multi-purposeful systems that can support sustainability goals (Wieringa 2010).

INSIGHT (R73): Systems thinking (social sciences) coupled with system dynamics (biophysical sciences) forms the worldview in support of our transition to becoming sustainable. Tackling complex trans-disciplinary integrated issues through innovation.

2.4.2.3. Industrial Ecology

John Ehrenfeld, one of the most prominent authors on Industrial Ecology (IE) (Ehrenfeld 2004) - the science of sustainability - defines sustainability more bleakly as: “The possibility that human and other life will flourish on this planet forever”. Whilst peace (avoiding war) is foremost in most people’s mind; business leadership, culture, collaboration and globalisation ought to be also, as these are key sustainability levers (Ball 2006; Broman et al. 2017; Kiron et al. 2017; Kurucz et al. 2017; Matinaro & Liu 2017), with governments providing a pivotal role in shaping legislation (UN Environmental Program 2015a; European Academies Science Advisory Council EASAC 2016; Schaltegger,

Hansen, et al. 2016) for a clean and healthy shared values-based society powered by renewable resources (Breuer & Lüdeke-Freund 2016). Furthermore, cooperation between enterprise and government is paramount, to avoid corporate greenwashing efforts (Najam et al. 2000) whereby organisations seek to pose as friends of the environment whilst in actuality, socially and environmentally destroying it.

INSIGHT (R74): Governments and their influence on legislation play a pivotal role in enacting the transformations needed in industrial ecology to arrive at a sustainable future.

2.4.2.4. Leadership

To this end, several businesses leaders, nurturing a culture of innovation as a sustainable advantage, are investing in a portfolio of innovations (Ball 2006; Kiron et al. 2013) – in particular the disruptive kind (Christensen 2005; Vecchiato 2015) - driving the development of new products and technologies, processes and supply chains, creative business models and value delivery paths and processes, leveraging on the shared resources at hand, improving effectiveness and efficiency of outcomes whilst reducing waste, environmental destruction and the squandering of resources.

2.4.2.5. Organisational (entity) strategy

Organisational strategy and its long-term aims (Clausewitz 1832; Porter 1996; Mintzberg 2007; Bleicher 2011) can benefit from a focus on sustainability. The 'triple bottom line' of people, planet, and profit (Elkington 1997) complements traditional objectives of organisational strategy such as shareholder value (Rappaport 1998) and customer satisfaction (Vargo & Lusch 2004). Sustainability is increasingly seen as a new source of competitive advantage (Nidumolu et al. 2009; Porter & Kramer 2011), with business model innovation being considered as one of the key tools to make strategic use of sustainability in organisations

(Boons & Lüdeke-Freund 2013; Boons et al. 2013; Bocken et al. 2014; Abdelkafi & Täuscher 2015).

INSIGHT (R75): Business leaders see BM innovation towards sustainability as a source of competitive advantage and building this into their strategy.

2.4.2.6. Values-based innovation

Breuer and Lüdeke-Freund (2014) propose that there is a direct theoretical link between values theory and innovation management as one move towards a more complete and integrative framework of values-based innovation. This values-based view, links values and integrated management to open innovation (Brasseur et al. 2017) thereby facilitating direct innovation and its management, as well as the creation of new products, services, business models, and networks (Breuer & Lüdeke-Freund 2016). Here, we define innovation as transformational; creating and capturing new value in new ways; and generating new insights that upon implementation create business value (Elliot 2011). Creativity and innovation has been widely acknowledged as a key mechanism for addressing sustainable development concerns (Hall & Clark 2003; Hall & Vredenburg 2003; Hart et al. 2003; Boons et al. 2013; Matos & Silvestre 2013; Huisingh et al. 2015; Silvestre 2015). In fact, there is ample evidence that an organisation's innovativeness is important to its survival and success (Khazanchi et al. 2007; Varadarajan 2009) and for sustainable competitive advantage (Khazanchi et al. 2007; Varadarajan 2009; Bowonder et al. 2015; Prasad & Junni 2017).

INSIGHT (R76): Creativity and innovation have been shown to be key mechanisms in addressing sustainable development. A values-based view links values to open innovation.

2.4.2.7. Business model innovation

Several studies show that business model innovation (BMI) is the most aggressive and impactful form of innovation and a key source of

sustained value creation (Ball 2006; Breiby & Wanberg 2011), however, few articles explain in detail how business model innovation (BMI) improves competitive advantage, profitability, innovativeness, or other aspects of organisational performance (Giesen et al. 2007; Aspara et al. 2010; Bock et al. 2012; Denicolai et al. 2014; Wei et al. 2014) (Zott & Amit 2007). Tools exist providing a common language for understanding and categorising sustainable business models (SBM) such as the Business Model Canvas (BMC) (Osterwalder & Pigneur 2010) and the Triple Layered BMC (Joyce & Paquin 2016), Flourishing Business Canvas (FBC) (Upward & Jones 2016), BM archetypes (Bocken et al. 2014) and Sustainable Business Model (SBM) patterns (Carroux 2017; Remane et al. 2017).

Morioka et al. (2016) have also proposed the "*performance prism*", a comprehensive and integrative performance measurement framework for SBMs measuring performance using both leading and lagging indicators that supports the identification of sustainability innovations, across five performance dimensions: stakeholders' satisfaction, strategic drivers, business processes, capabilities, and stakeholders' contributions. Bocken et al. (2013) contend that business model redesign may be a key to radically improving sustainable performance to create greater environmental and social value while delivering economic sustainability (Stubbs & Cocklin 2008; Yunus et al. 2010; Porter & Kramer 2011). These approaches contend that '*by design*' they produce more sustainable business models, however, without an empirical evaluation, there is no evidence of the same. Furthermore, whilst more sustainable business models are desired, merely being more sustainable is no assurance as to whether it is enough from a strongly sustainable perspective (Neumayer 2010a; Pelenc 2015; Landrum 2017).

INSIGHT (R77): Business model innovation is the most impactful form of innovation. Although BM 'by design' ought to be more sustainable, without an empirical assessment, it is unknown as to whether this is so, and to what extent.

2.4.2.8. Evaluate sustainable business model

The question of how leaders can innovate their business models toward greater sustainability has not been sufficiently addressed to date (Foss & Saebi 2016). Specifically, the ability to evaluate sustainable business model (SBM) patterns against an organisation's sustainability performance index (SPi) would provide a basis of comparison as to what innovations or transformations at the business model level is more likely to yield economic, social, and environmentally sustainable outcomes for the organisation and the broader eco-system. Contextualised and measured shared values, understood as subjective notions of the desirable, provides the scope and motivation for a sharing economy and collaborative based consumption eco-system, with foreseeable results fostering more business to adopt sustainable principles (Breuer & Lüdeke-Freund 2017). One previously attempted way to achieve this, was to develop a BMI/SBM assessment tool by overlapping GRI material topics onto the Flourishing Business Canvas (FBC) (see Obst 2015), providing the basis of matching and understanding elements of the GRI that affect the SBM (Lüdeke-Freund et al. 2015). This method however is ex-ante and not operationalised and therefore still lacks the empirical dataset to support its claim of being strongly sustainable (Neumayer 2010a; Pelenc 2015; Landrum 2017).

INSIGHT (R78): Business leaders are seeking to know a priori which innovations are subjectively more desirable. Which business model patterns are likely to lead to more sustainable outcomes.

2.4.2.9. The demand

With an ever-increasing population base approaching 9 Billion by 2050 (UN Environmental Program 2014), eradicating extreme poverty, improving waterways and air quality, reducing GHG emissions and deforestation, halting loss of biodiversity, reducing food wastage and landfill, switching to renewable resources and increasing the recycling of

raw materials are some of the greatest global challenges and an indispensable requirement for long-term sustainable development (Najam et al. 2000; Strange & Bayley 2008; Novacovici 2013; 2016; Broman & Robèrt 2017). With finite resources at our disposal, there is no time to wait and waste. We need proven solutions that have already been demonstrated to yield strongly sustainable long-term outcomes at scale (Ekins et al. 2003; Neumayer 2010a; Landrum 2017).

INSIGHT (R79): Given our finite resources and a myriad of VUCA problems in this world, there is little time to waste. We urgently seek proven solutions to our many challenges ahead.

2.4.2.10. Consequently, which business (entity) model innovation are empirically most sustainable?

Put simply, for each entity in each set of circumstances, we will not know until we measure. We also will need to ensure we are measuring what matters most, as we have no time to waste on unproven approaches. By far, most attempts at ensuring the sustainability of a chosen business model have been using business design tools, like the FBC (Upward 2013). Design tools such as the FBC are useful for enterprises, however as these constitute ex-ante business model '*by design*' approaches, there is no assurance that indeed, empirically, these will result in a more sustainable business.

Furthermore, in order to measure impacts on a worldwide basis, we require an approach that transcends the enterprise level, and is able to address impacts at scales, employing a systems view (Holmberg et al. 2012), considering the complex interconnected world we all live and need to operate within. Whilst some studies have taken the approach to ex-ante deconstruct the business model in order to better understand its function, this study develops a framework and tool for ex-post assessment. By doing so, there is no need to examine the components, as our assessment are empirically obtained in-situ ex-post. Therefore, based

on the foregoing, in this study, the author will demonstrate how this '*black-box*' approach is more quantitatively accurate and useful, in guiding transformation without needing to know the multitude of internal business logics.

This study develops a framework for the assessment of impacts and category of adopted entity model. It aims to identify how, enabled by globalisation and collaboration, and mediated by leadership and culture, innovation at the business model level will transition – for example, an enterprise, an industry, government, or bioregion from being unsustainable towards sustainability (Elkington & Upward 2016).

A summary of the key concepts revealed during the review is included in **Table 2.6**. Hence, given the several insights gleaned, how do business model innovations drive a successful sustainable strategy?

INSIGHT (R80): Take a systems view addressing the super-ordinate levels. Adopt a 'black-box' ex-post empirical assessment.

2.5. The Conceptual Framework

Turning the focus now onto the conceptual framework (CF) developed in this study, the INSIGHT(s) identified earlier, in ***Section 2.1-2.4***, deemed as necessary and sufficient for the development of the theoretical framework (TF) – the THRIVE Framework – are brought together. For easier navigation, ***Table 2.5*** has been added showing the relationship between the study's CF and the various tables and figures covering key concepts and outputs referenced. Each of the factors are codified by way of "R" codes from the earlier literature review and are connected to each of the 12 foundational focus factors in the TF covered in detail in the following ***Section 2.6***. Thus, informed by the sciences, this study is an exaptation – constituting an adaptation of principles and methods from other disciplines – exposing illustrative science-based technological rules. A summary of clusters of technological rules are shown in ***Table*** **2.7** connecting concepts with INSIGHTs, with a complete list of illustrative insights detailed in ***Appendix A: The THRIVE Framework***.

INSIGHT (R80): Take a systems view addressing the super-ordinate levels. Adopt a 'black-box' ex-post empirical assessment.

	Section	References	Key Concepts	Outputs
Conceptual Framework (Figure 2.20)	**CH 1 Introduction**	(Brundtland 1987; Costanza et al. 2009; Nidumolu et al. 2009; Abdelkafi & Täuscher 2015; Adams 2015; Clauss 2016; Williams et al. 2017; Messerli et al. 2019)	Strategy as BMPs in motion – measured performance ex post SOI-BMI = BMfS (observed vs predicted) Holistic top-down approach – sustainability transition Resilient & Regenerative – Ecological & Social THRIVE Project (Appendix C)	Research outputs (Figure 1.2) Design & Evaluate process (Figure 1.3) Integrative Literature Review (Figure 1.5) The THRIVE Project (Appendix C)
	CH 2 Literature Review	Several Factors (from 21 down to 12) Built on the FSSD (Broman & Robèrt 2017) (Lüdeke-Freund, Bohnsack, et al. 2018) List of key constructs (Table 2.8)	Appendix A INSIGHTs. Key historical references (Figure 2.9) Business model pattern definition (Figure 2.10) Categorisation/Typology of SBM (Table 2.1 & 2.3) SBM definitions (Figure 2.13) Classification of tools/ Performance (Figure 2.15)	Categorising entity models (Table 2.1) Sample policy reviews (Table 2.2) Evolution of the BM concept (Figure 2.12) Gap analysis (Table 2.4) Summary of key concepts revealed (Table 2.6) Illustrative Technological Rules (Table 2.7) 12 Foundational Focus Factors (Figure 2.21)
	CH 3 Methodology	(Simon 1969; Stake 1995; Hevner et al. 2004; Day & Bobeva 2005; Luck et al. 2005; Hevner & Chaterjee 2009; Thomas 2011; Yin 2013; Shrivastava & Guimarães-Costa 2016; Drechsler & Hevner 2018; Tobi & Kampen 2018)	General research dimensions (Table 3.1) Design Science Research (Figure 3.3) Delphi Study (Table 3.2, Figure 3.11) Case Study, grounded in the FSSD LADDER Approach (Figure 3.4) Management theory components (Table 3.3)	Overall research process (Figure 3.1) Reporting & evaluation structure (Figure 3.7) Evaluation activities ex-ante/-post (Figure 3.10)

Section	References	Key Concepts	Outputs
CH 4 Artefact Description	See references within Table 2.6.	THRIVE Framework (Theoretical Framework) 12FFF grouped into 4 quadrants SHM – Significance | Scale | Scope | Shift (Figure 4.2)	THRIVE Platform (Instantiation) (Appendix B) THRIVE Platform dashboard (Figure 4.9) Ciambella Charts (Figure 4.6)
CH 5 Evaluation	(Pries-Heje et al. 2008; Venable et al. 2012; Gill & Hevner 2013; Di Vaio et al. 2020)	Business model categorisation using machine learning (Figure 4.3) Classification of design (Figure 4.5) CUES usability criteria (Table 5.3) Participant selection (Table 5.5) Demographics (Table 5.7)	Systemic Holistic Model (Figure 5.3) Sustainability performance index (Figure 5.9) Keystone actors (Table 5.10) Business model patterns (Table 5.13) Seafood Stewardship Index (Table 5.15)
CH 6 Discussion	(Riedy 2007; Stubbs & Cocklin 2008; Borucke et al. 2012; Sonnenberg & Vom Brocke 2012; Bjørn et al. 2017)	Systemic Holistic Model (Figure 4.2) Methodological limitations (Table 6.1)	Systemic Orchestration (Guidance) Technological Rules – See Appendix A Strategies – i.e. Entity Models (Table 5.13) Methodological limitations (Table 6.1)
CH 7 Conclusion	(Adams et al. 2012; Famiyeh 2017; França et al. 2017; Kurucz et al. 2017; Fedeli 2020)	The SHM (Figure 7.2) The TF & 12FFF (Figure 7.3) Seafood Stewardship Index (Appendix B)	Limitations Significance Future research

***Table 2.5**. Relationship between the CF for the study and TF developed by the study with key concepts and outputs.*

Key Concept	Theoretical Insights	Empirical Evidence	Contextual Factors	Methodological Approaches	Policy Implications	Policy-Related	References
Context-based allocations	Understanding context-specific metrics for sustainability performance.	Limited empirical studies on context-based allocation methods.	Varies across different sectors and regions.	Need for standardization and harmonization of methodologies.	Standardized metrics can improve comparability and policy effectiveness.	Standardized context-based metrics can ensure fairness in resource allocation policies.	Kiron et al., 2017; LeBlanc & DeRose, 2016; Elkington, 1997; Porter & Kramer, 2011
Values-based innovation	Recognized as crucial for sustainable business models.	Limited empirical studies on the long-term impact of values-based innovation.	Importance of aligning business practices with sustainability values.	Longitudinal studies needed to assess impacts.	Promotes sustainable business practices and long-term value creation.	Policies should incentivize values-based innovation to align business with sustainability.	Fogelberg et al., 2017; IRIS, 2019; Breuer et al., 2018; Schaltegger et al., 2016; Stubbs & Cocklin, 2008
Systems thinking	Essential for addressing complex sustainability challenges.	Few practical frameworks integrating systems thinking into management.	Requires interdisciplinary and holistic approaches.	Develop and test practical frameworks for real-world applications.	Enhances the ability to address complex sustainability issues effectively.	Policies should support systems thinking in management practices.	Meadows, 2008; Senge, 2006; KPMG, 2020; Fogelberg et al., 2017
Lifecycle analysis	Used to assess environmental impacts of products and services.	Insufficient integration of social and economic dimensions.	Holistic view of sustainability impacts is necessary.	Methodologies needed to integrate social and economic dimensions.	Comprehensive lifecycle analysis can inform policy and practice.	Policies should mandate comprehensive lifecycle assessments for products and services.	UNEP, 2011; Guinée et al., 2011; LeBlanc & DeRose, 2016; KPMG, 2020
Multi-level governance	Crucial for effective sustainability strategies.	Lack of coordination and coherence in policies.	Varies across local, national, and international levels.	Research needed on best practices for multi-level governance.	Improved policy integration can enhance the effectiveness of sustainability initiatives.	Policies should ensure coordination and coherence across different governance levels.	Ostrom, 2010; Meadowcroft, 2007; IRIS, 2019; Fogelberg et al., 2017
Impact investing	Aims to generate positive social and environmental impacts alongside financial returns.	Limited understanding of long-term impacts.	Important for promoting sustainable finance practices.	Longitudinal studies needed to evaluate impacts.	Guides investors in making informed decisions and promoting sustainability.	Policies should promote and regulate impact investing to ensure positive outcomes.	Bugg-Levine & Emerson, 2011; Hebb, 2013; Kiron et al., 2017; IRIS, 2019
Smart technologies	Can enhance sustainability by improving efficiency and reducing resource consumption.	Insufficient research on potential negative impacts.	Potential negative impacts include increased e-waste and energy consumption.	Investigate potential negative impacts and develop mitigation strategies.	Ensures positive contributions of digitalization to sustainability.	Policies should address potential negative impacts of digitalization, such as e-waste.	Hilty & Aebischer, 2015; Bocken et al., 2014; KPMG, 2020; LeBlanc & DeRose, 2016

Key Concept	Theoretical Insights	Empirical Evidence	Contextual Factors	Methodological Approaches	Policy Implications	Policy-Related	References
Precautionary approach	Emphasizes preventive measures for sustainability.	Limited application in real-world scenarios.	Important for mitigating risks associated with sustainability challenges.	Need for frameworks that integrate precautionary principles.	Can inform policies to prevent negative sustainability impacts.	Policies should incorporate precautionary principles to mitigate sustainability risks.	Renn et al., 2011; Stirling, 2007; Klinke & Renn, 2002
Sustainability performance	Metrics and benchmarks for assessing sustainability.	Lack of standardization and harmonization.	Varies across sectors and regions.	Standardized methodologies needed for comparability.	Standardized metrics can enhance policy effectiveness and comparability.	Policies should standardize sustainability metrics for better comparison and evaluation.	Kiron et al., 2017; Elkington, 1997; Porter & Kramer, 2011
Business model innovation (BMI)	Innovation in business models to promote sustainability.	Limited empirical evidence on effectiveness.	Requires alignment with sustainability goals and values.	Longitudinal empirical studies needed to assess effectiveness.	Promotes sustainable business practices and long-term value creation.	Policies should support and incentivize business model innovation for sustainability.	Fogelberg et al., 2017; Breuer et al., 2018; Schaltegger et al., 2016
Sustainability value network	Networks and collaborations for sustainability value creation.	Limited understanding of network dynamics and value creation.	Important for enhancing collaboration and innovation in sustainability.	Research needed on network dynamics and value creation.	Can inform policies to enhance collaboration and innovation in sustainability.	Policies should foster the development of sustainability value networks and collaborations.	LeBlanc & DeRose, 2016; Fogelberg et al., 2017; KPMG, 2020
Global systemic transformation	Transformation towards global sustainability systems.	Lack of coherent strategies and frameworks.	Requires global cooperation and systemic approaches.	Research needed on global cooperation and systemic transformation strategies.	Can inform global policies and strategies for systemic sustainability transformations.	Policies should promote global cooperation and systemic approaches for sustainability.	Meadows, 2008; Ostrom, 2010; Meadowcroft, 2007
Sustainable consumption and production (SCP)	Emphasis on reducing environmental impacts through efficient resource use.	Limited empirical evidence on the effectiveness of SCP strategies.	Requires sector-specific approaches and adaptation to local contexts.	Methodologies needed to measure and track SCP impacts accurately.	Effective SCP strategies can inform policies to reduce environmental footprints.	Policies should support SCP practices through incentives and regulations.	UNEP, 2011; Fogelberg et al., 2017; LeBlanc & DeRose, 2016
Governance systems	Frameworks and mechanisms for sustainable governance.	Limited practical applications of governance frameworks.	Importance of integrating governance systems with sustainability goals.	Develop and test governance frameworks for sustainability.	Effective governance systems can enhance sustainability initiatives.	Policies should integrate sustainability goals into governance frameworks.	KPMG, 2020; Ostrom, 2010; Meadowcroft, 2007
Sustainability benchmarks	Metrics and indicators for	Lack of consensus on	Context-specific benchmarks are	Develop standardized	Standardized benchmarks can	Policies should establish	Kiron et al., 2017; Elkington, 1997;

Key Concept	Theoretical Insights	Empirical Evidence	Contextual Factors	Methodological Approaches	Policy Implications	Policy-Related	References
	measuring sustainability performance.	appropriate benchmarks.	necessary for accurate assessments.	benchmarks for different contexts.	improve comparability and policy effectiveness.	standardized sustainability benchmarks.	Porter & Kramer, 2011
Disruptive innovation	Potential for radical changes in sustainability practices.	Limited empirical evidence on the impact of disruptive innovation.	Disruptive innovations can vary widely in their sustainability impacts.	Research needed to understand the conditions for successful disruptive innovation.	Disruptive innovations can drive significant sustainability improvements.	Policies should support and regulate disruptive innovations for sustainability.	Bocken et al., 2014; Fogelberg et al., 2017; KPMG, 2020
Ecological integrity	Importance of maintaining the natural environment and biodiversity.	Limited research on practical approaches to maintaining ecological integrity.	Varies depending on regional ecosystems and species diversity.	Develop practical frameworks and guidelines for ecological integrity.	Ensuring ecological integrity is essential for long-term sustainability.	Policies can protect ecosystems and promote biodiversity conservation.	Costanza et al., 1997; Daily et al., 2000; Rockström et al., 2009
Circular economy	Promotes resource efficiency and waste reduction.	Growing interest but limited implementation in practice.	Context-dependent feasibility and scalability.	Need for comprehensive frameworks and best practices.	Can significantly reduce environmental impacts and resource consumption.	Policies can incentivize circular economy practices and infrastructure development.	Stahel, 2010; Ghisellini et al., 2016; Ellen MacArthur Foundation, 2013
Social equity	Addressing disparities and ensuring fair treatment and opportunities for all.	Limited integration in sustainability assessments.	Social equity considerations vary across different socio-economic contexts.	Develop methodologies for integrating social equity into sustainability assessments.	Addressing social equity is crucial for achieving sustainable development.	Policies can mandate the inclusion of social equity in sustainability reporting and practices.	Raworth, 2017; UNDP, 2019; Sen, 1999

Table 2.6. *Summary of key concepts revealed into theoretical, empirical, contextual, methodological, and policy-related reviews.*

General Topic Domain	Key (Repeating) Concepts	Associated 'R' Codes - INSIGHTs
Global Cooperation & Innovation	VUCA, worldwide cooperation, collaboration, innovation, resilience	R01, R02, R03, R04, R06, R08, R50, R55, R72, R73, R75, R76
Sustainability & Precaution	Precautionary approach, sustainability performance, sustainability value network, strong sustainability, systems thinking	R03, R05, R06, R08, R17, R18, R24, R27, R30, R38, R51, R57, R58, R69
Business Models & Innovation	Business model (BM), business model innovation (BMI), strategic advantage, value creation, competitive advantage	R09, R10, R11, R12, R13, R14, R15, R20, R21, R23, R29, R32, R35, R39, R40, R42, R45, R46, R54, R56, R61, R62, R63, R66, R67, R68, R70, R71, R74, R77
Disruptive & Systemic Innovation	Disruptive innovation, systemic change, interdisciplinary approach, technology, AI, complex systems	R19, R26, R31, R34, R37, R44, R52, R53, R55, R56, R73, R78, R79
Measurement & Benchmarking	Measurement methods, sustainability benchmarks, metrics, standardisation, impact assessment	R05, R28, R33, R34, R36, R43, R49, R60, R64, R65
Environmental & Social Well-being	Environmental footprints, planetary boundaries, ecological integrity, social equity, well-being	R16, R22, R29, R48, R52, R61
Governance & Policy	Governance systems, legislation, global systemic transformation, industrial ecology	R50, R51, R62, R70, R74

Table 2.7. *Illustrative Technological Rules emanating from this study.*



Figure 2.20. Conceptual Framework developed in this study.
The focus is on business model (strategy) innovation for sustainability (BMIfS).

This study lies at the intersection of sustainability, innovation, and strategy (***Figure 2.20***). It investigates how an entity's (e.g., business) model may impact the sustainability performance of that entity. It recognizes there are a number of enabling and moderating 'influences'. However, as this study takes a 'black-box' approach it does not concern itself with these 'influences'. The specific identification of these 'influences' are beyond the scope of this study and are only briefly alluded to for clearer context.

INSIGHT (R03): The need to take a precautionary approach to sustainability building on the FSSD. Radical innovations at the heart of addressing the wicked complex problems faced by humanity.
INSIGHT (R15): The BM is a new unit of analysis and seen as part of a comprehensive framework for systemic change, capturing a systems-level approach to how a firm conducts business.
INSIGHT (R19): Values-based innovation help organisations deal with complex and wicked problems and in dealing with systemic sustainability innovations in values-based networks and business models, even improving culture. Modelling is useful in addressing super wicked problems.
INSIGHT (R50): A global imperative has emerged, instilling a need for global systemic transformation.
INSIGHT (R56): Bring disruptive innovation to global systemic transformation requires tracking metrics and effectiveness and iterative continuous improvements of the BM. Technology plays a vital role as organisations prioritize transitioning towards sustainability as part of their business model innovations.

This conceptual exploratory study identifies the key factors in developing a theoretical framework used to formulate the corporate/governance strategy, and report and measure the sustainability impact of entities (e.g., business) models on sustainable (business) success by way of a public sustainability performance scorecard. Boons et al. (2013) argue that sustainable development requires radical and systemic innovations and that such innovations can be more effectively created and studied when building on the concept of entity (e.g., business) models, thus providing entities such as enterprises with a holistic framework to envision and implement a sustainable entity (business) innovation strategy.

2.5.1. Research Questions

INSIGHT (R46): Innovation for sustainability translates BMs into BMI for sustainability (BMIfS). Akin to strategy, these have shown to deliver competitive advantage. Empirically measured impacts are the only true measure of strong sustainability on a finite planet. BMI as a risk minimisation technique.

INSIGHT (R67): There is a myriad of self-assessment tools, open research platforms, assessment, and benchmarking tools available. It is important to address the context gap openly and transparently, where contextualisation and consistency of metrics is paramount (context matters). Embrace CBS.

INSIGHT (R51): GDP is not a suitable indicator of sustainable development. Building on ecological economics, society will need to transition to a steady-state economy.

Mainstream sustainability is a long-term corporate/governance strategy and a common practice (Ioannou & Serafeim 2019), whereby sustainability risks are assessed as entity (business) risks (WBCSD 2017b). Thus:

- Sustainable business models hold the key to transitions and to implementing Business Model Innovation for Sustainability (Schaltegger, Hansen, et al. 2016).
- How to recognize (identify and categorize) a sustainable entity (e.g., business) model pattern? [***RQ1***] Current reports lack Context Based Metrics (CBM) (McElroy 2013a) or use self-referential indicators (Haffar & Searcy 2018).
- How can the sustainability performance of an entity (e.g., business) model be assessed? [***RQ2***] From an ecological economist risk minimisation perspective (Redclift 1998), the THRIVE Platform ranks corporate sustainability performance alongside the business strategy or business model.

2.5.2. Research Output

The research output from this study are identified in ***Figure 1.2*** and include the Conceptual Framework (CF)(***Figure 2.20***), the 12 Foundational Focus Factors (Artefact) (***Figure 2.21***) and the THRIVE Platform (Instantiation). Furthermore, the 12 Foundational Focus Factors are explained in detail in the balance of this chapter. By way of summary, the key constructs and relevant citations have been documented in the

following ***Table 2.8***. Headings in yellow indicating totally new concepts not directly emanating from the literature review.

Construct(s)	Focus Factor (Abbreviation)	Notable Author(s)
Trans-disciplinary, Holistic approach	Trans-disciplinary -> Systems Thinking **(ST)**	(Elliot 2011; Lang et al. 2012; Senge et al. 2019)
Planetary Boundaries Doughnut economics Metric: denominator	Finite resources **(FR)**	(Rockstrom 2009; Raworth 2012; Steffen et al. 2015)
Complex wicked problems, Systemic approach	Integrated, complex, wicked **(CWP)**	(Churchman 1967; Lazarus 2008; Levin et al. 2012; Foss & Saebi 2018a)
Boundary, Unit of Analysis, Model/Ecosystem	Entity Model **(EM)**	(Schaltegger et al. 2012; UN Environmental Program 2015b; Evans, Vladimirova, et al. 2017) (Lambert & Davidson 2013)
Materiality, Topics	Materiality **(MT)**	(Eccles 2012b; UN Environmental Program 2015a; Lai et al. 2017)
Sustainability reporting, Integrated reporting, Tri-impact Metric: numerator	Sustainability and Integrated Reports -> Integral Thinking **(IT)**	(Riedy 2007; Stubbs & Higgins 2014; Lai et al. 2016; Lino Cinquini et al. 2016; Gibassier et al. 2017; Eccles & Krzus 2018; Elkington 2018)
Scientific evidence-based data, Congruent units Metric: denominator	Science-Based Targets **(SBT)**	(Lydenberg et al. 2010; UN Environmental Program 2015b; Bjørn et al. 2017)
Context-based sustainability, Scale-linked Formulation	Context-Based Metrics **(CBM)**	(Wahl 2006; UN Environmental Program 2015b; Haffar & Searcy 2018)
Strong vs weak sustainability, Greenwashing Precautionary Principle	Strong Sustainability **(SS)**	(Neumayer 2010a; Pelenc 2015) (Landrum 2017) (Najam et al. 2000; Upward 2013) (Upward & Jones 2016)
Values-based sustainability	Values-Based Innovation **(VBI)**	(Breuer & Lüdeke-Freund 2016; Lüdeke-Freund et al. 2016; Seiler et al. 2022)
Multi-capital approach	Multi-Capital Sustainability **(MCS)**	(McElroy & Thomas 2015) (IIRC 2013; Howitt & Thurm 2018)
Linear to Circular Economy Restorative & Regenerative Keystone Actors	Circular Economy **(CE)**	(Haanaes et al. 2011; Ellen McArthur Foundation 2013; Webster 2015; Ghisellini et al. 2016; Geissdoerfer et al. 2017)

Table 2.8. List of key constructs and focus factors addressed in this study, and notable authors. Headings in yellow indicate totally new concepts not derived directly from the literature.

2.6. Foundational Focus Factors

INSIGHT (R08): Integrating a scientifically informed strong sustainability approach is necessary in a finite world of unknowns operating within the sustainable value network.
INSIGHT (R38): SBM are about transformation and alignment with strong sustainability (thus avoiding substitution of resources). The normative approach to business model innovation "success" is toward sustainability.
INSIGHT (R46): Innovation for sustainability translates BMs into BMI for sustainability (BMIfS). Akin to strategy, these have shown to deliver competitive advantage. Empirically measured impacts are the only true measure of strong sustainability on a finite planet. BMI as a risk minimisation technique.
INSIGHT (R26): Scale-linking leading to multiple levels of regenerative capacities.
INSIGHT (R34): Emphasis on scale-linking at the super-ordinate level across multiple tiers. Developing predictive models that work universally at scale at solving complex solutions.
INSIGHT (R27): The need to bring humanities footprint within regenerative and absorptive capacities. The EF approach to "global overshoot" is simplistic by assessing what is happening today, rather than what is sustainable, ignoring scales, and contains numerous quantitative and congruency errors.
INSIGHT (R30): Environmental footprints and planetary boundaries are complementary and provide for the capturing of impacts at scales by incorporating harmonisation of the metrics. This forms the basis for mitigating sustainability (or a lack thereof) at the global level.

This study extends the paradigm of corporate sustainability beyond the business case and into the realm of the ecological sciences (Costanza 2019) and strong sustainability (Ekins et al. 2003), shedding light on the paradox of continual environmental degradation, despite business engaging with and adopting sustainability principles (Landrum 2017). As exposed earlier, this is often due to externalisation of costs and the general failure to scale-link (Wahl 2006) by not integrating the micro and macro perspectives of sustainability (Landrum 2017). Additionally, this study contends that by linking business strategy to sustainability performance, a clear understanding will emerge as to which entity (e.g., business) models, and thus innovations thereof, are likely to yield greater levels of sustainability performance (Nicolăescu et al. 2015).

INSIGHT (R28): Composite indices are well suited in measuring well-being and in capturing impacts in complex multi-dimensional trans-disciplinary systems that aggregate data across different domains.
INSIGHT (R35): Build strong trans-disciplinary approach to multitier conceptual framework to address complexity at scale. Be cognizant of feedback loops over temporal and spatial scales. Provide triangulation by combining qualitative conceptual analysis with on-the-ground data.

INSIGHT (R52): Colonialism persists till this day, creating social division, while the commons are being exploited and destroyed. An interdisciplinary approach, working with local communities and collective action globally, is seen as the best way to address these complex sustainability challenges.

INSIGHT (R55): For disruptive innovation to be effective we need a holistic and trans-disciplinary approach that factors in the supply and delivery chain, allowing for the benchmarking of any enterprise, industry, or sector. IT is an important enabler of a firm's sustainability strategy.

INSIGHT (R70): Improve interoperability by transferring the pluralistic, interdisciplinary, scientific knowledge, into tools for informed environmental decision-making leveraging significant local and global impacts. Consider the use of proxies and technology to predict the behaviour of complex systems.

INSIGHT (R73): Systems thinking (social sciences) coupled with system dynamics (biophysical sciences) forms the worldview in support of our transition to becoming sustainable. Tackling complex trans-disciplinary integrated issues through innovation.

INSIGHT (R21): See BMs as patters in action. Take a long-term view, holistic approach to sustainable development, with consumption and waste generation within carrying capacities.

INSIGHT (R58): Integral thinking connects the complex challenges of sustainability with sustainable entity models, helping entities develop effective sustainability strategies. Integral thinking is a holistic and multi-dimensional approach to complexity whereby sustainability is an extension of innovation.

INSIGHT (R01): Given VUCA times, the need for worldwide cooperation and collaboration amongst organisations, governments, and academia is needed, with risk management also playing a part.

INSIGHT (R17): Disruptive innovation, particularly of one's BM is the most rewarding. Entities do not work in isolation but are at the mercy of the ecosystem supporting them including other industry competitors and regulatory bodies. Collaborations is key to environmental sustainability.

INSIGHT (R31): Important to implement circular economy models emulating biomimicry, invoking collaboration to develop synergies towards the greater good.

By turning our attention to *measuring what matters most* (Fedeli 2019), this study constructs the THRIVE Framework, linking publicly available audited corporate sustainability and integrated reporting (IIRC 2013; Global Reporting Initiative 2016) with global footprint data (eg: from public GFN, UN, CDP datasets). Furthermore, in order to appraise the utility of the framework, an instantiation in the form of the THRIVE Platform is developed and evaluated (Venable et al. 2012) with a group of users of the system spanning experts, researchers, business leaders, policy makers and consumers. As noted by Sala et al. (2015) in their framework for sustainability assessment, an appropriate approach must be inter-disciplinary, holistic and encourage collaboration in the scientific realm, capturing complexity while ensuring transparency, comprehensiveness, completeness, and legitimacy. Hence the THRIVE Platform is the result of joint efforts by many with rich backgrounds and

diverse interests, offered as a public good to serve humanity (https://ThrivabilityMatters.Earth).

INSIGHT (R01): Given VUCA times, the need for worldwide cooperation and collaboration amongst organisations, governments, and academia is needed, with risk management also playing a part.
INSIGHT (R02): There is a need for innovative management, instilling a culture of innovation toward building resilience to avoid the worst in feedback loops in tackling VUCA times.
INSIGHT (R79): Given our finite resources and a myriad of VUCA problems in this world, there is little time to waste. We urgently seek proven solutions to our many challenges ahead.

Couched in the context of considerable literature promising numerous benefits from sustainability reporting (Stubbs & Higgins 2014; Alonso-Almeida et al. 2015; Szekely & Vom Brocke 2017), this study will initially concentrate on identifying the factors necessary and sufficient to address business (entity) model innovations for sustainability (Schaltegger, Lüdeke-Freund, et al. 2016; Karlsson et al. 2018). These factors inform THRIVE Framework, forming a mesh or grid which illustrate the characteristics of the path ahead to worldwide sustainability in these volatile, uncertain, complex, and ambiguous times (Kiron et al. 2017). This will be followed by the evaluation of the instantiated THRIVE Platform tool (Gregor & Hevner 2013; Joan E. van Aken et al. 2016). The next several sections will look at each of the 12 Foundational Focus Factors (12FFFs) in turn (***Figure 2.21***).

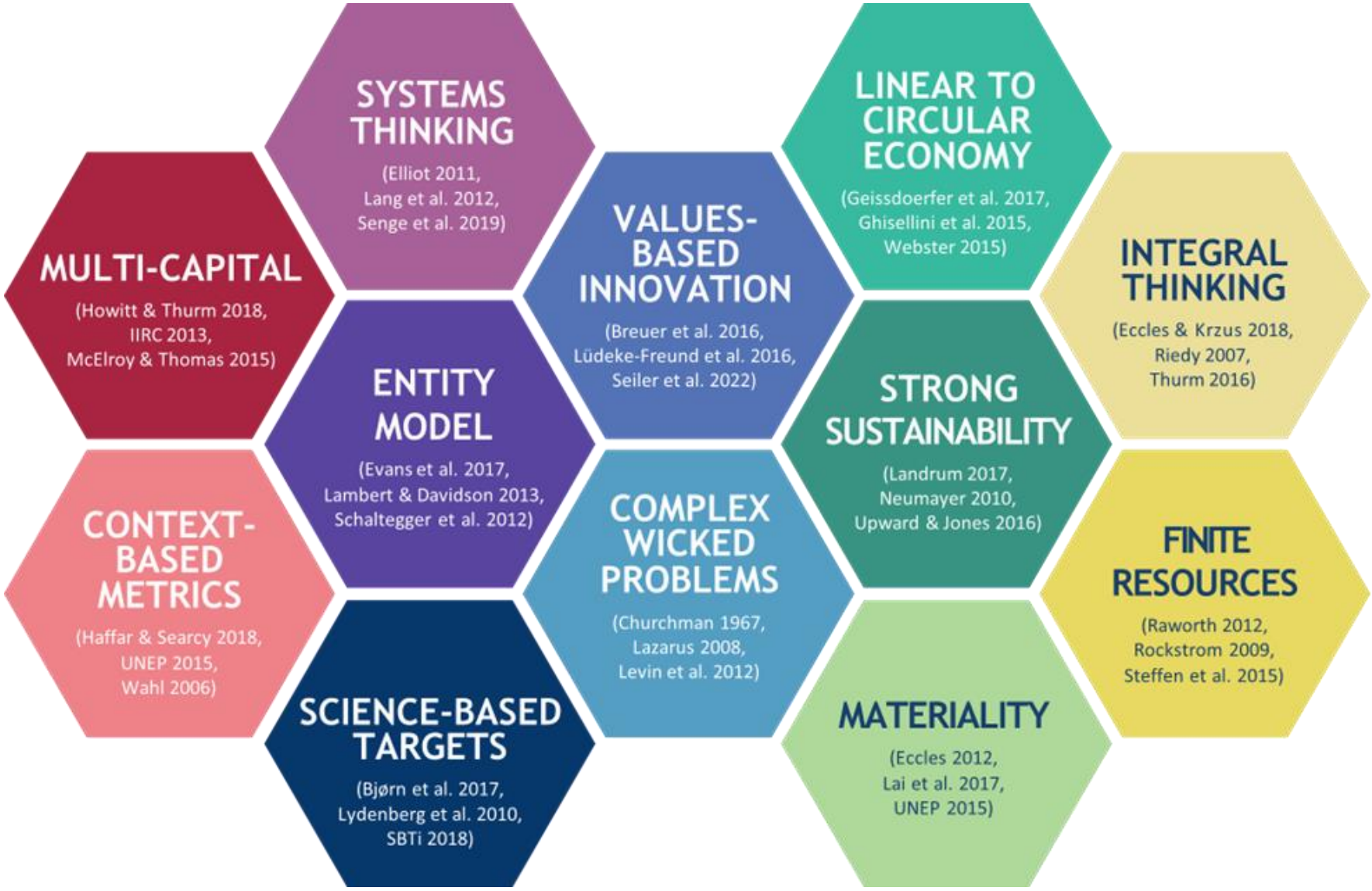


Figure 2.21. *The 12 Foundational Focus Factors identified and refined in this study.*

2.6.1. Systems Thinking

INSIGHT (R45): BM is a systemic representation of how a company creates, delivers, and captures value. Adopt system dynamics to incorporate sustainability into the innovation process. BM seen as a source of competitive advantage beyond mere strategy.
INSIGHT (R15): The BM is a new unit of analysis and seen as part of a comprehensive framework for systemic change, capturing a systems-level approach to how a firm conducts business.
INSIGHT (R19): Values-based innovation help organisations deal with complex and wicked problems and in dealing with systemic sustainability innovations in values-based networks and business models, even improving culture. Modelling is useful in addressing super wicked problems.
INSIGHT (R28): Composite indices are well suited in measuring well-being and in capturing impacts in complex multi-dimensional trans-disciplinary systems that aggregate data across different domains.
INSIGHT (R35): Build strong trans-disciplinary approach to multitier conceptual framework to address complexity at scale. Be cognizant of feedback loops over temporal and spatial scales. Provide triangulation by combining qualitative conceptual analysis with on-the-ground data.
INSIGHT (R36): Suggest integrated approach to BM analysis based on systems theory as measuring and evaluating BMs is difficult. More work needed in this area.
INSIGHT (R50): A global imperative has emerged, instilling a need for global systemic transformation.
INSIGHT (R55): For disruptive innovation to be effective we need a holistic and trans-disciplinary approach that factors in the supply and delivery chain, allowing for the benchmarking of any enterprise, industry, or sector. IT is an important enabler of a firm's sustainability strategy.
INSIGHT (R56): Bring disruptive innovation to global systemic transformation requires tracking metrics and effectiveness and iterative continuous improvements of the BM. Technology plays a vital role as organisations prioritize transitioning towards sustainability as part of their business model innovations.
INSIGHT (R73): Systems thinking (social sciences) coupled with system dynamics (biophysical sciences) forms the worldview in support of our transition to becoming sustainable. Tackling complex trans-disciplinary integrated issues through innovation.

The science of sustainability, by its very nature, is trans-disciplinary and fragmented (Lüdeke-Freund & Dembek 2017). Encapsulated in the field of industrial ecology (Sullivan et al. 2018), it concerns itself with material and energy flows through industrial systems (Ehrenfeld 2004). Leveraging complementary rather than competing views (Elliot 2011; Shrivastava & Guimarães-Costa 2016), it combines the natural sciences with social sciences together (Fam et al. 2016) with some aspects of mathematics, economics and politics (McIntosh 2015; Upward & Jones 2016; Persson, Hornborg, et al. 2018). Importantly, the strongly sustainable systems viewpoint will need to be integrated to ensure that the necessary and sufficient pre-conditions are in place to ensure flourishing or thrivability (Moggi et al. 2021; Hill et al. 2022).

2.6.1.1. Management theory

This study is premised on holistic systems thinking (Ackoff 1971; Gharajedaghi 2006; Williams et al. 2017) and benefits most from a creative practical evidence-based (Persson, Hornborg, et al. 2018) design science approach (Hevner 2007; Gregor & Hevner 2013). This ensures the adopted design science approach ensures to the formulation of the artefact has usefulness in solving the practical problems faced by humanity in their quest for sustainability and beyond (Hevner & Chaterjee 2009; Elliot 2011). The management theory resulting from this prescription-driven research approach is thus largely used in an instrumental way to design solutions to management problems (Joan E. van Aken 2004). Moreover, leveraging information systems (IS) solutions which are considered as socio-technical systems, further contribute to a trans-disciplinary design science dialog (Joan E. van Aken 2014).

2.6.1.2. Transformational solutions

Sustainable development is a trans-disciplinary and participative field of endeavour, aimed at solving real world problems (Lang et al. 2012). No one individual, group or discipline has all the answers nor all the questions (Gholami 2016). It thus requires an interactive community-based process of cross-fertilisation, and co-evolution and learning that involves design decisions informed by a holistic and integral perspective (Lang et al. 2012). As a transformational scientific study (Mertens 2007), it leverages expert opinion, and informed and responsible citizens to engage in the process of continuous, lifelong learning through trans-disciplinary dialogue and thus be co-designers of our sustainable future (Wahl & Baxter 2008). A holistic and integral perspective can help humanity to "*act locally and plan globally, while acting globally and planning locally at the same time*" (Beck & Cowan 2014).

Systems Thinking	**Implemented as follows**
THRIVE Framework	• Informs a systemic and holistic approach
THRIVE Platform	• Consistent method and formulation • User-driven examination of options • User feedback following evaluation

2.6.2. Finite Resources

INSIGHT (R07): The examination of the impact of keystone actors is a useful and exemplary way to tackle the sustainability of the environment and natural world.

INSIGHT (R08): Integrating a scientifically informed strong sustainability approach is necessary in a finite world of unknowns operating within the sustainable value network.

INSIGHT (R16): We live in a world of finite resources. Our economic activities and global actions sparked by consumerism are depleting natural resources including our carbon sinks.

INSIGHT (R46): Innovation for sustainability translates BMs into BMI for sustainability (BMIfS). Akin to strategy, these have shown to deliver competitive advantage. Empirically measured impacts are the only true measure of strong sustainability on a finite planet. BMI as a risk minimisation technique.

INSIGHT (R46): A combination of degrowth and/or green growth is necessary to stay within the natural regenerative and absorptive capacities.

INSIGHT (R51): GDP is not a suitable indicator of sustainable development. Integrating a scientifically informed strong sustainability approach is necessary. Building on ecological economics, society will need to transition to a steady-state economy.

INSIGHT (R66): Reporting lacks contextualisation within thresholds, based on environmental limitations identified by scientific evidence. These impacts need to be measured relative to production benchmarks through aggregate composite indices.

INSIGHT (R67): There is a myriad of self-assessment tools, open research platforms, assessment, and benchmarking tools available. It is important to address the context gap openly and transparently, where contextualisation and consistency of metrics is paramount (context matters). Embrace CBS.

INSIGHT (R79): Given our finite resources and a myriad of VUCA problems in this world, there is little time to waste. We urgently seek proven solutions to our many challenges ahead.

2.6.2.1. Steady state economy

Ghisellini et al. (2016), finds that the circular economy provides a reliable framework towards radical transformation for a restorative and regenerative environment, supporting the transition to a new BM where *well-being* is decoupled from resource consumption (Luck et al. 2005). This is the steady state economy (SSE) (O'Neill et al. 2018), or what some call the degrowth economy and where we recognize the finite

quantity of material resources (boundary) on the planet. Steffen et al. (2018) introduced the science-based concept of planetary boundaries, demonstrating that humans have already transgressed three of the nine boundaries. Their colleague Rockstrom (2009), has shown there is a growing sense of urgency in respect of ameliorating global warming (Intergovernmental Panel on Climate Change 2018), with earlier targets being refined and adjusted downwards. Furthermore, although the planetary boundaries are described in terms of individual quantities and separate processes, the boundaries are tightly coupled (Rockstrom 2009).

2.6.2.2. National Fair shares

Bjørn et al. (2017) in a review of 40,000 corporate responsibility reports found just 31 enterprises explicitly using ecological limits to define targets for resource consumption, and/or emission reductions, and/or stated a reason for adjusting their product portfolio, with only a few reports explicitly dealing with the issue of allocating resource and emission rights within ecological limits, amongst enterprises and other actors. Häyhä et al. (2016) has developed a framework for translating the planetary boundaries into national-level fair shares of Earth's safe operating space (Raworth 2012) from a strong sustainability perspective (Bonnedahl & Heikkurinen 2019).

Finite resources	**Implemented as follows**
THRIVE Framework	• Conservation of mass and energy means finite resources
THRIVE Platform	• Informs denominator, thresholds, and allocations • Implemented as inner, outer limits

2.6.3. Complex Wicked Problems

INSIGHT (R03): The need to take a precautionary approach to sustainability building on the FSSD. Radical innovations at the heart of addressing the wicked complex problems faced by humanity.

INSIGHT (R18): Systems thinking approach is necessary to implicate interconnectedness and address super-wicked problems.

INSIGHT (R19): Values-based innovation help organisations deal with complex and wicked problems and in dealing with systemic sustainability innovations in values-based networks and business models, even improving culture. Modelling is useful in addressing super wicked problems.

INSIGHT (R34): Emphasis on scale-linking at the super-ordinate level across multiple tiers. Developing predictive models that work universally at scale at solving complex solutions.

INSIGHT (R35): Build strong trans-disciplinary approach to multitier conceptual framework to address complexity at scale. Be cognizant of feedback loops over temporal and spatial scales. Provide triangulation by combining qualitative conceptual analysis with on-the-ground data.

INSIGHT (R52): Colonialism persists till this day, creating social division, while the commons are being exploited and destroyed. An interdisciplinary approach, working with local communities and collective action globally, is seen as the best way to address these complex sustainability challenges.

INSIGHT (R58): Integral thinking connects the complex challenges of sustainability with sustainable entity models, helping entities develop effective sustainability strategies. Integral thinking is a holistic and multi-dimensional approach to complexity whereby sustainability is an extension of innovation.

INSIGHT (R70): Improve interoperability by transferring the pluralistic, interdisciplinary, scientific knowledge, into tools for informed environmental decision-making leveraging significant local and global impacts. Consider the use of proxies and technology to predict the behaviour of complex systems.

INSIGHT (R73): Systems thinking (social sciences) coupled with system dynamics (biophysical sciences) forms the worldview in support of our transition to becoming sustainable. Tackling complex trans-disciplinary integrated issues through innovation.

2.6.3.1. Our world

We live in a world confronted by volatility, uncertainty, complexity, and ambiguity (VUCA) (Sarkar 2016). Whilst some aspects are more well-understood and thus manageable, the ability to predict how changes in one area affect another remains challenging. Domino and ripple effects require an extensive understanding of the intricacies of the system in question coupled with vast knowledge of the datasets at play.

2.6.3.2. Complexities

The sustainability landscape is plagued by wicked problems (Lazarus 2008; March & Vogus 2010; Levin et al. 2012; Breuer & Lüdeke-Freund 2017) requiring complex multi-faceted approaches spanning several fields of endeavour, such as material sciences, space technology, nano-technology, renewable energy, bio-medicine, agri-systems, environomics, artificial intelligence, and big data to name a few (Hawken 2017; Donnellan 2019).

2.6.3.3. Modelling

Developing and implementing these solutions pose risks and threats and have legal ramifications (Stubbs & Higgins 2014). Being able to model the inter-relationships and predict the outcome of innovations, causes and effects, can provide a safe way to experiment and gauge success (Foss & Saebi 2018a). Models allow for the analysis of long-term implications, with planetary boundaries and limits tightly coupled. Approaches include small scale experimentation, measuring the impact of how solutions in one area may negatively affect another, and the application of solutions across fields or geographic areas (Gholami 2016). In particular, the use of artificial intelligence through machine learning and in particular deep learning - all branches of computer science - can influence production and consumption patterns towards achieving sustainable resource management according to the Sustainable Development Goals (SDGs) outlined in the UN 2030 Agenda (Di Vaio et al. 2020).

Complex wicked problems	**Implemented as follows**
THRIVE Framework	• Emulation and evaluation of our complex world
THRIVE Platform	• Replication of datasets to inform platform • Platform simulates interdependencies • Able to conduct "what-ifs" • Support backcasting

2.6.4. Entity Model

INSIGHT (R44): Sustainable business model as a source of innovation. BMs as a (re)combination of BMPs. BMI can draw upon proven successful pattern combinations.

INSIGHT (R17): Disruptive innovation, particularly of one's BM is the most rewarding. Entities do not work in isolation but are at the mercy of the ecosystem supporting them including other industry competitors and regulatory bodies. Collaborations is key to environmental sustainability.

INSIGHT (R22): Organisations are not self-contained and thus must consider how it is affected by, and its effect are, on other organisations across boundaries and the ecosystem around it.

INSIGHT (R26): Scale-linking leading to multiple levels of regenerative capacities.

INSIGHT (R32): Need to better understand the role of BMs as it pertains to corporate success and how to evaluate BMs. BMs is a key driver for successful innovation, adaptation, and success.
INSIGHT (R33): Some studies suggest as valuable is the use of text mining automation tools on annual reports. Others analyse BM configurations as well as super-ordinate levels of portfolio.
INSIGHT (R34): Emphasis on scale-linking at the super-ordinate level across multiple tiers. Developing predictive models that work universally at scale at solving complex solutions.
INSIGHT (R37): Organisations exhibit multiple BMPs working across enterprises and scales and in support of super-ordinate patterns.
INSIGHT (R62): The One Planet Thinking initiative is an attempt to bring systems level thinking to the corporate level, thus recognising the holonic and scale-linking nature of the world in relation to biodiversity.
INSIGHT (R80): Take a systems view addressing the super-ordinate levels. Adopt a 'black-box' ex-post empirical assessment.

2.6.4.1. Scale-linked levels

This study takes a stratified, multi-scale approach, whereby at each level, the unit of analysis is the entity model of the entity under consideration. For example, when considering an enterprise (company, business, institution, firm etc), the unit of analysis is the BM. For an industry, this would be the sector model and for a region or country, its approach to governance. Each recursive level is scale-linked with the next successive level above it, and thus lends itself to be implemented by way of an automated software program (Rolnick et al. 2019). Specifically, BM narratives may be categorised by converting to a nominal classification value (taxonomy) based on BMPs, whereby each unit, such as BM is made from a set of grouped BMPs (Lüdeke-Freund, Carroux, et al. 2018). These patterns have been extensively discussed in the literature, with potentially millions of combinations available for experimentation (Lüdeke-Freund 2019) supported by automated technologies such as machine learning (Fedeli & Lüdeke-Freund 2020).

2.6.4.2. Business model or strategy

As in any study, the unit of analysis is essential to clearly bound the entity and phenomenon under investigation and to provide context (Foss & Saebi 2018b). This border informs the sphere of influence of the entity. For example, when considering the entity of *enterprise* (a.k.a. business), the abstract concept of BM (Foss & Saebi 2018b) is highly significant (Lai et al. 2006; Breiby & Wanberg 2011). This connects the internal strategy

to the external supply and delivery chain (henceforth the value chain) within the greater context of its operations, and impact on society and the environment (Teece 2010; Zott et al. 2011; Amit & Zott 2012) (Chesbrough 2010), thus ensuring competitiveness (Porter 1996), brand-awareness (Haanaes et al. 2011) and performance (Friede et al. 2015; Virakul 2015; Clauss 2016) (Ameer & Othman 2011).

Moreover, Braun et al. (2019) considers strategy and BMs representing two sides of the same coin, needing to be taken into consideration concurrently to realize long-term competitive profitability. Innovations of the BM support systematic, ongoing creation of business cases for sustainability (Schaltegger et al. 2012) and develops the need for tools to enable the management of, or transition, to BMs for sustainability (Schaltegger, Lüdeke-Freund, et al. 2016; Schaltegger et al. 2017). In a Kiron et al. (2017) BCG report on exploring business model innovation (BMI) opportunities, 50% of companies cited changing their BM because of sustainability opportunities.

Innovation of the BM encourages transitions to more SBMs (Spieth & Schneider 2016; Baldassarre et al. 2017) with enterprises changing their BM because of sustainability opportunities (Liyanage & Uusitalo 2016). With BMI still seen as an ill-defined problem (Foss & Saebi 2018b), experimenting with BMP by generating new BMIfS (Schaltegger, Lüdeke-Freund, et al. 2016) minimizes risk and generates superior value through the assembly of known successful BMPs (Lüdeke-Freund, Carroux, et al. 2018).

2.6.4.3. Business model innovation

Radical BMI is seen as a risk minimisation technique (Girotra & Netessine 2014), that creates new value propositions, and related value delivery and value capture systems, in order to generate superior value (Richardson 2014) by reinventing or reassembling (Sandow & Allen 2005) (Beckett 2016) two or more elements of a BM to deliver value in a new way that directly affects the greater sustainable value network (Donaldson & Preston 1995; Bocken & Bogaert 2013; Berends et al.

2016; Evans, Vladimirova, et al. 2017). BMI or business model design (Zott & Amit 2007; Gronum et al. 2016) may be expressed as an assembly or combination of business model patterns (BMP). The re-combining of these patterns provides the ability to experiment with known working business logics (Haddar et al. 2014; Lüdeke-Freund 2019) and develop BMs for sustainable innovation (Boons & Lüdeke-Freund 2013). In practice the most successful enterprises experiment with several business logics (e.g., Google, Amazon, Apple).

Boundary or Entity Model	**Implemented as follows**
THRIVE Framework	• Scoping: Unit of analysis
THRIVE Platform	• Clearly defined entity boundary • Multi scale-linked entities • Automation of BM narrative classification

2.6.5. Materiality

INSIGHT (R30): Environmental footprints and planetary boundaries are complementary and provide for the capturing of impacts at scales by incorporating harmonisation of the metrics. This forms the basis for mitigating sustainability (or a lack thereof) at the global level.

INSIGHT (R33): Some studies suggest as valuable is the use of text mining automation tools on annual reports. Others analyse BM configurations as well as super-ordinate levels of portfolio.

INSIGHT (R34): Emphasis on scale-linking at the super-ordinate level across multiple tiers. Developing predictive models that work universally at scale at solving complex solutions.

INSIGHT (R37): Organisations exhibit multiple BMPs working across enterprises and scales and in support of super-ordinate patterns.

INSIGHT (R60): Corporate reports by and large are disclosures addressing basic compliance requirements. These reports often lack metrics, science-based targets, and in-context based measurement, making them unusable for comparisons. Notably, impacts are often self-referential (inward looking) or greenwashed to appear favourable.

INSIGHT (R61): Standardisation of sustainability or integrated reports would provide a basis for fair comparison. Attempts to date have not provided the integrated and harmonised approach necessary.

INSIGHT (R64): Triple or authentic materiality measures sustainability performance relative to our regenerative and absorptive capacities. Many countries are requiring organisations to comply with various levels of standardisation, with the industry littered with often confusing requirements.

INSIGHT (R65): Reporting impacts is voluntary and suffers from a lack of alignment and harmonisation between the various rating/ranking/standards providers.

INSIGHT (R68): WBA is attempting to benchmark organisations worldwide sector by sector. There have been doubts as source data sets are not made available publicly and transparently (despite stating the contrary). Need for a comparative uniform universal harmonised sustainability performance index.
INSIGHT (R80): Take a systems view addressing the super-ordinate levels. Adopt a 'black-box' ex-post empirical assessment.

2.6.5.1. Sector-specific materiality

Eccles (2012b) and Lai et al. (2017) point to the need for sector-specific materiality, citing that standards are essential to make fair comparisons when building sustainability performance information into financial models, with the aim of turning them into robust BMs. Furthermore, using sector-specific materiality has implications for greater sustainability, as it requires enterprises to compete based on data in the public domain (Eccles & Krzus 2018), encouraging exposure of KPIs, and strategy and enforcing competition, and thus helps to build more robust BMs.

Calls for sector-specific reporting suggests that the integrated report <IR> can replace the management commentary by combining it with company KPIs and by presenting the BM together with the strategy (Lai et al. 2016). The integrated report <IR> meets a need, by combining a willingness to declare an enterprise's strategy, together with the effort to select relevant information to disclose, and thus has implications of materiality for integrated report <IR> preparers. However, Lydenberg et al. (2010) questions how to determine relevant sector-specific key performance indicators for use in sustainability reporting, and proposes that mandatory reporting on sector-specific KPIs will fundamentally allow insights into the most crucial aspects of an enterprises relationship with society and the environment. Furthermore, evidence on materiality by Khan et al. (2016), finds that enterprises with good performance on material issues and concurrently poor performance on immaterial issues perform the best. Overall, their study finds that investments in sustainability issues are shareholder-value enhancing and at a minimum not value-destroying.

2.6.5.2. Comprehensive mandatory quantitative reporting

Conceivably one way to support multiple material topics and taxonomies (e.g., GRIs, SDGs, B Corp) is to take an integral approach to true materiality (Thurm 2016). This means the inclusion of all topics (UN Global Compact 2018), including hard to measure, '*soft*' qualitative topics, narratives, and the inclusion of imputed values. Thus, impacts across all material topics may be quantified, reduced to numeric values, in order to be reported on in a comparative way and aggregated as necessary (Nardo, Saisana, Andrea Saltelli, et al. 2005). However, the IIRC (2013) finds this degree of standardisation largely contradictory to the primary thrust of Integrated Reporting, which is to "*enable each organisation to tell its own value creation story*". This author however disagrees with the IIRC (2013), suggesting that even qualitative measures such as '*well-being*', for instance, can effectively be quantified and rolled into a standardised (normalised) quantitative metric.

For example, '*quality of life*' could be measured on a scale from 0% - 100% where lower amounts represent various stages from innocuous pain to injury through to progressive forms of acute illness and 100% for death. Furthermore, one could record other aspects and assign targets, such as associated costs and impact of days off. Theoretically, as a last resort, any measurement can be converted to a nominal ordinal value (cf. disclosure reports) (Dixon-Woods et al. 2005). The hope is that with comparable sustainability data in the public eye, companies will begin to compete on the dimensions of sustainability that matter for long-term value creation (Eccles 2012a).

Materiality	**Implemented as follows**
THRIVE Framework	• Identification of specific topics for evaluation as determined by chosen taxonomies
THRIVE Platform	• Choice of classification system (e.g., GRIs, SDGs, or custom) and topics • Support multi-level and multi-weight taxonomies • Support imputation of missing values and harmonisation

2.6.6. Integral Thinking

INSIGHT (R20): Expressing the normative is essential if we are to achieve the desired outcome. Note that a BM stretches beyond the boundary of an enterprise.
INSIGHT (R22): Organisations are not self-contained and thus must consider how it is affected by, and its effect are, on other organisations across boundaries and the ecosystem around it.
INSIGHT (R30): Environmental footprints and planetary boundaries are complementary and provide for the capturing of impacts at scales by incorporating harmonisation of the metrics. This forms the basis for mitigating sustainability (or a lack thereof) at the global level.
INSIGHT (R60): Corporate reports by and large are disclosures addressing basic compliance requirements. These reports often lack metrics, science-based targets, and in-context based measurement, making them unusable for comparisons. Notably, impacts are often self-referential (inward looking) or greenwashed to appear favourable.
INSIGHT (R68): WBA is attempting to benchmark organisations worldwide sector by sector. There have been doubts as source data sets are not made available publicly and transparently (despite stating the contrary). Need for a comparative uniform universal harmonised sustainability performance index.

2.6.6.1. Engage with boundaries and limits

Integral thinking is a concept that focuses on the integration of various aspects of a system to create a cohesive and interconnected whole. This approach seeks to address tensions between different aspects of the system while recognising the boundaries that exist between them. The holonic nature of the world and its ecosystem is also acknowledged as an important factor in integral thinking (Riedy 2007). In the context of entities (e.g., businesses), demonstrating integral thinking can be achieved through sustainability and integrated reporting. Traditionally, organisations have focused their reporting efforts on shareholders, while others have expanded their scope to include stakeholders and rightsholders (Thurm 2016). However, the THRIVE Framework surpasses these traditional reporting methods by incorporating a more holistic approach to reporting, which encompasses all system-wide aspects of holonic entities across boundaries.

Comprehensive research suggests that sustainability and integrated reports <IR> often fail to include planetary boundaries and science-based targets (Bjørn et al. 2017). Therefore, to assess actual progress, finite resources need to be translated into national fair-shares within the Earth's safe operating space (Steffen et al. 2011; Raworth 2012). Science-based

data is thus necessary for enterprises to manage and engage within nature's limits and therefore compete on true performance. This forces enterprises to shift their thinking away from self-referential reporting, and from incremental towards radical improvements in their approach to sustainability, thus fostering enterprise-wide innovation (Haffar & Searcy 2018). Interestingly, in comparing integrated reporting with sustainability reporting, the latter contain more disclosures, target a wider audience, and inherently feature tighter integration between the capitals. Past attempts at harmonising the two has proven difficult, with some scholars declaring integrated reporting <IR> a myth (Gibassier et al. 2017).

2.6.6.2. Foster integral thinking for shareholders and beyond

Integrated reporting <IR> which focusses on "*shareholder value*" is seen as the most disruptive innovation in the field of corporate reporting (Simnett & Huggins 2015) in recent years. It requires executives to weigh up the consequences of their proposed strategies by addressing risks of litigation and the choice of metrics (IIRC 2013). However, corporate engagement in integrated reporting <IR> is not tri-impact (Milne & Gray 2015), nor a matter of strategic legitimation (Lai et al. 2016), and does not imply radically improved practices (Stubbs & Higgins 2014). Instead, the integrated reporting <IR> programme created by the IIRC (2013), asks enterprises to go beyond narratives and voluntary disclosures, tri-impact and triple bottom line reporting (Elkington 1997), by urging managers to abandon the compliance-driven logic underpinning external reporting, to foster integrated thinking (De Villiers et al. 2014; Adams 2015) and unlock its potential in practice (Torre et al. 2019).

The integration and convergence of static financial and sustainability reporting data into integrated reports, forms the basis for consistency in comparisons; with integrated reporting <IR> seen as a proxy for good governance, and thus helps to attract investors and employees, and increase retention (Blasco & King 2017). However, beyond shareholders (and integrated reporting), integral thinking opens the view to carefully considering the interactions between all material issues within and

between entities at all levels within context (Baue & Thurm 2018b; Institute 2019).

2.6.6.3. Real time platform: from disclosure to exposure

Although the question remains as to whether financial audit standards and sustainability assurance standards will ever converge (Villiers & Sharma 2017), real time database driven and dynamically generated integrated reports <IR> assists enterprises to score their progress beyond the voluntary disclosure checkbox (López et al. 2007; KPMG 2020), to measure their actual (numerator) impact against established true material targets, and thus assess the significance of their effort towards a sustainable society. Lewis and Young (2019) place narrative disclosures at the heart of evolving reporting, although uptake in the financial reporting domain has been surprisingly slow. Whilst natural language processing (NLP) methods are quite advanced, they currently are predominantly applied as an afterthought. <XBRL> or iXBRL markup tags applied to integrated sustainability reports can provide consistency in comparisons for numerator data extraction.

Approaches like THRIVE Framework and its associated THRIVE Platform encourages enterprises to publicly communicate their sustainability performance. This process is seen as a progression as illustrated in ***Figure 2.22*** whereby enterprises are initially mandated to disclose (Schaltegger & Burritt 2010), then later report incremental year-on-year knowledge of their improvements, and finally grasp the importance of contextualised understanding and reporting (Baue 2019). This ought to inspire the wisdom for transformational change in how an enterprise envisions its ability to *do good to do well* (O'Tooie 1991).



Figure 2.22. *Reporting Funnel: Stages of Sustainability and Integrated Reporting referenced in this study and illustrated by the author.*

Integral Thinking	**Implemented as follows**
THRIVE Framework	• Corresponds to context-based entity impact data
THRIVE Platform	• Scale-linked impact entity data used and calculated at each level • Numerator data obtained from corporate sustainability and integrated reports • Transformational wisdom appears in the form of backcast targets defining the path forward

2.6.7. Science-based Targets

INSIGHT (R35): Build strong trans-disciplinary approach to multitier conceptual framework to address complexity at scale. Be cognizant of feedback loops over temporal and spatial scales. Provide triangulation by combining qualitative conceptual analysis with on-the-ground data.

INSIGHT (R51): GDP is not a suitable indicator of sustainable development. Building on ecological economics, society will need to transition to a steady-state economy.

INSIGHT (R66): Reporting lacks contextualisation within thresholds, based on environmental limitations identified by scientific evidence. These impacts need to be measured relative to production benchmarks through aggregate composite indices.

INSIGHT (R67): There is a myriad of self-assessment tools, open research platforms, assessment, and benchmarking tools available. It is important to address the context gap openly and transparently, where contextualisation and consistency of metrics is paramount (context matters). Embrace CBS.

INSIGHT (R60): Corporate reports by and large are disclosures addressing basic compliance requirements. These reports often lack metrics, science-based targets, and in-context based measurement, making them unusable for comparisons. Notably, impacts are often self-referential (inward looking) or greenwashed to appear favourable.

INSIGHT (R06): An outside-in a-posteriori black-box approach can provide empirical quantitative results which is focussed on measuring value.

INSIGHT (R27): The need to bring humanities footprint within regenerative and absorptive capacities. The EF approach to "global overshoot" is simplistic by assessing what is happening today, rather than what is sustainable, ignoring scales, and contains numerous quantitative and congruency errors.

2.6.7.1. Frameworks galore

A myriad of frameworks have been proposed over time ranging from open standards like GRI to one-off proprietary ones (Pojasek 2006; Van Cauwenbergh et al. 2007; Dao et al. 2011; Sala et al. 2015; Villiers & Sharma 2017). Morioka et al. (2016), for example, provides a comprehensive and integrative performance measurement framework for

SBMs in support of the identification of sustainability innovations. Many, such as the DJSI, aimed at investors, are based simply on disclosures (López et al. 2007) and thus do not measure sustainability performance (White & Lenssen 2009). Other reports include sustainability reporting and Integrated reports covered earlier. Although higher sustainability companies disclose more (Eccles et al. 2014), there is a need to go beyond disclosure to include context and thus actual performance using science-based targets. Even standards who affirm being context-based such as GRI, do not appear to enforce this requirement (McElroy 2017b), nor do their reports contain the necessary information needed for judging corporate sustainability performance (Isaksson et al. 2009).

2.6.7.2. From disclosure to exposure

Nonetheless, the Global Reporting Initiative (GRI) is still the most widely used set of reporting guidelines and standard with 85% of member enterprises using the GRI Guidelines or Standard (WBCSD 2017b). Another example is the Task Force on Climate-Related Financial Disclosure (TCFD), whose recommendations encourage organisations to report on climate-related risks and opportunities, on the way in which they are governed and managed, the metrics and targets used to assess and manage them, and the potential impacts of those risks and opportunities on the organisation's strategy, thus increasing the regulatory requirements and the comparability of information. In yet another Harvard University study, Lydenberg et al. (2010), establishes that sustainability KPIs for all sectors will enable companies to move from a compliance driven "*disclosure*" mindset to one of managing and engaging (WBCSD 2017b) — and even competing on—sustainability performance issues that matter most. Overall, many reports claim the use of science-based targets, yet very few provide concrete evidence of doing so, often further compounded by the absence of a clear methodology and calculation method (Bjørn et al. 2017).

2.6.7.3. From qualitative to quantitative

Several studies by the IPCC (Intergovernmental Panel on Climate Change 2018), UNEP (UN Environmental Program 2014), SBTi (SBTi 2018) and others show *that business-as-usua*l (Steffen et al. 2011; Bocken 2014) (Randers 2012; World Wide Fund for Nature 2019) will not bring humanity to become sustainable, much less go beyond it. Instead, a radical and not incremental approach is necessary (Thurm & Baue 2018a) to traverse the sustainability gap (Ekins & Simon 1999) and progress to a steady-state economy (SSE) (O'Neill et al. 2010; Costanza 2019). This inevitably requires actual science-based data, rather than disclosure scores. Resources such as the Global Footprint Network (GFN) (Mathis et al. 2005), Carbon Disclosure Project (CDP), World Resource Institute (WRI) and other local government databases can provide actual real denominator data for this purpose (Zhou et al. 2012; Guo et al. 2015; Haffar & Searcy 2018).

Science-based targets	**Implemented as follows**
THRIVE Framework	• Necessary and sufficient criteria for sustainability performance assessment
THRIVE Platform	• Basis for thresholds and allocations • Defines acceptable sources for data • Source for denominator data

2.6.8. Context-based Metrics

INSIGHT (R26): Scale-linking leading to multiple levels of regenerative capacities.

INSIGHT (R30): Environmental footprints and planetary boundaries are complementary and provide for the capturing of impacts at scales by incorporating harmonisation of the metrics. This forms the basis for mitigating sustainability (or a lack thereof) at the global level.

INSIGHT (R33): Some studies suggest as valuable is the use of text mining automation tools on annual reports. Others analyse BM configurations as well as super-ordinate levels of portfolio.

INSIGHT (R34): Emphasis on scale-linking at the super-ordinate level across multiple tiers. Developing predictive models that work universally at scale at solving complex solutions.

INSIGHT (R37): Organisations exhibit multiple BMPs working across enterprises and scales and in support of super-ordinate patterns.

INSIGHT (R56): Bring disruptive innovation to global systemic transformation requires tracking metrics and effectiveness and iterative continuous improvements of the BM. Technology plays a vital role as organisations prioritize transitioning towards sustainability as part of their business model innovations.

INSIGHT (R60): Corporate reports by and large are disclosures addressing basic compliance requirements. These reports often lack metrics, science-based targets, and in-context based measurement, making them unusable for comparisons. Notably, impacts are often self-referential (inward looking) or greenwashed to appear favourable.

INSIGHT (R61): Standardisation of sustainability or integrated reports would provide a basis for fair comparison. Attempts to date have not provided the integrated and harmonised approach necessary.

INSIGHT (R62): The One Planet Thinking initiative is an attempt to bring systems level thinking to the corporate level, thus recognising the holonic and scale-linking nature of the world in relation to biodiversity.

INSIGHT (R66): Reporting lacks contextualisation within thresholds, based on environmental limitations identified by scientific evidence. These impacts need to be measured relative to production benchmarks through aggregate composite indices.

INSIGHT (R67): There is a myriad of self-assessment tools, open research platforms, assessment, and benchmarking tools available. It is important to address the context gap openly and transparently, where contextualisation and consistency of metrics is paramount (context matters). Embrace CBS.

INSIGHT (R68): WBA is attempting to benchmark organisations worldwide sector by sector. There have been doubts as source data sets are not made available publicly and transparently (despite stating the contrary). Need for a comparative uniform universal harmonised sustainability performance index.

INSIGHT (R80): Take a systems view addressing the super-ordinate levels. Adopt a 'black-box' ex-post empirical assessment.

2.6.8.1. From disclosure to exposure

Several studies have shown that sustainability reports often amount to simply disclosure (UN Environmental Program 2015a; WBCSD 2017b) and fail to provide adequate context (Bernard et al. 2015; Belkhir et al. 2017; Baue 2019). Most are self-referential, reflect performance relative to previous years and not relative to planetary boundaries (Bjørn & Røpke 2018; Steffen et al. 2018). The World Business Council for Sustainable Development (WBCSD 2019), in partnership with the Stockholm Resilience Center (SRC) has embedded the planetary boundaries in its *Action 2020 and Vision 2050* initiatives, acknowledging the challenges around translating the science on thresholds into enterprise-level allocations and business-ready applications. Likewise, the UN Environmental Program (2015b) *Raising the Bar* report outlines how unclear boundaries, inconsistent measurements and assumptions, and a lack of context affects comparability.

2.6.8.2. Measuring what matters most

Context-based metrics (CBM) is premised on the notion of a sustainability quotient (McElroy et al. 2008; Baue & Thurm 2018a; White 2019), derived from the nominal actual impact numerator value divided into the total carrying capacity denominator value (McElroy & Thomas 2015). Just as one cannot manage what they do not measure (Drucker 1995), it is imperative that one measures what matters most (Fedeli 2019), within context and relative to actual threshold and allocations (UN Environmental Program 2015b; Baue & Thurm 2018a; Haffar & Searcy 2018), scale-linked (Wahl 2016) across scopes from the nano-scale to the macro-scale (Thurm & Baue 2018a).

Context-based denominator data allows sophisticated software to calculate projected allocations and set backcast targets by employing a variety of formulations or methods as dictated by the targets at each scale. Scale-linking is a critical element for both the implementation of science-based targets and context-based metrics. Thus, the selection of allocation and weights, all play a role in determining the just and fair resource share for a sustainable future (Daly 1992). In particular, the ability for a user to select topics, weights and formulae provides the flexibility necessary to conduct a multitude of congruent analysis across entities and scales. This approach encourages measuring what matters most through CBM, assessing impacts (numerator) within the context of vital capital availability (denominator) (Thurm & Baue 2018b). The result is captured in the form of a score across each material topic, normalised, harmonised and weighed, to form an overall aggregate composite score or index (Munda & Nardo 2005; Nardo, Saisana, Saltelli, et al. 2005).

2.6.8.3. Scale-linking

Building on literature in the field of regenerative design (Wahl & Baxter 2008) and context-based thinking (Thurm & Baue 2018d), this study proposes seven scale-linked levels grouped as follows: a) macro-level (Cosmos); b) meso-level (Continent, Country, City, Community); c) micro-level (Company); and nano-level (Creature), collectively referred to

as the 7Cs. Illustrated in ***Figure 2.23***, scale-linking ensures that each level of impact is usurped by the level above it until we arrive at the top level of the whole of Mother Earth (although the THRIVE framework does include provisions for multi-planetary ecosystems to be evaluated).

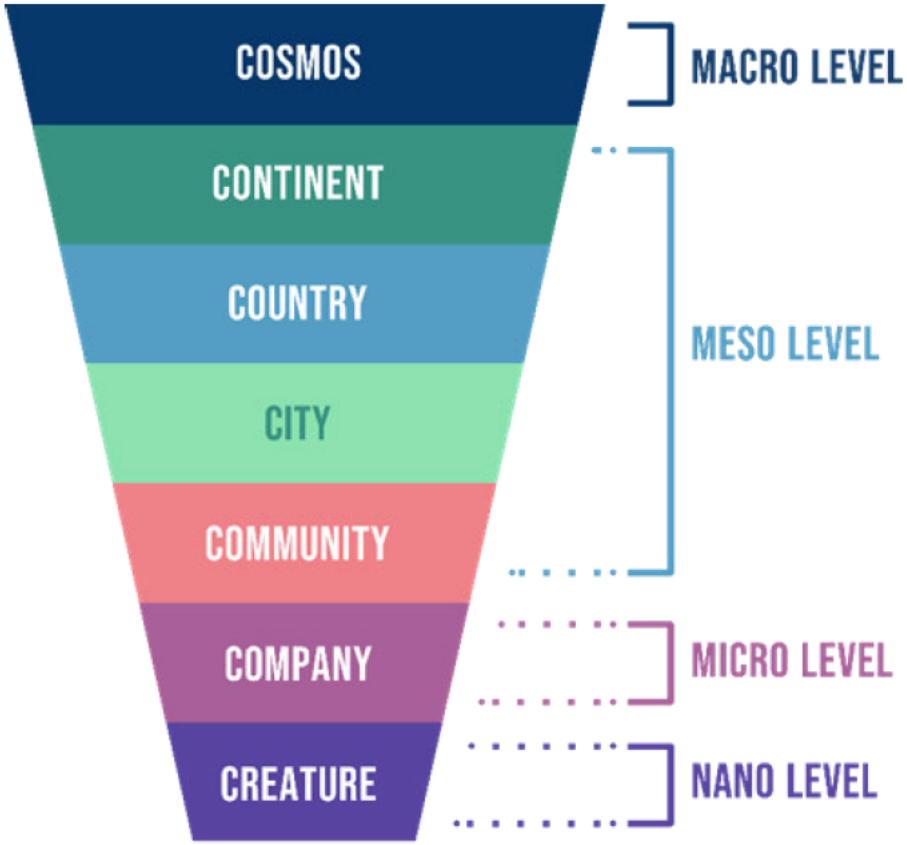


Figure 2.23. *Assailing the 7Cs: THRIVE Framework and Platform Brochure (2020). The THRIVE platform integrates the 7C's, by measuring performance, adopting a scale-linked, values-based, context-based, and science-based approach informed by the natural and social sciences.*

Context-based metrics	**Implemented as follows**
THRIVE Framework	• Impacts measured relative to resource availability
THRIVE Platform	• Formulation determines impact relative to base resource • Denominator data obtained from global public repositories such as UN, CDP etc. • Impacts to include thresholds and allocations at each scale • Formulation to take into account weights and allocation • Each level is scale-linked by design into the next

2.6.9. Strong Sustainability

INSIGHT (R03): The need to take a precautionary approach to sustainability building on the FSSD. Radical innovations at the heart of addressing the wicked complex problems faced by humanity.
INSIGHT (R08): Integrating a scientifically informed strong sustainability approach is necessary in a finite world of unknowns operating within the sustainable value network.
INSIGHT (R15): The BM is a new unit of analysis and seen as part of a comprehensive framework for systemic change, capturing a systems-level approach to how a firm conducts business.
INSIGHT (R38): SBM are about transformation and alignment with strong sustainability (thus avoiding substitution of resources). The normative approach to business model innovation "success" is toward sustainability.
INSIGHT (R46): Innovation for sustainability translates BMs into BMI for sustainability (BMIfS). Akin to strategy, these have shown to deliver competitive advantage. Empirically measured impacts are the only true measure of strong sustainability on a finite planet. BMI seen as a risk minimisation technique.
INSIGHT (R50): A global imperative has emerged, instilling a need for global systemic transformation.
INSIGHT (R56): Bring disruptive innovation to global systemic transformation requires tracking metrics and effectiveness and iterative continuous improvements of the BM. Technology plays a vital role as organisations prioritize transitioning towards sustainability as part of their business model innovations.
INSIGHT (R60): Corporate reports by and large are disclosures addressing basic compliance requirements. These reports often lack metrics, science-based targets, and in-context based measurement, making them unusable for comparisons. Notably, impacts are often self-referential (inward looking) or greenwashed to appear favourable.
INSIGHT (R69): True sustainability impact may only be assessed after the fact (of taking some action), and the value comes from developing methods that enable us to predict which configurations will persist. Taking a holonic view, it is crucial to adopt policies that are precautionary in nature.

2.6.9.1. Systemic solution

For a truly thriving society, a strongly sustainable approach is necessary and sufficient (Upward & Jones 2016) to effect cumulative change, whilst keeping in line with regenerative capacities across all material topics and capitals identified by global thresholds and allocation (Reporting 3.0 2018). Landrum (2017), advocates for integrating strong sustainability into the entity's worldview to avoid obfuscating (a.k.a. "*greenwashing"*) sustainability indicators. This is reinforced by Redclift (1998) who suggests making it *"an axiom of social scientists that knowledge cannot be divorced from the uses to which it is put".* Devising models for sustainable innovation, at enterprise or industry level, beyond lessening impact (Varadarajan 2009) requires a strongly sustainable approach. It also implies no double-counting and non-substitution of

resources in the quest to develop strongly sustainable solutions through BMI (Sironen et al. 2014).

Acknowledging we use 1.8 Earths worth of resources (Steffen et al. 2018; *Global Footprint Network Homepage* 2019; Wackernagel et al. 2019), this study constructs an innovative data-driven (Maltz et al. 2018) systemic and holistic model or framework which captures how individuals, enterprises, and governments alike, contribute their fair share to defining a sustainable trajectory (Pourdehnad & Bharathy 2004; Williams et al. 2017). Acting as an experimental 'digital twin', this multi-disciplinary (Sironen et al. 2014; Lüdeke-Freund & Dembek 2017) approach lends itself to be operationalized as a real time sustainability information system (IS), enabling the modelling of complex dynamic scenarios towards established science-based targets for a regenerative economy (Borucke et al. 2012; Wahl 2016).

2.6.9.2. Precautionary Principle

Advances in science and technology has allowed humans to improve our understanding and develop innovative solutions to our current challenges (Ringel et al. 2017; Fedeli 2018). However, history has shown, this cannot be assumed and therefore we ought to invoke the precautionary principle (Neumayer 2010a; Pelenc 2015) and preserve natural capital stores. To account correctly for all capitals, we take a strong sustainability (Neumayer 2010a; Upward & Jones 2016) stance and employ multiple capitals (Esbjörn-Hargens 2012) in our record keeping approach. Doing so ensures that we do not drain a resource beyond its ability to regenerate itself (Ellen McArthur Foundation 2015; Nicolăescu et al. 2015).

This means considering Earth as a finite resource and taking into account social floors and environmental ceilings (Bjørn et al. 2017; Reporting 3.0 2018). An example of when these limits have been thwarted is when it was revealed in Aug 2019, that the Amazon Rainforest - considered the lungs of the Earth, providing over 20% of our

oxygen - was shown to drop below its regenerative capacity (Massoca 2019). Reporting guidelines, such as the GRI reporting standard provide a high level of discretion to the reporting enterprise and thus may encourage an extensive amount of "*greenwashing*" and "*window dressing*" (Laufer 2003) through intentionally misleading information (Haffar & Searcy 2018). Reported units of key indicators and metrics are rarely consistent within an industry, especially for parameters that are harder to quantify such as water usage, human rights protection and safety indicators (Bernard et al. 2015). Similarly, in cases where parameters are hard to quantify, one may choose to use proxy goals – measuring what matters most - and seen as conforming to the precautionary principles and more stringent than typical benchmarks (Willard et al. 2013).

2.6.9.3. Greenwashing

The data overload of the reports tends to (intentionally or otherwise) obfuscate true sustainability indicators (Aldhous 2019). In the case of WBCSD, a body heavily funded by member enterprises, Najam et al. (2000) points to how, posing as friends of the environment, they are helping to eliminate poverty, whilst reducing regulation of their member's activities. At times, greenwashing is seen as an acceptable public relations and communications exercise (Eccles et al. 2014; Eccles 2018).

Strong sustainability	**Implemented as follows**
THRIVE Framework	• For a truly sustainable society we must aim for strong sustainability
THRIVE Platform	• Invoke precautionary principle • Eliminate greenwashing • Implement non-substitution

2.6.10. Values-based Innovation

INSIGHT (R08): Integrating a scientifically informed strong sustainability approach is necessary in a finite world of unknowns operating within the sustainable value network.
INSIGHT (R17): Disruptive innovation, particularly of one's BM is the most rewarding. Entities do not work in isolation but are at the mercy of the ecosystem supporting them including other industry competitors and regulatory bodies. Collaborations is key to environmental sustainability.
INSIGHT (R19): Values-based innovation help organisations deal with complex and wicked problems and in dealing with systemic sustainability innovations in values-based networks and business models, even improving culture. Modelling is useful in addressing super wicked problems.
INSIGHT (R24): The sustainable value network model and their value forms provide the link between an individual firm and the larger production and consumption system. Sustainable value creation is at the juncture of systems thinking and sustainability-oriented innovation.
INSIGHT (R42): Evaluating BM risks with respect to the sustainable value network. Use BMI to improve the same. Assess BM using a canvas and scorecard.
INSIGHT (R76): Creativity and innovation have been shown to be key mechanisms in addressing sustainable development. A values-based view links values to open innovation.

2.6.10.1. Value-based networks

Values-based innovation has been strongly linked to sustainable business models (SBMs), whereby these are defined as BMs for sustainability (BMfS) (Schaltegger, Hansen, et al. 2016). A longitudinal study of SBM adoption among S&P 500, found that it is the strongest among those enterprises engaging in environmentally-oriented activities (Ritala et al. 2018). Affected by globalisation, studies conclude that the crucial starting point for systemic sustainability innovations can be found in values-based networks and BMs (Hansen et al. 2009; Breuer & Lüdeke-Freund 2017), where the business logic contributes positively to ecological justice and the development of the natural environment (Marcus et al. 2010), human society, and the economy (Schaltegger et al. 2012; Boons et al. 2013; Wells 2013).

Increasingly, technological complexity and innovation speed are major drivers for the emergence of value networks (Breuer & Lüdeke-Freund 2016). Globalisation encourages collaborative elaboration of shared goals and values (Sadovnikova & Pujari 2017), whereby strategic alliances, "co-opetition", and virtual organisations, have become the rule rather than the exception, allowing for experimentation and the

exploitation of otherwise unattainable opportunities (e.g., airline alliances, joint production facilities, shared innovation platforms). A consistent values-based view on innovation management (Ringel et al. 2017) allows for the elaboration of values as levers for the formation of business networks used to solve problems that individual enterprises and BMs cannot (Breuer & Lüdeke-Freund 2017).

2.6.10.2. Innovation management

The elaboration of values among enterprises and indeed sectors and beyond (Breuer & Lüdeke-Freund 2016) encourages innovation, and experimentation. Thus, innovation management, acts as a lever for new business networks to solve problems that individual enterprises cannot, thus fostering collaboration (Berman & Korsten 2013), and spurring on globalisation (Ferreira et al. 2015; Varadarajan 2017). The pursuit of values-based networks encourages measuring performance beyond efficiency gains and to integrate sustainability within the fabric of an enterprise, thus facilitating the transition to the circular economy (Dentchev et al. 2018).

Values-based innovation	**Implemented as follows**
THRIVE Framework	• Innovation in value networks
THRIVE Platform	• All activities contribute towards value • Value from synergy between enterprises

2.6.11. Multi-capital Sustainability

INSIGHT (R08): Integrating a scientifically informed strong sustainability approach is necessary in a finite world of unknowns operating within the sustainable value network.

INSIGHT (R38): SBM are about transformation and alignment with strong sustainability (thus avoiding substitution of resources). The normative approach to business model innovation "success" is toward sustainability.

INSIGHT (R46): Innovation for sustainability translates BMs into BMI for sustainability (BMIfS). Akin to strategy, these have shown to deliver competitive advantage. Empirically measured impacts are the only true measure of strong sustainability on a finite planet. BMI as a risk minimisation technique.

INSIGHT (R64): Triple or authentic materiality measures sustainability performance relative to our regenerative and absorptive capacities. Many countries are requiring organisations to comply with various levels of standardisation, with the industry littered with often confusing requirements.

2.6.11.1. Monetisation as a weakly sustainable approach

Traditional economics monetizes all resources, reducing all stocks and flows to a measure of financial capital (IIRC 2013). Stated in the IIRC report, *Capitals: Background Paper for <IR>*, is that reporting on different resources and relationships or '*capitals'* (financial, manufactured, human, intellectual, natural and social), is critical to a meaningful assessment of the long-term viability of an enterprise's BM or strategy and that integrated reporting <IR> results in a broader explanation of performance than traditional reporting with each capital examined from a multi-disciplinary perspective. Monetisation of a capital resource is explicitly seen as a weakly sustainable approach as this allows the substitution of one commodity for another (Dohrmann 2015; McElroy 2017a).

2.6.11.2. Coping with narratives and aggregates

The IIRC – a supporter of the multi-capital approach - argues that some capitals are best, and maybe only, able to be reported in narrative forms, rather than through metrics. It notes that apart from efforts to monetize various capitals, there appears to be no reasonable way to aggregate measures with respect to the full range of capitals because of the lack of a common unit of measurement. Moreover, the IIRC considers that aggregating capitals requires standardisation to a degree that is largely contradictory to the primary thrust of <IR>, which is to enable each enterprise to tell its own value creation story (IIRC 2013). Additionally, whilst some capitals can be traded, generally natural capital may not be re-acquired once depleted or destroyed (Ekins 2003).

Again here the author disagrees with the IIRC (2013), finding that both individual and aggregate values of interest may be calculated, by adopting statistical techniques to minimize non-substitution of resources and ensure fair aggregation of material topics. Typically, a group of

targets converge to contribute to a material topic, with a set of topics forming a goal. In some nomenclatures, the groupings change; however, ultimately feed into a set of multi(ple)-capitals (Esbjörn-Hargens 2012; McElroy & Thomas 2015) that all together cover the three pillars of economic, social and environmental sustainability (Elkington 2004). By adopting specific aggregation techniques such as MPI (Mazziotta & Pareto 2017), one can ensure non-compensatory aggregation formula is used (Sironen et al. 2014; Mazziotta & Pareto 2015a; Zhang & Zhou 2018). In fact, there are specific techniques employable to measure this over time (Mazziotta & Pareto 2015b).

Multi-capital sustainability	**Implemented as follows**
THRIVE Framework	• Supports for multiple capital
THRIVE Platform	• User selectable multi-capital approach • User selectable (aggregation) formula • Statistical support for non-substitution/non-compensatory (i.e. strong sustainability)

2.6.12. Linear to Circular Economy

INSIGHT (R16): We live in a world of finite resources. Our economic activities and global actions sparked by consumerism are depleting natural resources including our carbon sinks.
INSIGHT (R25): Systems thinking, leading to envisage a society by design that is restorative and regenerative.
INSIGHT (R31): Important to implement circular economy models emulating biomimicry, invoking collaboration to develop synergies towards the greater good.
INSIGHT (R72): There is a transition to being sustainable. There is no doubt that this will be the default modus operandi for all organisations (entities) into the future.

2.6.12.1. Embracing circularity

If society is to win the environmental challenge, it must move from the linear to the circular economy model (Webster 2015; Lewandowski 2016; Bocken et al. 2017; Geissdoerfer et al. 2017), and that of collaborative consumption or sharing economy model (Lüdeke-Freund et

al. 2016). This means reduce, reuse and recycle and ultimately eliminate waste production altogether (Vladimirova 2017), thus increasing utilisation whilst reducing overall consumption costs (European Academies Science Advisory Council EASAC 2016; WBCSD 2017a). Another common approach is biomimicry (Elliot 2011; Giampietro 2023), which much like the natural world, goes beyond incremental efficiency gains to deliver transformative change (Preston 2012; Ellen McArthur Foundation 2015) by closing the loop on energy and materiality (Antikainen et al. 2017). A Haanaes et al. (2011) BCG study, found that those enterprises who reap the benefits of higher performance, do so by integrating sustainability, not as a separate layer, but within the fabric of the business.

A WBCSD (2017a) report shows substantial opportunities (USD4.5 trillion) have been identified in the transition to future-proof business, with the following materials: steel, aluminium, plastic, cement, glass, wood, primary crops and cattle, responsible for 20% of greenhouse gas emissions, 95% of water use and 88% of land use with a third of these materials contributing to each of shelter and food creation. Examples of sharing economy BMs are ridesharing, computer-leasing, and renting of clothing (Kopnina 2017); and circular economy BMs include dormant goods, re-manufacture, recycling, and re-distribution, just to name a few (Lüdeke-Freund et al. 2019).

However, moving to a circular approach to address resource depletion is not enough in of itself. With several natural resources below their environmentally sustainable threshold, there is a need to move beyond breakeven and become regenerative to counteract past losses. This is especially true in respect of land use, afforestation, climate change, biochemical flows, and biodiversity loss where natural sustainable levels have been eroded (Steffen et al. 2018).

Linear to circular economy	**Implemented as follows**
THRIVE Framework	• Encourage closing the loop across scales
THRIVE Platform	• Multiple scale approach • Identification of keystone actors

2.7. Conclusion

This chapter explores and exposes the literature that informs the field of industrial ecology, and sustainable business model innovation towards achieving thrivability. It considers current approaches, best practices, examines real world problems, highlighting the importance of materiality, and how business models enact strategy. It also highlights the present gap in connecting actual business/entity models with observed sustainable performance.

It then lays out the foundational constructs used throughout this study, and outlines the purpose, research questions, and outputs. It introduces the THRIVE Framework and the 12 Foundational Focus Factors (12FFF) used in developing the instantiation of the THRIVE Platform and in evaluating its utility over the next few chapters. These factors are deemed as necessary and sufficient to deliver on thrivable solutions to our many pressing environmental challenges and social ills. Factors covered include invoking strong sustainability, applying systems and integral thinking, and taking a values-based, context-based, and science-based view. Clear identification of the boundary of the entity under consideration, choice of material topics and a multi-capital perspective, determining how to transform from the linear to the circular and regenerative economy, applying radical innovation strategies, given our finite resources, and the complex wicked challenges we face as a society.

The outcome from the investigation is the THRIVE framework, a blueprint to guide humankind onto the trajectory towards thrivable

transformations. It exposes the relationship between business (entity) model innovation and sustainability performance and was undertaken between 2017 to 2023. During this investigation the above 80 insights were discovered, and several academics and seminal authors were directly consulted. Their input served to guide the investigation, refine the approach, test options and ultimately build the case for an AI inspired framework and case study tool, linking sustainability performance with entity model.

CHAPTER 3: METHODOLOGY

3.1. Background

The blueprint espoused in ***Section 2.5*** introduces us to the basic constructs required for developing a framework that inspires business, industry, and society at large toward thrivability. Given the strong sustainability stance, systems and integral thinking approach using context-based, science-based and values-based innovative understanding, it was best thought that the approach ought to build on established ecological scientific principles (Ehrenfeld 2004). This will allow for the development of a solution for a class of problems (Winter & Aier 2016) built on a well-accepted foundation, namely the Framework for Strategic Sustainable Development (FSSD) (Waldron et al. 2008; Alliance SSD 2019).

The methodology derived was the result of the review of a range of methodologies and several methods along the way. This included a systematic literature review, bricolage, interviews, and survey. Other options investigated was a single case study, a quantitative only study, and mixed methods. It has come to pass since the study first started a number of global events, including severe floods, droughts, and the coronavirus epidemic – all existential threats to humanity – which re-enforce the nature and need for this particular study's approach looking to illuminate by design the future we seek, rather than simply evaluate our past performance to date (March & Vogus 2010).

Furthermore, worth noting, that whilst this study refers to entities at various levels (***Appendix A: The THRIVE Framework***), most examples and explanations will revolve around organisations, seen as social constructs that depend on human behaviour (Searle 1996; Lewis 2020). These constructs are conceptual artefacts - policies, rules, roles, responsibilities, authority, work systems, all designed to enable and empower people individually and/or in groups to accomplish tasks and achieve goals.

Thus, as each approach examined presented some advantages and disadvantages, it was ultimately decided to settle on a design science research (DSR) approach as it:

- Supports the partial development of strong theory improving relevance through illustrative data, something which all-encompassing theory alone could not do (Sutton & Staw 1995; Drechsler & Hevner 2018).
- Offers the integration of a combination of methods (Creswell & Plano Clark 2011), as found in bricolage (Kincheloe 2001), each best suited for the task on hand, like design (Yee & Bremner 2011).
- Is congruent with repeated cycles of (1) artefact construction; (2) prescriptive theorising; (3) study of artefacts in use; (4) tests of knowledge with artefacts in use; and (5) descriptive theorising (Gregor & Baskerville 2012).
- Investigates complementary prescription-driven/solution-oriented research based on the paradigm of the 'design sciences' thereby producing management theory that are field-tested and grounded in technological rules (Joan E. van Aken 2004).
- May be augmented with a Delphi study (Day & Bobeva 2005) to improve rigour with the introduction of field experts.
- Is grounded on a comprehensive literature review which adds rigour and robustness ahead of undertaking the evaluation (Shrestha et al. 2014).

This was supplemented by a Seafood Stewardship Index case study (Luck et al. 2005; Easton 2010) where the artefact was evaluated in reference to previously publicly available raw data for the seafood industry *(WBA 2018)*. It is estimated that a third of the world is affected by this industry either directly or indirectly and as such the business model used by those actors in this field are highly relevant to how the industry can move towards sustainability *(Merino & Williams 2015; Schorr 2022)*. Whilst some activities in the industry such as subsistence fishing is

necessary, fishing in the commercial and recreational space has brought us below levels of sustainability *(Blöcker et al. 2023; NOAA 2023)*.

The final approach settled upon is illustrated in ***Figure 3.1***, whereby there was an initial DSR ex-ante and ex-post evaluation followed by the expert Delphi study, and finally the Case study assessment of keystone actors.

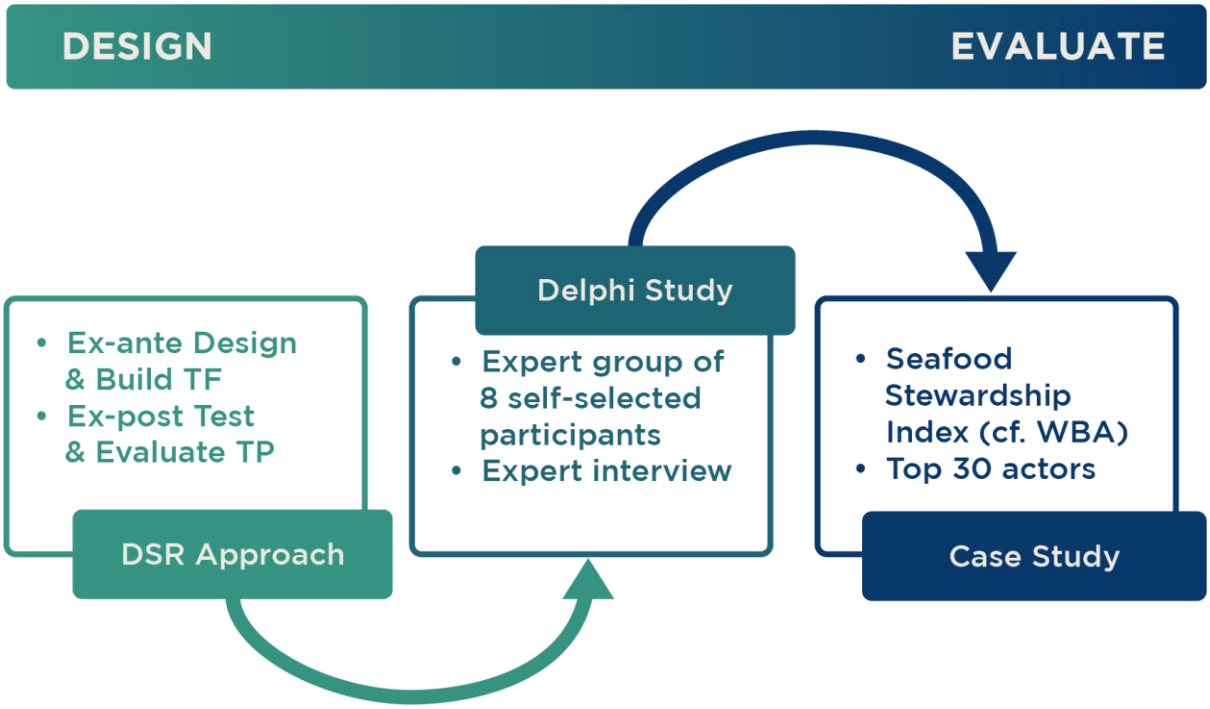


***Figure 3.1**. Overall research process used in this study.*

The balance of this chapter will proceed as follows:

- Research dimensions: articulating the world view and general epistemological and ontological principles in use in this study.
- Research design process: the process adopted in reaching a conclusion as to the best way forward to tackle the investigation.
- Design science research: the chosen research methodology adopted and reasons for why it was determined to be the most suitable.
- Evaluation strategy: the chosen protocol and expected outputs from the evaluation.

- Management theory: the specific area of discovery that this study contributes towards.
- Summary: overall summary of the chosen methodology.

The structure of this chapter is such whereby the research design, the DSR process, and evaluation strategy are shared, as well as to how this study informs management theory (***Figure 3.2***).

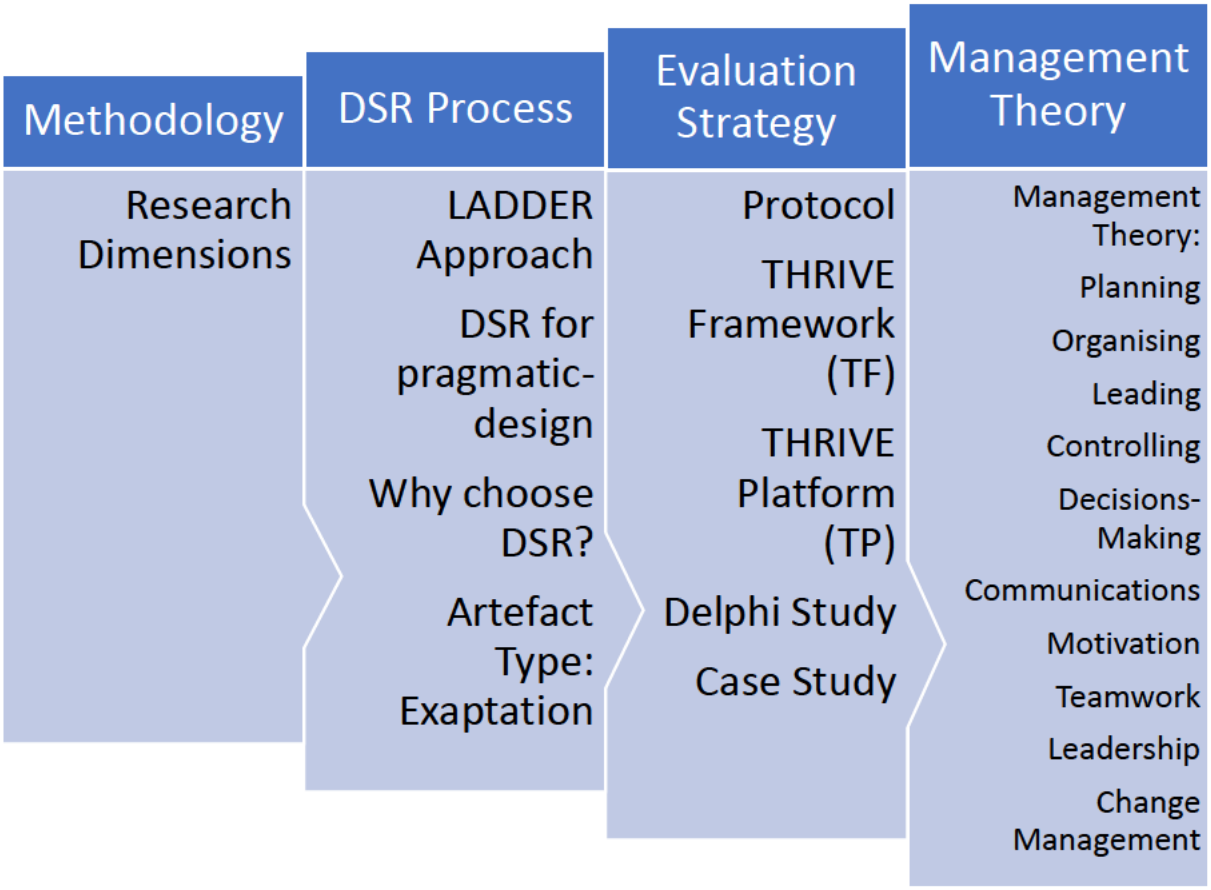


Figure 3.2. Chapter 3 METHODOLOGY chapter layout.

3.2. Research Dimensions

Given the conceptual and theoretical nature of the study a reasonable amount of time was devoted to identifying the appropriate posture to the issues of world view, general approach, and other related issues of ethics, and so forth. There were some movements on these issues that took place over time to best ensure an adherence and congruency between chosen approach and what could be expected from the study.

For example, insofar as the choice of paradigm is concerned, Carlsson (2005) suggests that critical rationalism (Miller 2007) should be considered as a philosophical underpinning for information systems (IS) DSR. In contrast, Goldkuhl (2012) investigated pragmatism and its epistemological foundations and found it as the candidate paradigm for design research. Pragmatic validity stems from testing (Joan E. van Aken et al. 2016), and determining general and future use, utility, and employing peer-review through expert feedback. Furthermore, in the synthesis of realism and pragmatism, a realist adopting a pragmatic stance considers beliefs for their practical implications alongside their alignment with an objective reality (Montague 1909). This equilibrium accentuates the interplay between theory and action. When applied to problem-solving and decision-making, this approach evaluates solutions based not only on their correspondence with reality but also on their effectiveness in practical contexts. This integration ensures decisions are grounded in accurate interpretations of the world based on the deterministic physical sciences, while also acknowledging their tangible real-world outcomes as derived in, for example (non-deterministic), integrated assessment models (Marvel 2023). In this dynamic framework, the realist-pragmatist harmonizes the pursuit of truth with the pragmatic exigencies of daily life.

Eventually the dimensions shown in ***Table 3.1*** were settled upon.

GENERAL RESEARCH DIMENSIONS							
WORLD VIEW			APPROACH		OTHER		
ONTOLOGY	EPISTEMOLOGY	PARADIGM	DESIGN/METHOD	FRAMEWORK/TYPE	LOGIC	OUTCOME	ETHICS
ATHEIST REALIST	RATIONALIST	CRITICAL REALIST	DESIGN SCIENCE THEMATIC ANALYSIS	TRANSFORMATIVE EXPLORATORY OBSERVATIONAL	REDUCTIVE ABDUCTIVE	CROSS-SECTIONAL BASIC THEORETICAL	HUMANIST

Table 3.1. *General research dimensions for this study.*

Whilst most research dimensions are straightforward, noteworthy is the authors assertion that this study – contrary to most – specifically provides a blueprint for guidance, formulating what actions humanity *ought* to take to ensure providence and prosperity for the benefit of us all (Alexander 2015). Some may argue that through science one cannot derive an "*ought"* from an "*is"* (Curry 2006, p. 237). Natural science studies "how things are". Design science studies how things "ought to be" (Simon 1969, p. 4). Natural science and design science are not dichotomous - they are simply two sides of the same coin (Hevner et al. 2004).

The author contends that the prescriptive insights into the long-term thrivability of humanity is at risk, if we do not heed the very insights provided by the 12 Foundational Focus Factors of the THRIVE Framework. We can come to this conclusion quite simply, suppositionally, if we assume that generally life is preferable to death (even though noted that there may be exceptions). Thus, unlike ordinary research that is truth-seeking, we use DSR here to develop generic solution-oriented knowledge upon which future researchers may build upon (Joan E. van Aken et al. 2016).

This desire has been publicly supported by several organisations within this domain including in a recent speech by UN Secretary General, António Guterres, in the COP27 presentation held in Egypt in November 2022 whereby he stated that, to "*keep [the target of] 1.5C alive*" nations need to collaborate rather than compete. In an address on the same day, former vice-president of the USA, Al Gore, stated that we – society at large – are causing so much death and destruction and therefore it is incumbent on us to take actions to mitigate the situation towards a more prosperous future for us and future generations (United Nations 2022a). The hope is there will come a time where we will no longer be in a planetary emergency, and that there will be no call for entities to '*become*' sustainable as all entities will be designed to be so (Künkel 2021).

3.3. Design Science Research (DSR) Process

The research design process is the iterative approach undertaken to develop and refine the design over the approximately 28-months spent on the study design phase. It includes an extensive evaluation of literature around the theoretical underpinnings of the complexity around human and natural systems, as well as feedback loops (Liu et al. 2007), informing further processes of adaptation as further input from the broader sustainability community was added to the study. As the main requirements on DSR is that of relevance and rigour (Benbasat & Zmud 1999; Hevner et al. 2004), this study proceeded as shown in ***Figure 3.3***.

On the left of ***Figure 3.3*** we see the descriptive knowledge fuelled by the relevance cycle whereby each aspect of the artefact is checked at a practical level. In this regard, the question was posed as to whether the newly found information met the requirements, and was tested against the people, organisations, and technical systems in reference to the chosen problems/opportunities it was addressing. In other words, was it relevant to the requirements? On the right of ***Figure 3.3*** we see the prescriptive knowledge emerging from the rigour cycle whereby each new piece of literature in the accumulated knowledgebase was carefully reviewed and evaluated for significance and value to the overall objective. Thus, was the knowledge obtained rigorously?

DSR's strengths when developing artefacts results from combining the cyclic rigorous nature and the practical relevance aspect with the philosophical theoretical underpinnings. Philosophically these arguments draw from the pragmatists (Aboulafia 1991) who argue that truth (justified theory) and utility (artefacts that are effective) are two sides of the same coin and that scientific research should be evaluated in light of its practical implications (Hevner et al. 2004). Thus, building on the paradigm of the 'design sciences', the relevance problem in academic management research is mitigated by complementing the description-driven research with prescription-driven research, resulting in what we may call management theory (Aken 2004).

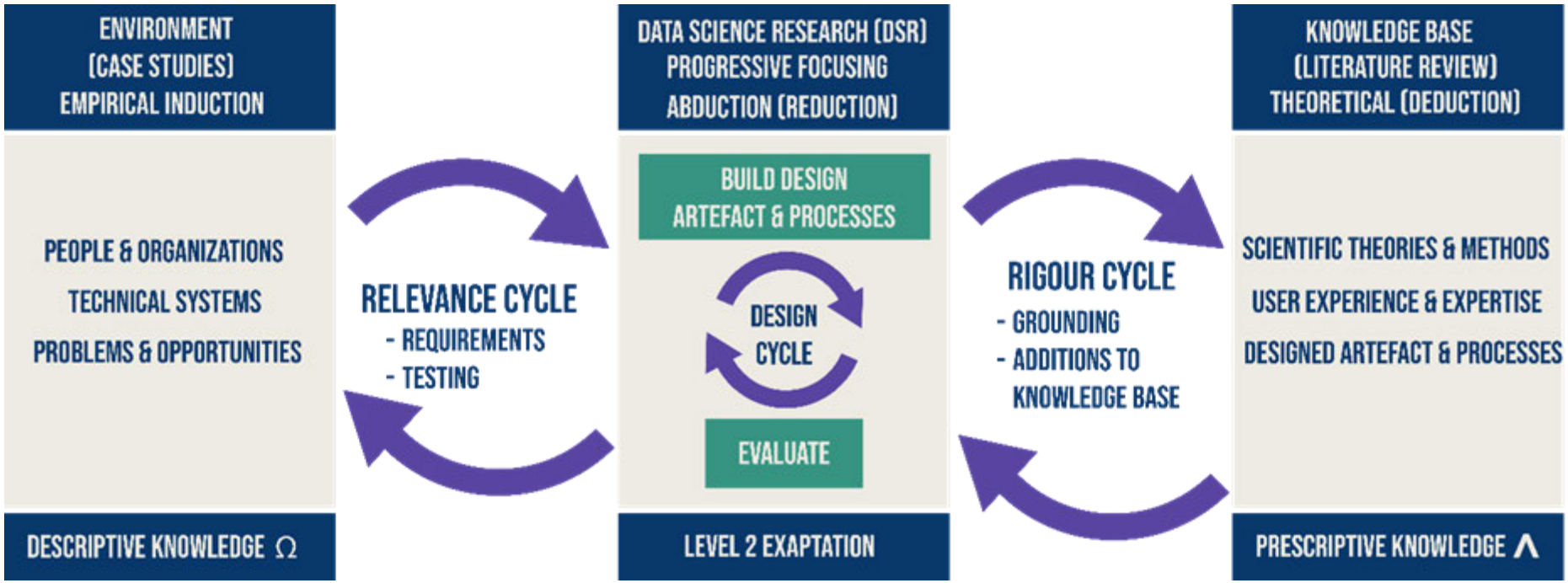


Figure 3.3. *Research design process created by the author for this study. Adapted from Hevner (2007).*

Overall, the formal build (demonstration) and evaluation of the THRIVE Framework, in iterative design cycles (Pfeffer & Salancik 2003), involved the evaluation of the descriptive knowledge and prescriptive knowledge as illustrated in ***Figure 3.3***. The DSR methodology used in the study incorporated the following key methods: the evaluation of management theory components (Joan E. van Aken et al. 2016), the Delphi study (Day & Bobeva 2005), followed by the case study (Eisenhardt 1989). The research process included realising a problem situation, analysing published literature for ideas, developing prototype pattern solution, and testing this prototype in practice, both personally and with others through the Delphi study.

The first, concerning the evaluation of management theory, is outlined in ***Table* 3.3** and addresses the problem and solution space through a range of constructs, principles and testable heuristic and algorithmic propositions. In this study a test case or instantiation, known as the THRIVE Platform, was developed using 30 cases of enterprises that were evaluated in terms of business model (BM) and Sustainability Performance Index (SPi). The second concerns the Delphi Study, comprised of interviews of a small group of experts in the field as structured in ***Table* 3.2**. Full details are contained in ***Appendix D: Study Collaterals***.

Criteria	Choice
Purpose of the study	Explore, build, test, and evaluate the THRIVE Framework and THRIVE Platform instantiation
Number of rounds	Build (3 major, several minor)
Participants	Heterogenous group
Mode of operation	Remote access online
Anonymity of panel	Anonymous - only known to the author. Permission to publish later.
Communication media	Online via zoom by appointment
Concurrency of rounds	Real-time online conferencing

Table 3.2*. Structure of Delphi design used in this study. Adapted from Day and Bobeva (2005).*

3.3.1. Formulation and structure

In the domain of business innovation, the overarching goal of design-oriented theorizing is to achieve a comprehensive design theory seen as the holy-grail of design-oriented business innovation research (Winter & Aier 2016). Venable's (2012) characterisation of a design theory as a utility theory emphasizes the crucial link between solution technologies and the specific problem aspects they address. Extending beyond the structural elements, as outlined by Gregor and Jones (2007) in their conceptualisation of "anatomic" components, a robust design theory for business innovation necessitates a thorough examination. This includes not only covering anatomic components but also delving into application/use contexts and valuation considerations. By adopting such a holistic approach, the resulting design theory becomes a valuable contribution to the broader knowledge base of business innovation. Venable (2009) and Gregor and Jones (2007) underscore the significance of establishing connections between solution technologies and problem domains, as well as the imperative to explore anatomic components in a comprehensive manner as part of the research formulation.

As shown in ***Table* 3.3**, the research formulation includes a comprehensive design theory, articulating the purpose and scope, establishing the overarching objectives and prerequisites of the theory, concurrently specifying the domain of artifact applicability and demarcating the theoretical boundaries. This includes defining the problem space as the “context-based and science-based evaluation of sustainability performance and entities models” with the solution space being the “ranked sustainability performance and associated entity models based on audited public reports” for consumers, analyst, consultants, government, and business leaders.

Next, the theory development involves the conceptualisation of constructs, which function as symbolic representations of focal entities within the theory. These constructs provide a means to effectively comprehend and analyse the core elements addressed by the theory.

Building upon this, the principles of form and function include the models (the 12 FFF), methods, and instantiations (Gregor & Jones 2007). Moving to the artefact mutability, we consider the dimensions which delineate the permissible extent and character of modifications that can transpire while aligning with the theory's foundational premises.

Testable propositions encapsulate pivotal principles of design theory in verifiable declarative statements, fostering empirical validation. This includes heuristic as well as algorithmic propositions (Fu et al. 2015), together with the integration of justificatory knowledge drawn from pertinent natural, social, or design sciences, furnishing the rationale and explanatory framework for the theory's design tenets. As espoused by Winter and Aier (2016), the culmination of these steps results in a coherent design theory primed to guide the creation and assessment of entity-system artefacts within the predefined objectives, constructs, principles, and real-world contexts. Additional materials found in the Appendices as indicated provide further information, including a coverage on principles of implementation and expository instantiations.

As for the structure of the Delphi design (Day & Bobeva 2005), the approach lends itself well to theory generation by seeking input from experts with substantive knowledge in the field. It allowed for the gathering of subjective judgements moderated through group consensus at a time when lockdowns prevailed due to COVID-19. The method spans both the positivist/quantitative and the interpretive/qualitative divide, offering reliability and generalisability of outcomes. The design was reviewed by the supervisors on several occasions before being implemented, as well as going through Ethical review by the University of Southern Queensland (see HREC approval in *Error! Reference source not found.*). Delphi studies are applied to small groups and do not produce statistically significant results hence this research included a case study.

Components	Descriptions

Purpose & Scope	**Purpose & Scope:** • Problem space: Context-based and science-based evaluation of sustainability performance and entities models (e.g., business model) • Solution space: Ranked sustainability performance and associated entity models of based on audited public reports (e.g., GRI reports) • Target groups are consumers, analyst, consultants, government, and business leaders
Constructs	**Constructs** (e.g., where entity is company): • Enterprise: defined as those corporations, business, organisation, firms, company, or institutions which also may operate outside of its home country • Business Activity Groups (BAG) (GRI 2018) • Business Model (BM) (Teece 2010) • Sustainability Performance Index (SPi) (***Appendix B: The THRIVE Platform***) • Sustainability Performance Scorecard (SPS): a descriptive model artefact (Winter 2014)
Principle of Form & Function (Blueprint)	**Models:** • Based on comprehensive research of the Foundational Focus Factors (FFF) (***Appendix A: The THRIVE Framework***) **Methods:** • Business Model (BM) group/pattern (Ludeke-Freund et al. 2018) (***Appendix E: Reference Tables***) • Sustainability Performance Index (SPi) (***Appendix B: The THRIVE Platform***) • Material Topics (GRI 2018) (***Appendix E: Reference Tables***) • Context & Science-based Targets (Lydenberg et al. 2010) • Multi-capital Scorecard (MCS) (McElroy & Thomas 2008) **Instantiations:** • Sustainability Performance Scorecard (SPS) (***Appendix F: Historical Documents***)
Artefact Mutability *(reliability)*	**Areas of mutation** (Feedback to refine design, database for consistent implementation): • Enterprises chosen (may vary as necessary) • Business Activity Groups (fixed) • Business model categorisation (Subject to interpretation – in practice an entity exhibits multiple business models) • Material Topics (fixed) • Multi-capital score card (fixed subject to accurate self-reported numerator and public denominator data) • Sustainability Performance Index (SPi) calculation (Normatively fixed based on the prevailing science)
Testable	**Testable Propositions:**

Propositions	The test is utility and fitness for purpose and NOT truth value although the results should be true. Will it initiate action on behalf of enterprises and individuals? • Heuristic propositions: Inclusion of material topics (degrees of freedom); choice of business model pattern • Algorithmic propositions: Calculating the SPi; Business Activity Groups & Material Topics from GRIs/SDGs
Justificatory Knowledge	**Justificatory Knowledge:** See references in Foundational Focus Factors and RP1.8 (***APPENDIX F: Historical Documents***), plus the following methodological references drawing on natural and social sciences: • van Aken (2004): Management Theory • Gregor & Hevner (2013): Design Science Research • Gregor & Jones (2007): Design Theory • Winter & Aier (2016): Business Innovation Research • Ackoff (1971), Gharajedaghi (2006): Systems Thinking • Martin (2009), Liedtka and Randall (2014): Design Thinking • Gill & Hevner (2013): Usefulness & Fitness-Utility Models
Principles of Implementation (Optional)	**Principles of Implementation** (Guidelines/protocol for implementations): ***(Appendix E: Reference Tables)***
Expository Instantiations (Optional)	**Expository Instantiations** (THRIVE Platform: Example with 30 cases (Enterprises) using a spreadsheet or a database): ***(Appendix B: The THRIVE Platform)***

Table 3.3. *Management theory components identified in the study. Adapted from Winter and Aier (2016).*

3.3.2. The LADDER Approach

DSR processes have three common threads: identifying the problem for which a solution is to be found, designing/building the artefact that represents a solution to the problem and evaluating the artefact. For example, in formulating innovative solutions to the circular economy challenges we employed a top-down, scale-linked and participative design science approach (Malhotra et al. 2013). It is important to note that if we were to develop new theory, in the future, then more abstracting and testing would be required (see ***Appendix A: The THRIVE Framework***).

For the DSR process, a technique originally developed by me many decades ago in the 80's and refined over time was used. Many IT-related projects have been delivered using the LADDER approach – both at a project management level as well as at a software level. It employs a

scaffolding approach whereby one builds knowledge over time and implements and refines the same at each iteration.

One may see this akin to the agile methodology often espoused today in many technology-focused solutions (Ilieva et al. 2004). Agile can be both a software development method as well as a project management approach (Rasnacis & Berzisa 2017). The approach utilizes the following steps: Learn, Analyse, Design, Develop, Evaluate, and Review. One can go back to any preceding step at any time throughout the process and hence the iterative nature of this approach which lends itself well to DSR. A diagram for how LADDER was applied within the THRIVE Framework and Platform is shown in ***Figure 3.4***.



Figure 3.4. *The LADDER agile scaffolding approach to software development, developed by the author, circa 1985.*

3.3.3. DSR for pragmatic-design

DSR is an *extra-theoretical* approach which builds on extant theory and design knowledge fundamentally suited to a creative and novel approach to a problem space. In this study, knowledge was developed as a result of the examination of the literature and production of novel problem-solving artefacts such as constructs, models, methods, instantiations, and ultimately design theory (March & Smith 1995; Hevner et al. 2004). Design theory includes kernel theory that helps to explain why the artefact is expected to work as intended along with testable propositions. By presenting the research with greater accuracy, utilising more abstract language, and conducting further tests to validate beliefs, the field advances towards a more sophisticated and established body of knowledge—the ultimate objective (Nagel 1961; Rosemberg 2000). We hereby present the artefact in this study through various representations followed by a rigorous evaluation of its utility thus providing a solution to unsolved problems in unique ways (Gregor & Hevner 2013).

3.3.3.1. Paradigms

The DSR paradigm focuses on the construction and evaluation of novel artefacts with the design open to revision and updating, based on outcomes from tests and user feedback (March & Vogus 2010). Design science and natural science complement each other in the field of management, with DSR focusing on creating innovative and effective artefacts that enhance a managers' ability to transform current situations into desired ones (Simon 1969). For a business innovation design theory to be a valuable contribution to the field of business innovation, it must consider the context of its application and the evaluation criteria. Business organisations and their operating environments are shaped by human social constructs (Searle 1996; Barkin 2003). They are artefacts created to fulfil human goals, purposes, and intentions, and are impacted by and function within the context of both intentional and spontaneous human behaviour.

3.3.3.2. Recognition

DSR has been gaining recognition as a significant companion to behavioural science research in the field of management, particularly in areas such as organisational science (Romme 2003) and information technology (Hevner 2007; Iivari 2010). The contributions of DSR are considered valuable due to the combination of the novel and practical aspects of the artefacts created (March & Vogus 2010). This study provides valuable insights by utilising well-established and recognised mechanisms and methods such as "bricolage" (Berry 2004) combining a variety of methods, including prototyping (representing generic solutions to demonstrate the artefact's suitability), expert interviews (Sonnenberg & Vom Brocke 2012), and a case study (Day & Bobeva 2005). This process involves the integration of an individual's technical and social expertise, logic, and a generic explanatory theory that provides a deeper understanding of the phenomena at play. Additionally, the study employs a thorough cross-case analysis of iterative design instantiations (Denzin & Lincoln 2017) (from v1.x to v2.x), which adds to the overall depth and richness of the insights gained. Overall, this study exemplifies the power of DSR in providing a unique perspective on management challenges and helping to develop innovative and practical solutions.

3.3.3.3. Phenomenon

This study contributes constructs, models, methods, and instantiations for developing the designs, foundations, and methodologies aimed at impacting people and organisations through technology (Hevner et al. 2004). The outcome is theory that informs, for example, the phenomenon of business model innovation towards sustainability. These organisational phenomena are both emergent and designed, aiding a manager's professional responsibility to transform existing situations into preferred ones, and shape social organisations and economic processes to create value (Boland et al. 2008).

3.3.3.4. Justification

As a DSR study, the justification for decisions made at each step of the process were paramount, as these contributed to the understanding surrounding the technological rules thus revealed (Joan E. van Aken 2004). Efforts were made to journalize these throughout the process. Critically this study combined both a qualitative and quantitative investigation – a mix methods approach - to the subject domain, showcasing DSR as a complementary approach to the common explanatory research. Von Wehrden et al. (2017) argue that the use of advanced mixed methods approaches is better suited for approximation of solutions as they cover a wider array of knowledge, and a plurality of methodologies can be more effective in addressing wicked problems as found in the science of sustainability. Thus, interim attempts at theorising were seen as beneficial stepping points along the way as the constructs, methods, and instantiations were refined over time. The codification of the technological rules based on justificatory decisions made along the way, forms the basis of generating theory (March & Vogus 2010). This all contributes into building a strong theory around the observations being made (Weick 1995).

3.3.3.5. Rigour

In this study, efforts were made to minimize bias by maximising rigour, hence maximising the legitimacy of the research output. Reducing bias inherently meant an increase in the variance of results and thus constituted a trade-off between the specific and generalisation of results (Mehrabi et al. 2019). In this design science study, it was considered that the sustainability of the design artefact, that is the direct and indirect effects on society and the natural environment in terms of general design principles, when applied rigorously will provide the basis for rules of practice, which can be used throughout each stage of the process (Brocke & Seidel 2012).

To ensure repeatability and replicability (Baskerville et al. 2017), and usefulness (Gill & Hevner 2013) from the study for scholars and

practitioners, articles were selected from upper-quartile peer-reviewed journals, together with expert reviews (Sutton & Staw 1995; Lang et al. 2012; Persson, Hornborg, et al. 2018), recent conference proceedings, and this researchers' thirty-five years of practical experience (Persson, Johansson, et al. 2018) in qualitative analysis (Miles et al. 2014) in the innovation and sustainability domain, thus capturing insights beyond academia and existing literature (Gholami 2016; Snyder 2019).

3.3.4. Why choose Design Science Research

3.3.4.1. Introduction

A DSR approach was chosen because of the nature of working with design within constraints as problem-solution combinations. The investigation adopted a broad search, given the fragmented nature of sustainability research (Tranfield et al. 2003), the accelerated pace of trans-disciplinary knowledge production (Snyder 2019), the adoption of multi-disciplinary methods/approaches (Elliot 2011), and comprehensive, concept-centric (Salipante et al. 1982) literature review approach (Snyder 2019), informed by the natural sciences (Upward 2013).

This allowed for the identification of key themes across disciplines, engagement in theory development, and integration of perspectives and insights from different fields of research traditions (Baumeister & Leary 1997; Torraco 2005), and thus recognises the variation, inconsistency, and incongruency in terminology and meaning (Tobi & Kampen 2018). Guided by systems thinking (Ackoff 1971; Gharajedaghi 2006), a strongly sustainable stance (Neumayer 2010a; Upward & Jones 2016), and built on the Framework for Strategic Sustainable Development (FSSD) (Robèrt et al. 2013), a set of competing models were developed, arriving finally at a point of view about the phenomenon under consideration (Bem 1995).

Arguing that theories should be built from multiple paradigms (meta-triangulation) (Webster & Watson 2002), the analysis was guided through continuous exposure and ongoing discussions by the author - acting as the instrument - with experts (Day & Bobeva 2005), thus

encouraging this author to formulate an IS-informed solution (instantiation) for the field of sustainability (Gholami 2016).

3.3.4.2. Identification

Following Peffers et al. (2008), we begin the process by conducting an extensive detailed examination of over 1020 documents (including 181 Q1 journals published recently) in the BMI and BMIfS domains (Schaltegger, Hansen, et al. 2016), and 18 informal discussions with seminal authors, resulting in the identification of twenty-one clusters, subsequently synthesised, and categorised into twelve key themes (FFF) within four groupings (Snyder et al. 2016; Witell et al. 2016) producing a parsimonious, falsifiable, and useful evaluation model (Sutton & Staw 1995).

Thus, in taking this approach the author exposed himself to:

- **Interdisciplinary** and **Transformative** study approach building on design science (Mertens 2007; Brocke & Seidel 2012; Tobi & Kampen 2018).
- **Systemic Design Science Research (SDSR)** (Upward 2013; Jones & Kijima 2018) and **Design Science Research** (Gregor & Hevner 2013) methodology.
- **Systems Thinking** (Ackoff 1971) mindset and **Strong Sustainability** stance (precautionary principle) (Neumayer 2010a).
- Using the **business model** (Teece 2010; Evans, Vladimirova, et al. 2017) as the **unit of analysis** and innovations upon the same.
- **Strongly Sustainable** Business Model Ontology (Upward & Jones 2016).
- **Adopting business management** as a design science (Joan E. van Aken 2004; March & Vogus 2010).

- A process whereby the **usefulness of the artefact** is determined by **fitness-utility** (Gill & Hevner 2013).
- **Comprehensive theory-building (theorisation, level-1)** of the artefact (Orlikowski & Iacono 2001).
- **Delphi study** for participant selection and interviews (Day & Bobeva 2005).
- Contributing to level-2 **nascent design theory** (***Figure 3.5***) (Gregor & Hevner 2013).

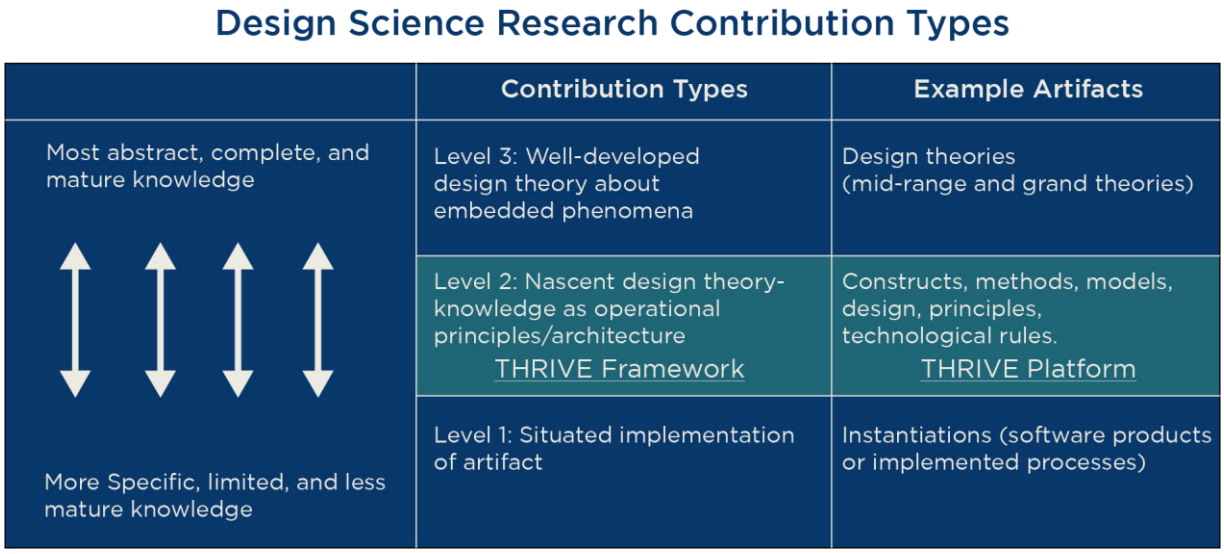


Figure 3.5. *Design Science Research Contribution Types applicable to this study, adapted from Gregor & Hevner, 2013.*

3.3.4.3. Aesthetics

The study of the THRIVE Framework and instantiation of the THRIVE Platform (software) as they relate to the field of Information Systems (IS) design highlights the importance of style in the design evaluation process. Accordingly, style is a key component of the design and should be given consideration during the evaluation process (Kernighan & Plauger 1974; Winograd 1996).

As the author and designer, a unique element of style was incorporated to greatly enhance the overall user experience and contribute to the effectiveness of the design (Norman 1988). The THRIVE Framework features a deliberate arrangement of elements, such as typography, colour, and images, to communicate the purpose and

usefulness of the framework, platform, and various other elements including the custom Ciambella Charts (***Figure 4.6****)*.

The style of the THRIVE Framework and THRIVE Platform played a significant role in the user experience. The THRIVE Platform interface exhibits a consistent structure as one moves from level to level and colour scheme. The appealing style should help improve the user's perception of the system and increase their engagement with it. Similarly, the THRIVE Framework includes a series of artefacts from the conceptual model to the 7Cs, Ciambella Charts (***Figure 4.6****)*, and the THRIVE Framework and THRIVE Platform, and several more, all designed to be consistent in style, colours, and design, providing a uniform user feel and experience.

Usability is also important, with the THRIVE Framework and THRIVE Platform evaluated as part of this study for usability and utility as described in **CHAPTER 5: EVALUATION**. Ultimately, the artefact needs to address and give attention to both style and functionality to be deemed useful. This further extends to the context within which the artefact is being used, to include understanding the target audience, their needs, and the environment in which the design will be used. The style of the design must be appropriate for the intended audience and must effectively communicate the intended information in the context of use (Winograd 1996).

The context of use is also a crucial aspect that was considered in this study of the THRIVE Framework and Platform. Wanting to ensure the style of the design was appropriate for the intended audience and was able to effectively communicate the intended information in the context of use. Understanding the target audience, their needs, and the environment in which the design was being used was essential to ensuring a successful design of all the major elements.

The study of the THRIVE Framework and Platform highlighted the importance of style in this design evaluation with a range of unique elements of style brought about by the author, which greatly enhances the overall user experience. The style of the design of the THRIVE

Framework aimed at abstract, aesthetically pleasing, whereas the THRIVE Platform aimed for a more functional, simple design. The latter served to demonstrate the proof-of-concept, and thus more appropriate for the intended audience and context of use. A balanced approach, considering both style and functionality, was felt necessary for the creation of a successful design, for the THRIVE Framework and THRIVE Platform.

3.3.4.4. Wicked Problems

Lastly, the deliberate choice to select a design science approach provided the right methodology to address complex wicked problems, also referred to as "wicked organisational problems", that pose significant challenges for design and decision-making (Rittel & Webber 1973). These types of problems require a paradigm shift that can only be achieved through DSR. Designing an organisation is a complex and dynamic process that is constantly evolving in response to changing circumstances. One key characteristic of complex wicked problems is the presence of conflicting, changing, and ambiguous desired ends. In addition, there is often many design alternatives, some of which are unknown, and the consequences of design decisions are difficult to assess. This creates significant uncertainty, particularly with respect to objectives and alternatives (Rittel & Webber 1973).

DSR is a systematic approach to solving design problems to create practical, useful, and usable artefacts, such as products, services, or systems. The key goal of DSR is to create new knowledge and theories that can be applied in practice to solve complex problems and improve the design of artefacts (Hevner et al. 2004). In the context of organisational design, DSR provides a holistic approach that considers all the various components and complexities of the design process. It requires an interdisciplinary approach that brings together experts from various fields, such as design, engineering, and management, to collaborate on finding solutions (Rittel & Webber 1973).

The design science approach to complex wicked problems involves several key steps, including defining the problem, developing a conceptual model, designing, and testing prototypes, and implementing the solution. It is an iterative process that requires continuous feedback and adjustment to ensure that the solution meets the evolving needs and circumstances of the organisation. One of the key benefits of the design science approach is its ability to create new knowledge and theories that can be applied in practice to solve complex problems. DSR often involves the creation of prototypes or working models that can be tested and evaluated in real-world settings. This enables researchers to gain a deeper understanding of the problem and to identify new and innovative solutions that may not have been possible using traditional research methods (Hevner et al. 2004).

Another important reason to use a DSR approach, is its focus on creating practical, useful, and usable artefacts. The goal of DSR is not simply to generate new knowledge, but to create practical solutions that can be applied in real-world settings (Hevner et al., 2004). This focus on practicality and usefulness makes DSR particularly well-suited to addressing complex wicked problems in organisational design (Rittel & Webber 1973), as these pose significant challenges for organisations and require a paradigm shift in thinking and approach. DSR provides a holistic and interdisciplinary approach to addressing these types of problems and offers a solution that is dynamic, iterative, and responsive to ever-changing circumstances. Through the creation of prototypes and working models (simulations), DSR enables us to gain a deeper understanding of the problem and to identify new and innovative solutions. With its focus on creating practical, useful, and usable artefacts – thus demonstrating a degree of utility (Gill & Hevner 2013) - DSR is well-suited to addressing complex wicked problems in organisational design.

3.3.5. Artefact Type: Exaptation

Design is both a process (a set of activities) and a product (artefact) (Walls et al. 1992). DSR was used in this study to address unsolved

problems in distinctive or innovative way, with common design artefacts produced including constructs, models, methods, and instantiations (March & Smith 1995). In this study, our design artefact is of the '*object-value*' type, as espoused by Chmielewicz (1994) in his ontology, theory, technology building and judgement approaches, and thus a 'technology' that constitutes the foundation for choosing normative actions towards a desirable end. This "*object-value*" is known as an exaptation, whereby we apply known solutions and extend these to new problems. The novel expropriation of facts from one fields to solve problems in another adds to the grounding and rigour of the study (Gregor & Hevner 2013).

Seminal author E.O. Wilson defines consilience as occurring when "*units and processes of a discipline conform with solidly verified knowledge in other disciplines to have been proven consistently superior in theory and practice to units and processes that do not conform*". We find that weak sustainability does not pass the test of consilience with the established laws of the physical and biological sciences and therefore cannot be reconciled with accepted knowledge (Ayres et al. 2001). This understanding concurs with the accepted understanding of Exaptation as defined in DSR.

Furthermore, as a conceptual framework, the artefact is presented with a higher-level degree of abstraction allowing it to be generalised to other situations (Gregor & Hevner 2013). As a descriptive model (Winter 2014), the THRIVE Platform is best categorised as a level 1 contribution (situated implementation of artefact) with the THRIVE Framework rising to a level 2 contribution (nascent design theory) as referenced in the DSR Knowledge Contribution Types (Gregor & Hevner 2013). Nascent design theory is knowledge that exhibits as architecture or operational principles including constructs, methods, models, design principles, or technological rules. This study primarily developed the basis for the latter, with brief examples shared in **CHAPTER 6: DISCUSSION**.

During the investigation a great number of prescriptive artefacts were designed and developed for utility (Winter & Aier 2016) as illustrated

in ***Figure 3.6*** (Gregor & Hevner 2013). The specific prescriptive knowledge contribution to the DSR knowledge base (**Λ**) includes (Gregor & Baskerville 2012):

- **Constructs:** covering the new concepts introduced by this study and their relationships such as the THRIVE Framework, the 12 Foundational Focus Factors, the 7Cs (Fedeli 2020), and the THRIVE Platform (Fedeli, M. D. 2023).
- **Models:** includes key conceptual models used in this study like the Conceptual Framework, Ciambella Charts (***Figure 4.6***), and SPRINT (Fedeli & Lüdeke-Freund 2020) designed to address a class of problems.
- **Methods:** includes the author devised LADDER method, and the mathematical algorithms developed for the THRIVE Platform, the formula engine (FE), and weight engine (WE).
- **Instantiations:** includes physical systems such as the THRIVE Platform, various training and operational guides.
- **Design theory:** this is the emergent theory for design and action arising from this study. It's the justification (justificatory knowledge) and abstract prescriptive knowledge describing the principles and methods above.

The design theory is thus the result of the design-oriented theorising in business innovation (Winter & Aier 2016), and can be seen as a utility theory linking the solution space to the problem space (Venable et al. 2012). The justificatory knowledge or theory links the natural, social, and design sciences together through principles of form, testable propositions, and expository instantiation in the form of the THRIVE Platform and SSI case study (Winter & Aier 2016).

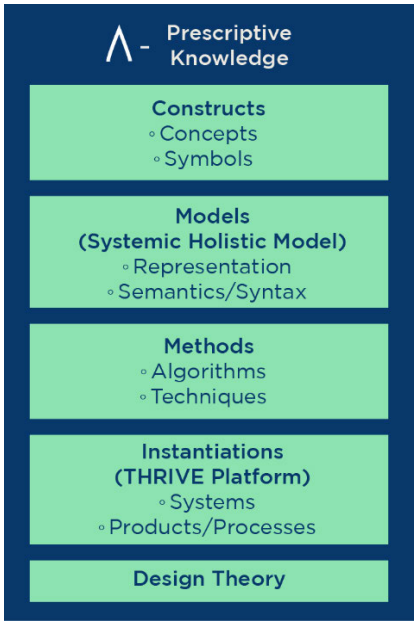


Figure 3.6. *Design science research knowledge base concept adapted from Gregor and Hevner (2013).*

3.4. Evaluation Strategy

There is no set method for conducting evaluations in DSR as it aims to not establish how the world *is*, but rather how it could *be* (Carlsson 2005). The evaluation strategy used builds on the DSR evaluation strategic framework by Pries-Heje et al. (2008), later expanded by Venable et al. (2012), and articulated by Shrestha et al. (2014), and describes inputs, outputs, and outcomes that can empower impacts (***Figure 3.7***). This involved two main activities, developing a demonstration and detailed evaluation of the design (Peffers et al. 2008) with participant selection derived from a Delphi study (Day & Bobeva 2005). The built design was then evaluated by the degree to which its implementation fulfilled the purpose (March & Vogus 2010). Worth noting is the author's freedom to mark the line between the ex-ante and ex-post evaluation (Pries-Heje et al. 2008), an important issue that became more apparent as time went on during the development of the artifact.

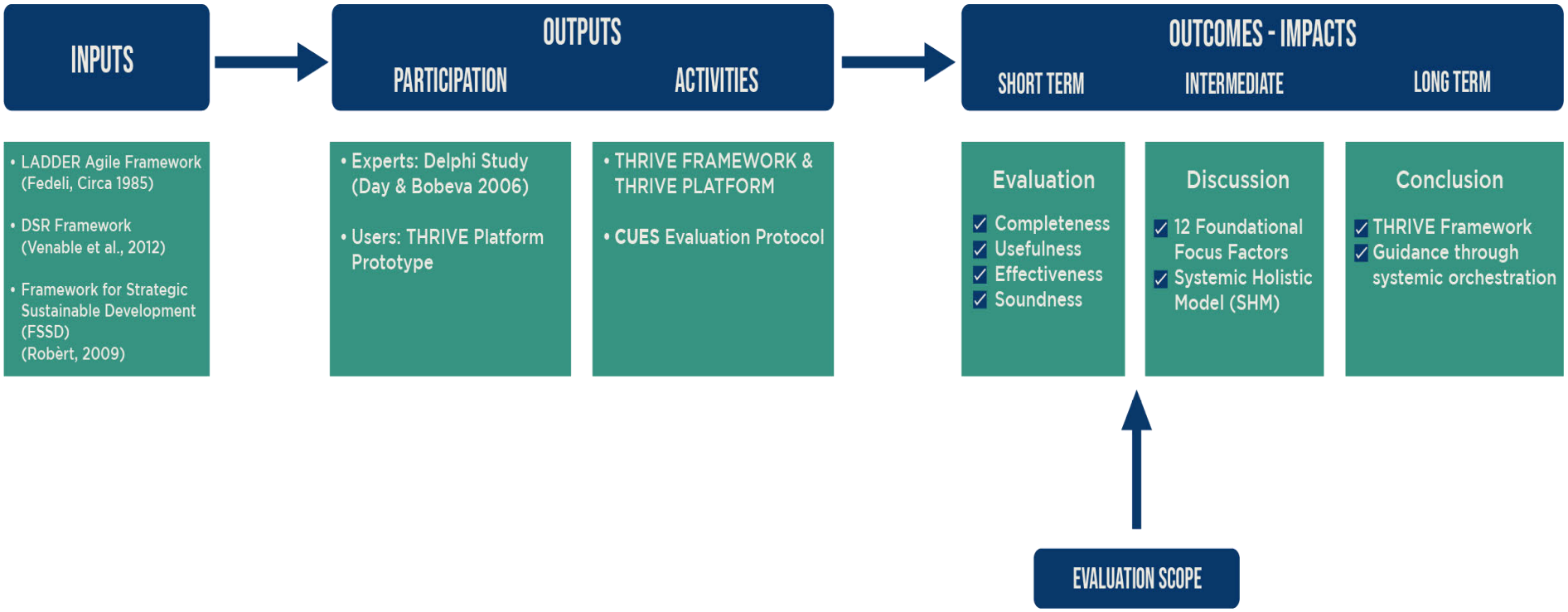


Figure 3.7. *Reporting structure for the evaluation developed in this study. Adapted from Shrestha et al. (2014, p. 3).*

The aim of a rigorous and robust evaluation strategy is to determine the utility of how well the artefact performs (March & Smith 1995), and thus being fit for purpose (Gill & Hevner 2013). This in turn informs management theory whereby through the examination of cases and potential innovations of the business model (Eisenhardt & Graebner 2007; Varadarajan 2017) one may transform organisations, moving them towards sustainability. It is expected that the designed artefact, once analysed for usability and performance, will guide enterprises towards innovations in their behaviour with respect to systems, people, and their organisation overall (Vaishnavi & Kuechler 2004). Although applying a reductionist logic, hermeneutics in ex-ante evaluations recognize the author's instinct and intuition, among other influences, to affect the perception of value and thus may challenge the replicability of this formative study (Pries-Heje et al. 2008).

The design evaluation method involved a descriptive analysis based on an extensive review of the prevailing literature to include all the necessary and sufficient requirements with an ex-ante evaluation and an experimental simulation of the instantiated case study (ex-post). The design is inherently an iterative and incremental activity, and thus the evaluation phase serves to provide essential feedback to the construction phase as to the quality of the design process and the design product under development (Hevner et al. 2004).

In this study, the author invokes an artificial ex-ante design process to develop the conceptual framework (THRIVE Framework), and then designs and builds the prototype consisting of the 12 foundational focus factors and the THRIVE Platform as the demonstration. An ex-ante evaluation through the Delphi study provides some critical feedback. Feedback on the conceptual framework was noted and incorporated as the study progressed and was refined. Feedback on the instantiation instead was batched for updates as part of THRIVE Platform v2.x (Sein et al. 2011).

Thus, as illustrated in ***Figure 3.8***, although the THRIVE Framework is the result of an ex-ante artificial DSR evaluation strategy, the ex-post review of the instantiation does provide naturalistic support for the conceptual framework (theory) being examined (Sonnenberg & Vom Brocke 2012; Venable et al. 2012). A naturalistic evaluation involves the use of real systems by real users for real purposes, whereas artificial evaluation involves a simulated experience (Myers & Venable 2014). Moving from design research to strategic design science is accomplished through the evaluation process as depicted in ***Figure 3.9***. Furthermore, as illustrated in ***Figure 3.10***, evaluations that take place during the refinement of THRIVE Platform from v1.x to v2.x, showcase how this construct helps the building process through the iterative constant refinement approach adopted.

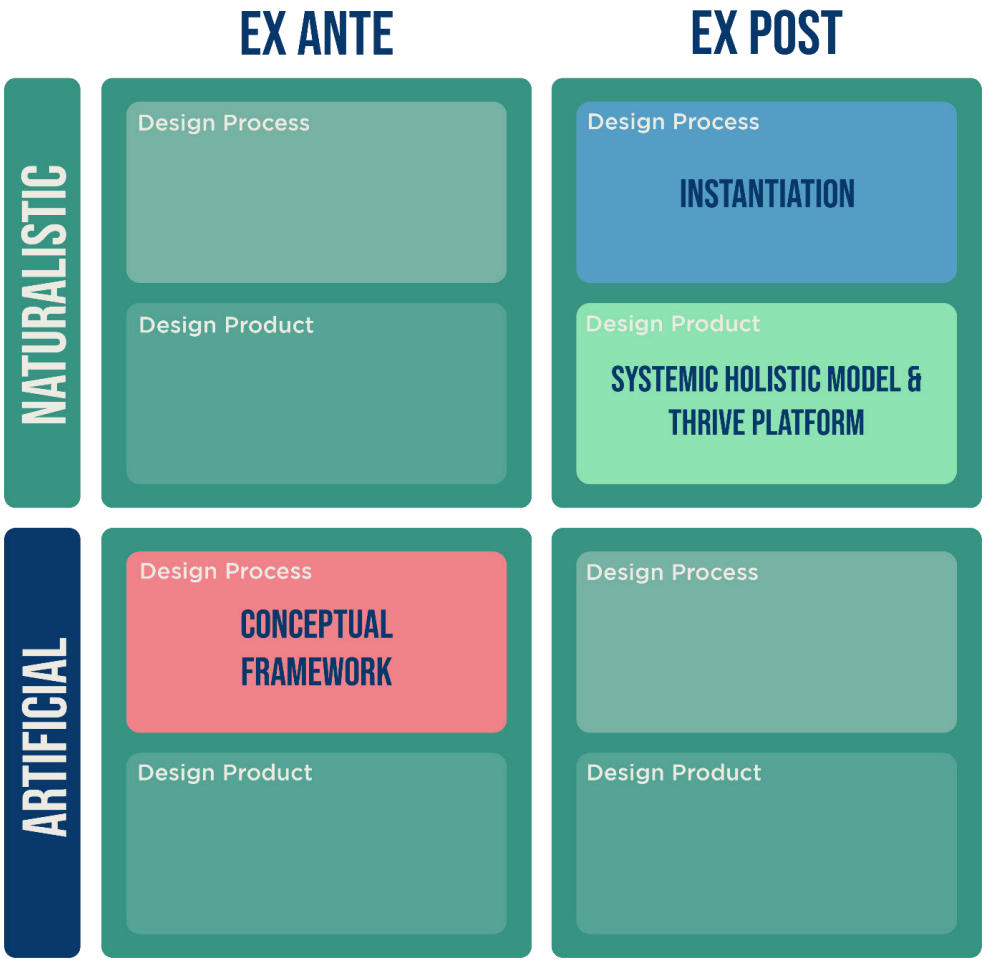


Figure 3.8. DSR Ex Ante (conceptual study) and Ex Post (THRIVE Framework & Platform) evaluation.

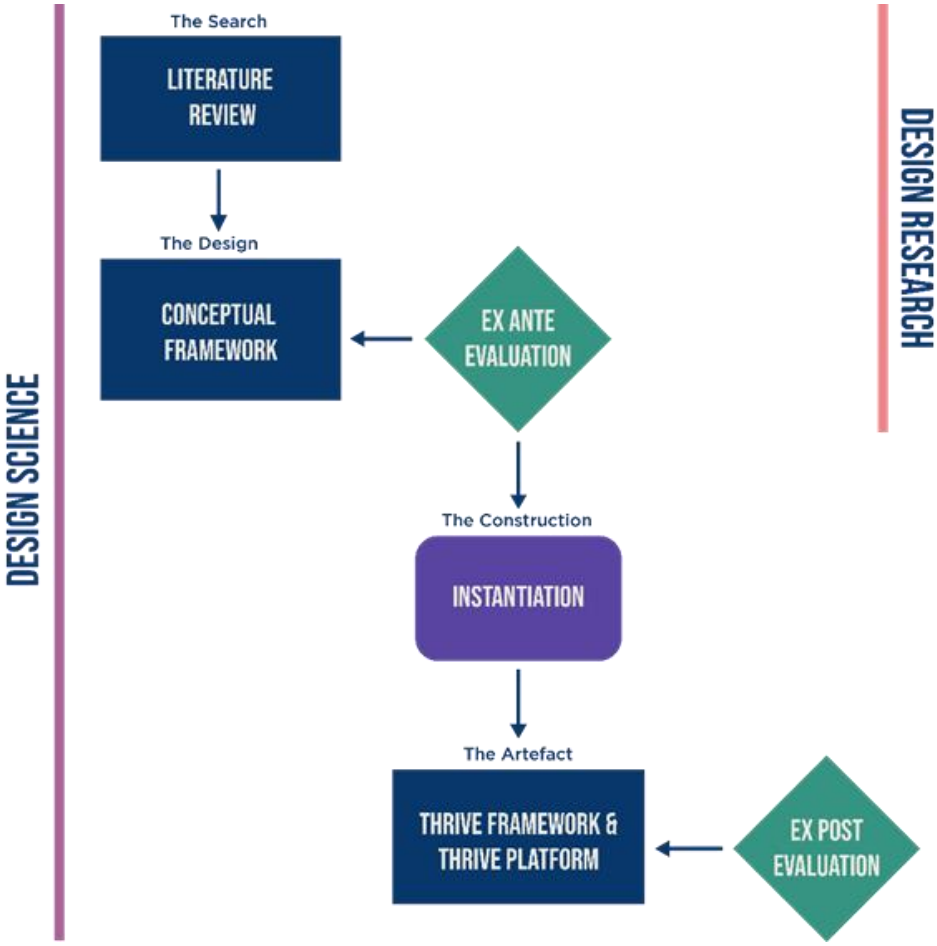


Figure 3.9. *The strategic DSR evaluation ex-ante vs ex-post distinction as applied in this study with respect to the artefact.*

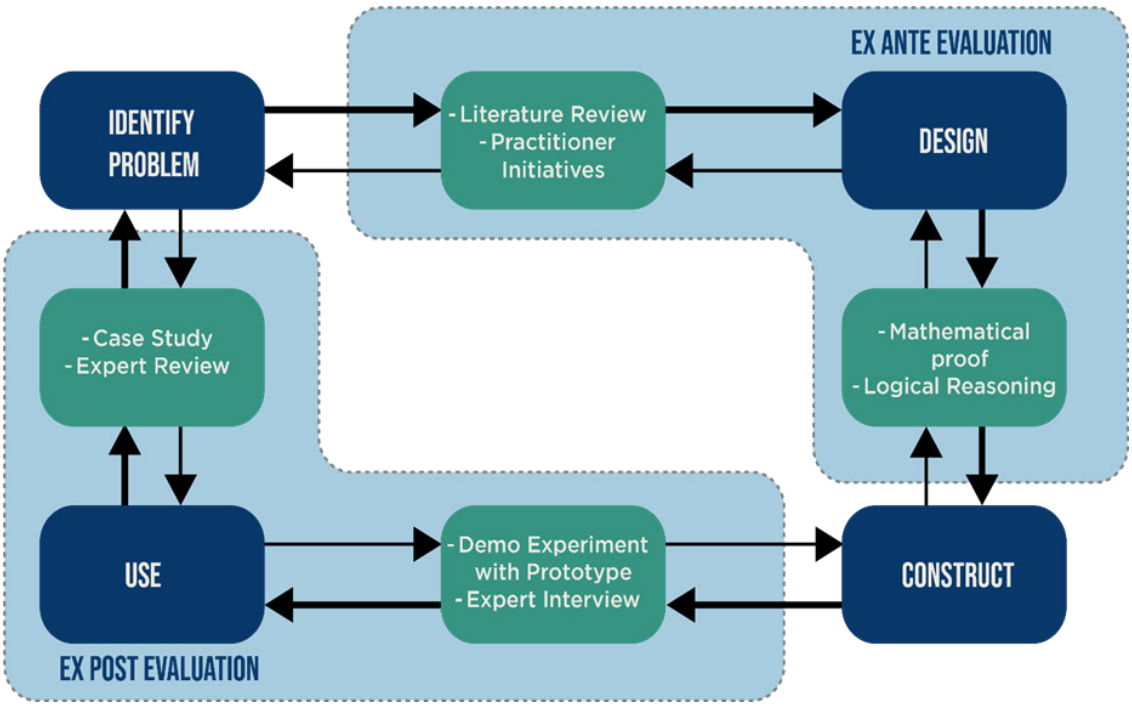


Figure 3.10. *Adapted from Sonnenberg (2012) by the author showing the evaluation activities within this DSR process.*

3.4.1. Evaluation Protocol

Hevner et al. (2004) and Vaishnavi and Kuechler (2004) underscored the importance of evaluation in the design process. According to Hevner et al. (2004), rigorous evaluation methods are essential to demonstrate the utility, quality, and efficacy of a design artefact. Similarly, Vaishnavi and Kuechler (2004) argued that analysing the use and performance of designed artefacts is critical to understanding changes and improvements in the behaviour of systems, people, and organisations. Pries-Heje et al. (2008) further emphasised the significance of evaluation in ensuring that design artefacts fulfil their intended goals and improve the quality of systems and organisations. Thus, effective evaluation during this study revealed limitations of the design and facilitated further refinement and enhancement of the artefact.

The evaluation protocol was devised with reference to using DSR for the THRIVE Framework construction and verification by way of the THRIVE Platform, coupled together with a further case study involving the investigation of the Seafood Stewardship Index (SSI) using the THRIVE Platform. In practice this meant the analysis of the literature and informal discussions with experts to arrive at the most important factors affecting the sustainability of enterprises, which was then later extended to include its super-ordinate, the community, bioregion, and the world environment within which entities operate.

Revealed during the literature review were several points for consideration during the evaluation phase:

- Organisations seldom operate in isolation. Therefore, it was determined that the resulting framework would need to be able to capture impacts at various levels in reference to the environment within which these impacts occur. This was eventually fully captured in the factor termed Context-Based Sustainability.
- Although individual factors were captured, ultimately formulated into a lattice of 12, the interconnectedness of the factors is an

important aspect of how these are perceived in importance. This was further developed during the evaluation phase.

- Combining the points above, evaluating impacts within context and at the same time discovering the interconnectedness of the domain illuminated the issue of the hierarchical nature of impact assessment. The evaluation protocol this revealed the need for a universal all-inclusive approach.
- A universal broad approach, leveraging context-based impact assessment gave rise to the systemic holistic terminology used for the SHM.

In evaluating the usefulness of the THRIVE Framework blueprint (theoretical understanding) a prototype of the THRIVE Platform software was constructed (practical tool). This was then given to the expert panel to review in a Delphi study. Lastly, a case study was developed focusing on one industry – the Seafood Industry - whereby comparative data and analysis was available to verify the accuracy of the outcome from the THRIVE Platform. Given the novelty of the artefact as a proof-of-concept, and the significant expended effort by the author in developing the same, with significant formative testing, there is less of a need for an in-depth summative testing as compared to a behavioural research project where the artefact is developed by another (Gregor & Hevner 2013).

3.4.2. THRIVE Framework: The artefact

The THRIVE Framework is the artefact evaluated in this study. It is a formulation arising from an expansive and comprehensive investigation of the literature, expert discussions, and review of practices over several decades. Since this study is at the leading edge of a new frontier in the sustainability movement, much time and effort were placed on cross-pollination of ideas among leading organisations, knowledgeable experts, consultants, and seminal authors in the field. More details on the design may be found in ***Appendix A: The THRIVE Framework***.

3.4.3. THRIVE Platform: The Prototype

By developing a prototype software, acting as a proof-of-concept (POC), provided the means to share a uniform experience with all those who participated in the study. Moreover, a recorded video explaining how to use the system was recorded as well as access to multiple whitepapers and reference materials via the website. More details on the construction may be found in ***Appendix B: The THRIVE Platform***.

3.4.4. The Delphi study: The Expert Panel

The Delphi study research method was used to gather expert opinions and reach a consensus on a specific aspect of the THRIVE Framework as instantiated via the THRIVE Platform (Day & Bobeva 2005). This method was thought to be particularly useful as there is a general lack of consensus in the literature, and a decision needed to be made based on experts' opinion. The following is an outline of the process undertaken:

1. Defined the questions: A set of questions were devised to elucidate each of the areas of the THRIVE Framework, namely the 12 Foundational Focus Factors. These questions were used to address aspects of the model relevant to the design sciences.
2. Identify experts: A panel of experts were self-selected randomly based on a social media broadcast to groups with relevant knowledge and experience in the field. The panel was diverse and representative of different perspectives. This included researchers, practitioners, consultants, and academics.
3. Phase I: Invitation to use the THRIVE Platform: The first phase consisted of inviting the panel of experts to register and use the THRIVE Platform, and thus providing direct input into answering the research questions whilst providing a broadness of understanding as to what was of interest to those in the

Delphi study as user's interactions with the system were being captured and evaluated.

4. Phase II: Interviews with the panel: Structured interviews were undertaken with the panel of experts on the results of their personal evaluation in Phase I. This was augmented with a series of questions, highlighting any areas of agreement or disagreement. Experts were asked to explain their answers and opinions based on the feedback through an online face-to-face meeting. The interviews were structured to allow for open-ended responses as well as through multiple-choice questions. These responses were collected, collated, and analysed through largely a qualitative analysis together with some basic demographics.

5. Phase III: Shared results with experts: The panel was sent a copy of the anonymised results, asking them to partake in follow up activities, such as demonstrations, or workshops and provide testimonials (if they so desired). Collect and analyse the responses.

6. Consensus: An analysis of the final responses was undertaken to determine if a consensus had been reached among the experts. A consensus is reached when, a majority of the experts have similar opinions or responses. If a consensus was not reached, then additional future rounds of interviews and feedback may be necessary. Top level results were publicly shared anonymously six months after the study first took place.

7. Report findings: The full study findings have been kept with the THRIVE Project organisation until such time that this research piece is published. This includes information about the participants, the level of agreement among the experts and any recommendations for further research. The findings

will be presented in a clear and concise manner, highlighting key points and any conclusions.

8. Implications: It is expected that the implications of this study will re-enforce the applicability for the design sciences, in areas beyond information technology, to include management theory and other practical applications and recommendations for future research.

9. Limitations: Discussion about any limitations of this study and how it may have affected the results.

10. Conclusion: Summary of the main points of the study and its overall contribution to the field of design sciences and management theory.

Note that in the Delphi study an iterative process was adopted where the number of phases was unknown at the outset, as this depended on the research questions and the level of agreement among the experts. It was also important to consider ethical issues such as confidentiality and informed consent for this Delphi study. Overall, the Delphi study methodology was a valuable tool for gathering expert opinions and reaching a consensus in the field of design sciences and design theory.

3.4.5. The Case study: The Seafood Stewardship Index

The conservation and sustainable use of marine resources is one of the United Nations Sustainable Development Goals (SDGs) (SDG 14, Life Below Water). However, the increasing consumption of seafood products worldwide actively works against this goal. Our study adapted the THRIVE Framework and used the THRIVE Platform to analyse the sustainability performance of 30 "keystone" (Osterblom et al. 2015) companies operating in the seafood industry. Whilst the publicly released whitepaper may be found online here, further details are also available in ***Appendix B: The THRIVE Platform***.

The prospect was to undertake a detailed qualitative content analysis using official websites, annual reports, and sustainability reports to understand each of the company's offerings, business model and operations. It was envisaged to use various levels of automation for this and thus the business model patterns matching the organisations were derived using AI machine learning algorithms and the Sustainability Performance Index using strongly sustainable formulations of context-based sustainability.

The data for the case study was loaded using the THRIVE Platform v1.x of the system before being updated to the THRIVE Platform v2.04, because of the learnings from v1.x deployment. Furthermore, as the need to implement scale-linking was recognised, and 'industry level' was added to the 'enterprise level' in v1.x. In the THRIVE Platform v2.04 was re-engineered from the ground up and further extended to include all levels as depicted by the 7Cs (Fedeli 2020).

A summary of the evaluation process for each stage in diagram form can be found in ***Figure 3.11***.

3.5. Management Theory

A key aim of this study is to inform management theory (Joan E. van Aken 2004). Doing so aims to address several factors which should help managers to manage and lead their organisations effectively towards more sustainable outcomes. Collectively, management theory refers to the various ideas, concepts, and techniques that have been developed to help managers effectively plan, organize, lead, and control resources within an organisation.

No one study could be exhaustive of the science of management theory, and therefore it is expected that many more areas will follow later. These are just few of many ideas and techniques that managers may use to help them effectively lead and manage organisations. It is hoped that the ideas developed in this study are applied by organisations who aim to change the landscape of sustainable practices around the world (Broman et al. 2017; Kurucz et al. 2017).

Examples of technological rules emanating from this study for practical use relate to the case study for the Seafood Stewardship Index. These findings can be used to provide strategic direction to policymakers within governments, management teams within organisations, portfolio funds managers and individual consumers (Joan E. van Aken 2004). More on this found in the **Chapter 6 EVALUATION** section of this study where the findings are shared.

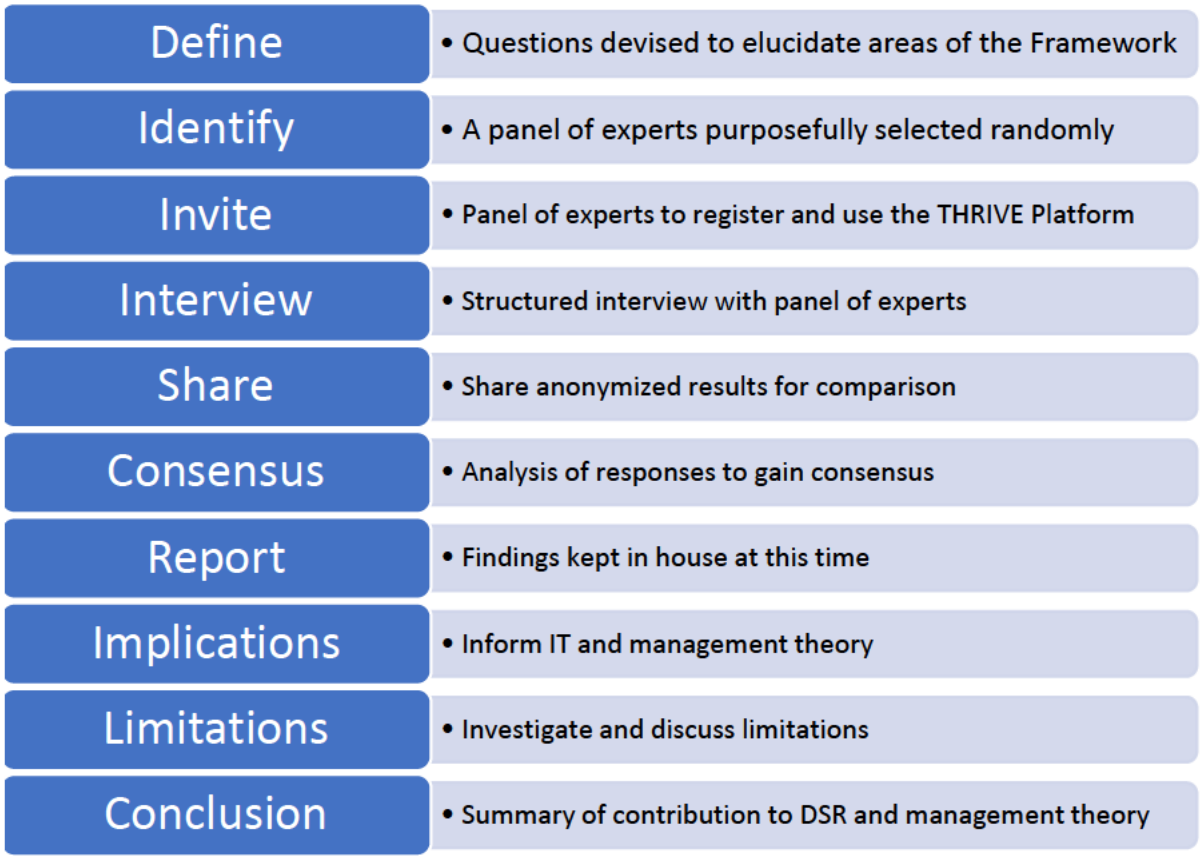


***Figure 3.11**. The Delphi study expert panel evaluation process used in this study.*

3.6. Conclusion

This study, couched in the design research sciences (DSR), sets out to investigate and thus identify learnings that managers may be able to adopt as they innovate and transition their enterprises towards sustainability. These learnings are the product of management theory, whereby leaders can apply ideas, concepts and approaches shown to carry utility based on the results of this study.

The study applies a critical realist world view and through the development of a software prototype, Delphi expert panel assessment,

and finally a case study, it is able to make inferences, and provide useful guidance for managers and leaders by way of the application of its blueprint. The developed artefact is an exaptation, with the case study example of the Seafood Stewardship Index (SSI), gauging the impact humanity is having on the fisheries and seafood industry where it has been estimated that over 85% of marine stocks are either fully exploited or overfished. This is significant, as more than 3 billion people in the world rely on wild-caught and farmed seafood as a significant source of animal protein (Schorr 2022).

Van Aken's seminal work in 2004 explicates the symbiotic relationship between management theory and design theory. This theoretical alignment underscores their complementary roles in shaping organisational innovation. Management theory provides the structured framework for resource allocation and operational optimisation (Drucker 1995), while design theory contributes creative problem-solving strategies. Van Aken contends that integrating these paradigms enhances holistic problem-solving, spanning identification, formulation, and resolution phases. This amalgamation cultivates an agile approach that navigates complex, uncertain environments adeptly (Schick et al. 2017; Millar et al. 2018). The resultant synergy fosters adaptive, innovative outcomes. Consequently, the confluence of management and design theories emerges as an instrumental avenue for addressing intricate challenges and fostering sustained organisational advancement.

The methodology was instrumental in ultimately identifying a series of 21 target areas, which were regrouped into 12 factors that later became known – individually - as the 12 Foundational Focus Factors (FFF) and holistically has been termed as the Systemic Holistic Model (SHM). The resultant theoretical framework includes the SHM (embodying the 12FFF), employing superior theoretical thinking, and supporting the assessment of qualitative narrative data, and producing a truly integrative critical review (Snyder 2019), contributing to the new conceptual model (MacInnis 2011): the THRIVE Framework.

CHAPTER 4: ARTEFACT DESCRIPTION

4.1. Background

In the preceding section, we expounded on the utilisation of the DSR methodology alongside a Delphi approach and a case study in this investigation. The objective is to formulate the THRIVE Framework, described by the 12 Foundational Focus Factors (FFF) and collectively referred to as Consider rephrasing to avoid repetition of "in the preceding section." Example: *"The previous section outlined the use of DSR methodology, Delphi approach, and case study* the Systemic Holistic Model (SHM). This upcoming section will delve into the artifact creation (Peffers et al. 2008) and description in greater detail. It will commence by exploring the complex, trans-disciplinary, and integrative nature of the SHM, explaining how systemic orchestration is employed to address different levels of stratification (Thurm & Baue 2018d). Machine learning techniques will be employed to categorize entity models and establish links between sustainability performance through backcasting methods. The end result is a set of well-informed technological rules or principles guiding the domain of sustainable entity models.

This section of the thesis describes and sets out some of the underlying principles employed in the formulation of the artefact, comprising the THRIVE framework and THRIVE platform tool. First it looks at the Systemic Holistic Model (SHM), combining the 12 Foundational Focus Factors (12FFF) from ***Section 2.5*** into the four quadrants: Significance, Scale, Shift, and Scope. This is followed by a detailed description of the artefact: the THRIVE framework (theory) and its first instantiation in the form of the THRIVE platform tool (software).

The developed web-based THRIVE platform inspired by the THRIVE framework is unique and first of its kind featuring quantitative sustainability impact measurements alongside categorical entity models. Although the approach has gained traction and support by the likes of UN-affiliated research groups, it is a minimal viable product (MVP) which acts

as a proof of concept or a case study rather than a complete solution. It is just one approach to how the proposed framework could be implemented. Since its first release, we have seen attempts by other organisations to implement a few of the factors addressed by the framework, but none as foundationally and comprehensively as shown here. Potential future iterations of the system will be discussed in the conclusion and future research section of this thesis.

This chapter's structure starts off by laying out the Systemic Holistic Model (SHM) covering the 12 Foundational Focus Factors (12FFF). It then outlines the THRIVE Framework class and THRIVE Platform instantiation, before turning the Seafood Stewardship Index case study. A comprehensive whitepaper on the latter is available online here.

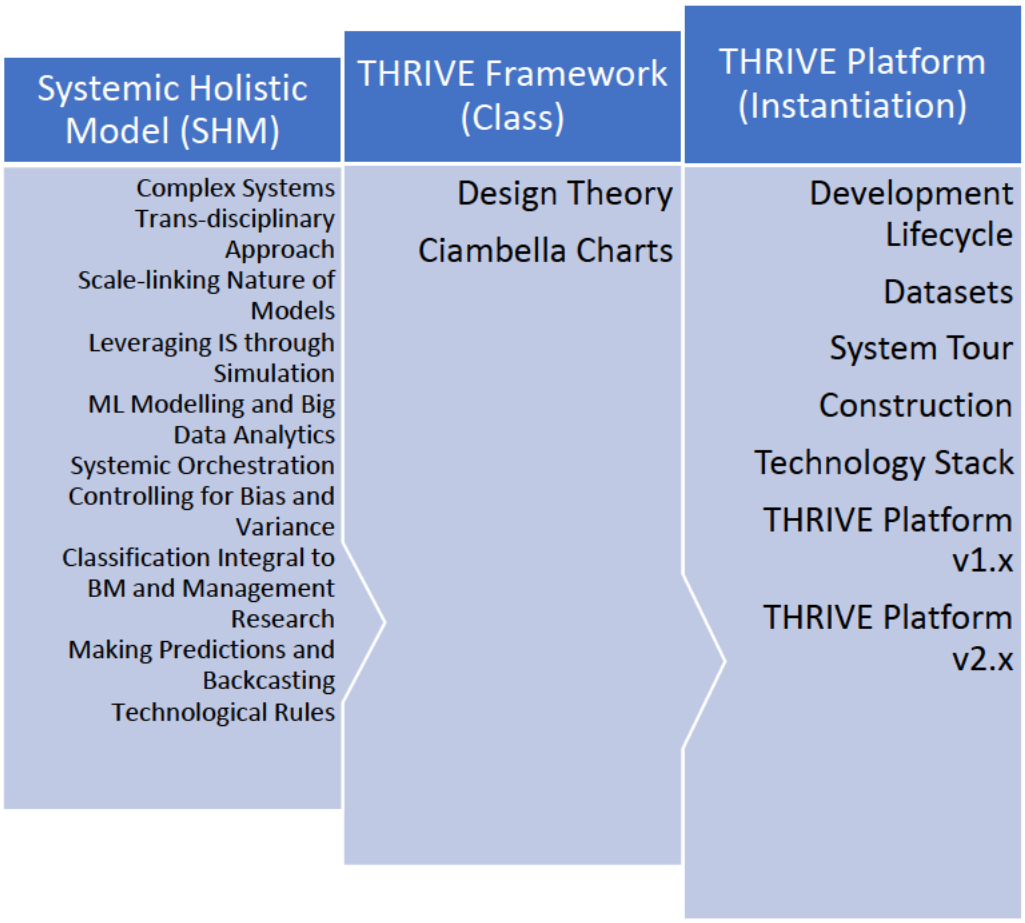


Figure 4.1. Chapter 4 ARTEFACT DESCRIPTION chapter layout.

4.2. Systemic Holistic Model

Flowing on from the conceptual development and refinements as described in ***Section 2.5***, the overarching Systemic Holistic Model (SHM) was developed as shown here (***Figure 4.2***). The four quadrants are interwoven, demonstrating the interplay among the various factors in the quest toward thrivability. Next, the key elements are discussed as they are combined in support of one another, or conversely create tensions between competing factors, culminating in a theory of change guided by supporting technological rules (Joan E. van Aken et al. 2016).

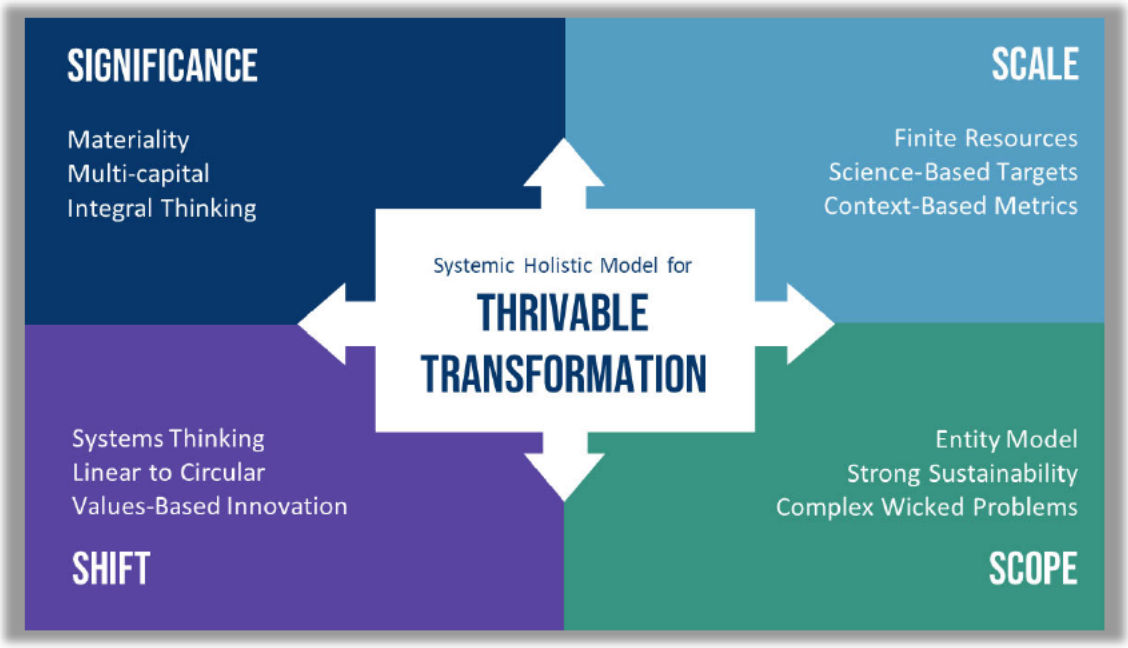


Figure 4.2. The Systemic Holistic Model (SHM) shows the four quadrants of significance, scale, shift, and scope.

4.2.1. Complex Systems

We live in a world confronted by volatility, uncertainty, complexity, and ambiguity (Patnaik 2020). Despite these challenges, we are required to make exacting decisions which affect the future of our families, our business, society, country, and the whole world. This requires a thorough understanding of nature and the interconnected science in support for the long-term sustainability of our species. As such we are dependent and co-dependent on several biophysical, social, environmental, economic, and other complex systems (Steffen et al. 2018).

Being able to model these interdependencies, experiment at a safe distance, undertake "what-if" analysis, and construct alternate scenarios using advanced computing techniques, allows us to investigate the foreseeable outcome of actions well before they occur, and to draw inferences between what undertakings are likely to yield better outcomes. This represents a true submission of what we know to be facts and application of the best theoretical understandings of the science which informs the field of sustainability.

4.2.2. Trans-disciplinary Approach

As called for by Dao et al. (2011), this thesis isone of the first trans-disciplinary studies to combine human resource management, enterprise resource planning, supply chain management, and management information system resources, in support of the performance measurement and quantification of sustainability impacts.. This trans-disciplinary approach enables enterprises, industries, and beyond to assimilate different management perspectives on sustainability and to develop holistic (Berns et al. 2009), integrated, sustainable capabilities for different sustainability objectives (Dao et al. 2011).

4.2.3. Scale-linking nature of Models

Through the advanced computerised analysis of millions of data points, at successive scales of integration from the nano-level to the macro-level together with scale-linked mathematical models, the science of global thresholds and allocations may be translated into actionable targets, within context, using consistent and comparable units of measure (Rolnick et al. 2019). Furthermore, as building sustainable business models requires the ongoing benchmarking of sustainability performance (Maltz et al. 2018) devoid of greenwashing (Laufer 2003; Schaltegger et al. 2012), this study links enterprises (Dao et al. 2011) to their value chains and sustainable value networks (Evans, Vladimirova, et al. 2017) by aligning their '*growth'* trajectory with what the best available science shows us is necessary and sufficient for a thrivable society.

As advocated by Ostrom (2007), this process necessarily requires dynamic complex modelling across multiple scale-linked levels. **Figure 2.23** shows each of the levels in diagram form whereby each level is totally contained or usurped within the one above it. The chart is characterised as "Assailing the 7Cs" as each level – representing a unit of measure - is depicted with a word starting with the letter "C". These are Creature, Company, Community, City, Country, Continent and Cosmos. Furthermore, the concept of "assailing" is attributed to this scale as to conquer one level is to place one within the eco-system of the level above it. For example, the sum-total of all enterprises (companies) within a sector is the total for that industry (community). Similarly, the sum-total for a set of nations (countries) within a continent, represents the impact of all those countries within that region or continent.

4.2.4. Leveraging IS through Simulation

"Green information systems" is a key resource required to tackle our urgent problems (Watson et al. 2010; Malhotra et al. 2013) by supporting enterprises transforming towards an ecological sustainable society (Melville 2010; Elliot 2011). Enterprises will need access to decision support systems for identifying design principles for information systems that support sensemaking in environmental and social sustainability transformations (Seidel et al. 2017). Modelling using a software-based solution allows enterprises to see the effects of decoupling performance from growth (Jackson 2009), opening the opportunity to transition to the steady-state-economy (SSE) (O'Neill et al. 2018) and beyond. It allows them to experience the implications of finite resources, and the impact of the inter-related dependencies whilst engaging with a holistic approach (Dao et al. 2011) and leveraging the resources of a distributed database system.

This study takes an integral perspective (Riedy 2007) and adopts a critical, first-principled, examination of the science-based facts (Kopnina 2017) that allow an enterprise to innovate their business model by shifting their focus towards radical offerings. An information system

enabled solution, involving large-scale distributed databases, mathematical modelled simulations and sophisticated statistical techniques (Gholami 2016), can play an integral role in an enterprises' broader impact and sustainability strategy (Dao et al. 2011), and in its ability to embrace the business models that allow the enterprise *to do good to do well* (Elliot 2011). The use of technology platforms powered by extensive information systems allows enterprises to experiment with a range of business models and potential solutions (Remane et al. 2017).

4.2.5. Machine Learning Modelling and Big Data Analytics

Modelling tools augment and foster collaboration between humans and machines, through discoverable data, open innovation and open science (Messerli et al. 2019). Experiments in the laboratory can be supplemented by quicker, automated, and much safer computer-based models and simulations with integrated datasets, fed by an array of real-time data acquisition sensors (e.g., internet of things, drones, and robotics) and large-scale distributed automation systems, converting data into information, for decision and action. Massive open datasets ensure science integrity, repeatability, and increased significance (Mehrabi et al. 2019).

Coupled with machine learning, these platforms can extract patterns and discover trends indicating which business models are more conducive to producing sustainable outcomes. Furthermore, the use of software simulations can give users of these systems the ability to manipulate weights and allocations to see the effects based on historical data or as extrapolations, and thus measure the impact of shifts in business model innovation (Ball 2006).

During the initial phase of discovery, the machine learning system will use a training set of pre-identified data to match against each business model pattern and develop a rule set (***Figure 4.3***). Over time as more reports are identified and categorised, the system will be able to improve its accuracy and thus learn from prior recognition attempts. As more attempts are made with ever increasing sets of data points, the

accuracy of the predictions improves. Conservate estimates show that 150 fully identified sets of sustainability reports should produce a consistent outcome in the 90 percentiles.

The benefits of using the machine learning process at this point should be clear. Not only does it allow for the automated processing of large volumes of data, moreover, it improves the accuracy of the predictions over time, providing a consistent and uniform analytical approach far superior to what an individual researcher or expert could provide on their own (Salvatier et al. 2018; Lewis & Young 2019; Rolnick et al. 2019). An example of the process, using the SPRINT engine, is illustrated in the ***Figure 4.4*** confusion matrix with the predictive regression and decision tree classifier outcomes showing the differences in the accuracy of the prediction.

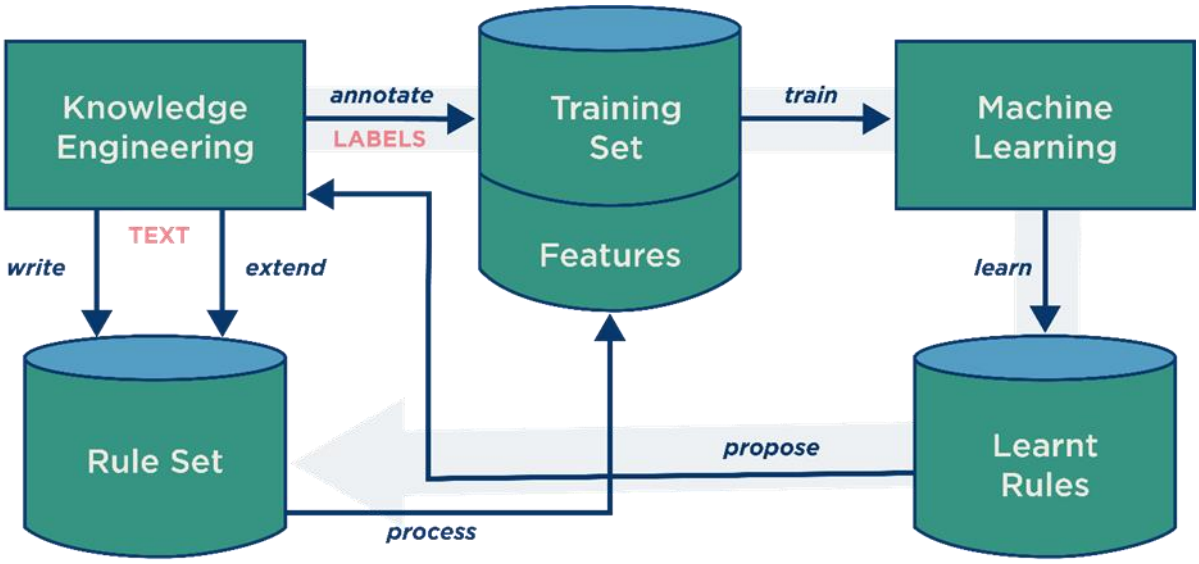


Figure 4.3. Sustainable business model categorisation method using machine learning. Source: The Classification of Sustainable Business Model Patterns using Machine Learning, Fedeli & Lüdeke-Freund (2020).

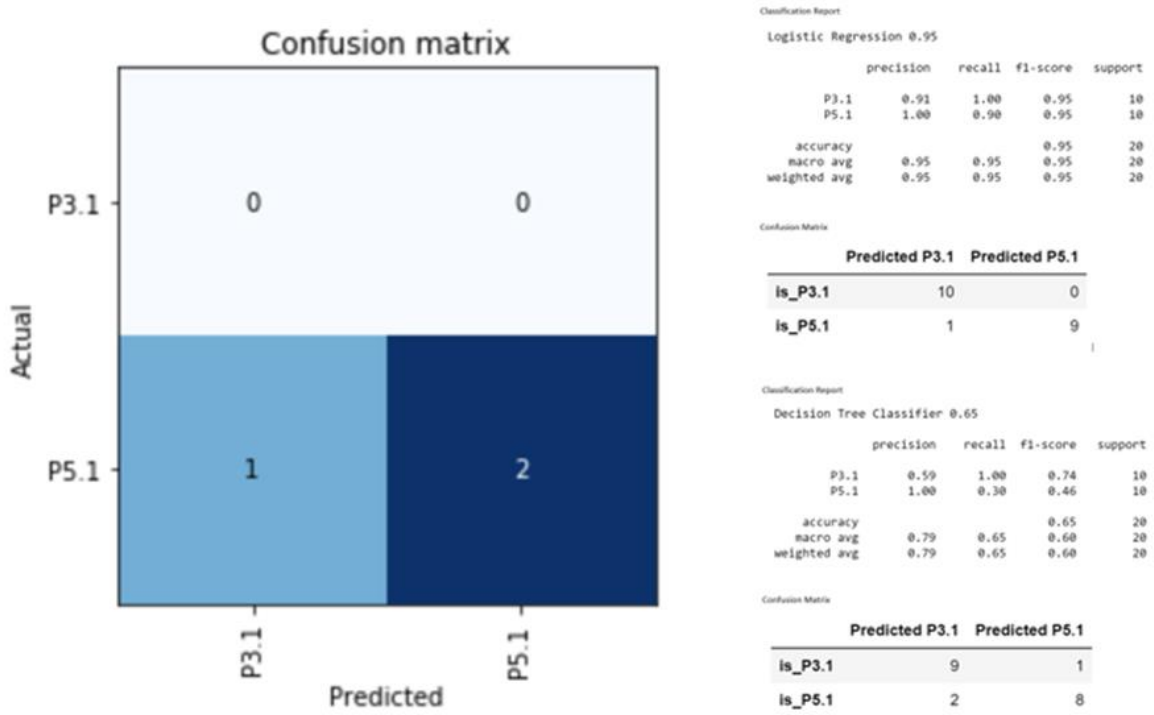


Figure 4.4. Confusion matrix, predictive regression and decision tree classifier used in the study. Source: The Classification of Sustainable Business Model Patterns using Machine Learning, Fedeli & Lüdeke-Freund (2020).

4.2.6. Systemic Orchestration towards thrivability

Systemic orchestration links business model categorisation with context-based sustainability performance, by charting a trajectory towards thrivable transformations (i.e. thrivability). The Systemic Holistic Model supports systemic guidance, leveraging pattern theory and information systems (Skyttner 2006; Breiby & Wanberg 2011), in an effort to predict and indeed to prescribe such a path to prosperity with providence (Winter & Aier 2016) (Smith & Roberts 2018). This is based both on what we know is sufficient and necessary to achieve sustainability, as well as the application of the precautionary principle (Neumayer 2010b). Thus, elucidating the shift in business models that give rise to sustainable outcomes.

Some authors suggest using pattern theory as a framework for the identification, description, and systematic categorisation of business models (e.g., Gassmann et al. 2014; Remane et al. 2017; Lüdeke-Freund, Bohnsack, et al. 2018; Lüdeke-Freund, Carroux, et al. 2018). Patterns are

mostly derived from experience and empirical observations, and are therefore demonstrated to be proven problem-solution combinations (Leitner 2015). Patterns are instruments to codify knowledge systematically and to transform it from the tacit to the explicit (Lüdeke-Freund, Carroux, et al. 2018).

Opportunities offered by the increasing sophistication of information systems in areas such as big data analytics and machine learning (Melville 2010) can help us to discern patterns in the description of business models as they appear in corporate literature and websites, as well as in official reports such as financial statements and sustainability reports (Michalak et al. 2017; Villiers & Sharma 2017). In the case of multinational enterprises, where the law often requires it, these audited documents are commonly made available publicly online via the internet (Szekely & Vom Brocke 2017).

Given the magnitude of open data available, an advanced software-based pattern recognition system using machine learning can help search, identify and classify textual business model data (Gholami 2016). Developing a tool that can be operationalised through machine learning places information systems at the cornerstone of solving this modern-day challenge, in what is an otherwise difficult trans-disciplinary and fragmented field of research (Fielt 2013; Lüdeke-Freund & Dembek 2017), by utilising innovative knowledge to deliver a practical solution.

The use of a technology platform powered by extensive information systems and AI, allows enterprises to experiment with a range of business models and solutions (Remane et al. 2017). Supported by information systems, these platforms can extract patterns, and combinations thereof, thereby discovering trends indicating which business models are conducive to transitioning enterprises to a more sustainable outcome (Lüdeke-Freund 2017).

4.2.7. Controlling for Bias and Variance

Unlike traditional approaches which aim to zero-in on a discrete unique answer, the exploration of a vast array of approaches can aid in

identifying a plethora of more and less viable solutions (Olsen 2007; Shrivastava & Guimarães-Costa 2016). Generating alternatives removes confirmation bias, thus benefitting artificial intelligence and machine learning systems (Donnellan 2019). Distributed data-intensive eScience and big data analytics, brings a sophistication in process far above static reporting (Malhotra et al. 2013), with reduced costs for data acquisition, curation, integration, collaboration, analysis, visualisation, exploration, and predictive knowledge (Wang et al. 2016). Through a continuous iterative process of refinement, computer-based decision support systems facilitate the calculation of a sustainability index (Vinodh et al. 2013). Worth noting, Mehrabi et al. (2019), emphasize the significance of addressing bias in AI systems to ensure fairness. While algorithmic decision-making offers advantages such as impartiality and the ability to consider a vast number of factors, unlike humans, it is not immune to biases that can lead to unfair outcomes. The researchers identify two possible sources of unfairness in machine learning results - biases in the data and biases in the algorithms, whereby it was established that it is crucial to mitigate these sources of bias to ensure that AI systems make just decisions.

4.2.8. Classification Integral to BM and Management Research

According to Hanks et al. (1994), there has been a proliferation of conceptually-based models in business research due to a lack of careful empirical analysis. This scarcity of taxonomical research has hindered the progression of business model research towards theorising, highlighting the need for the development of a general classification of business models that is empirically derived (Albino & Fraccascia 2015; Lambert & Montemari 2017). Such a classification, as described by Lambert (2015), serves as a mid-range theory that helps to organize abstract and complex concepts, allowing for the explanation of why some business models perform better or are more sustainable than others (Weill et al. 2005; Malone et al. 2006). Thus this study enables the development of mid-range theories capturing sustainability performance and generalisation of

business models (Rich 1992) towards sustainability. The general steps involved in the classification of design is illustrated in ***Figure 4.5***.

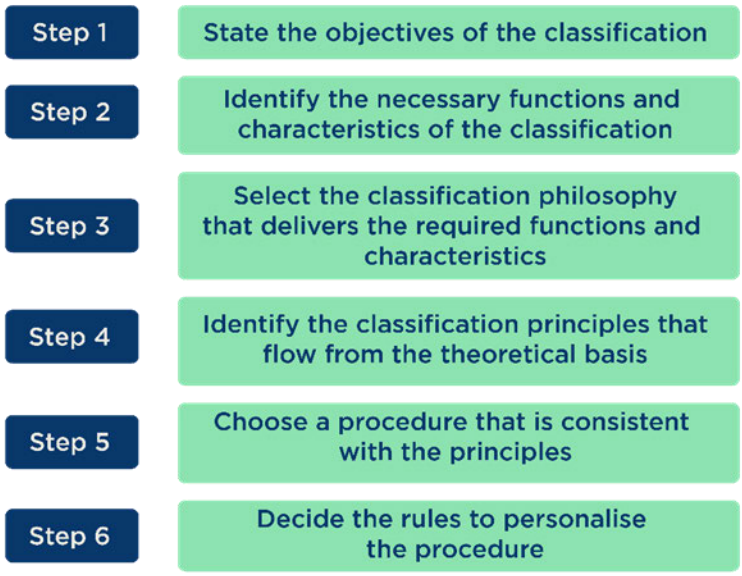


Figure 4.5. *Steps to the classification of design. Adapted from Lambert (2015).*

4.2.9. Making Predictions and Backcasting

Modelling complex systems (e.g., weather patterns, ocean acidification or crop productions) and the interdependence between variables is difficult, and best achieved with forward-looking sustainable strategy modelling software that is able to merge multiple world views, together with a computational engine and set of assumptions (e.g., formula engine and aggregation methods) (Lloret 2016). Whereas forecasting sits alongside descriptive business intelligence based on past trend-analysis, backcasting sits alongside predictive analytics, producing forward-looking models, which may incorporate the augmentation, experimentation, simulation, optimisation and analysis of impacts arising from complex wicked problems (Donnellan 2019).

4.2.10. Technological Rules

Using a design science research (DSR) approach, in this study a set of design principles are developed that concern a class of information systems, that is the product of design (Walls et al. 1992; Iivari 2010).

This provides the guidance necessary from established rules (in other domains) (Joan E. van Aken 2004) governing the formulation of threshold and allocations and a method for composition of an aggregate composite index from all material topics regardless of the chosen taxonomy.

Accordingly, as was shown in ***Figure 4.2***, the Systemic Holistic Model (SHM) includes an arrangement of foundational focus factors for eliciting the key components of numerator, denominator, thresholds and allocation, and aggregation, necessary for the formulation of the transformation towards the thrivable trajectory as follows:

- **Significance** (numerator): Materiality, Multi-capital, and Integral Thinking. This quadrant specifically brings together related material topics and across multiple capitals to derive the numerator required when measuring impact. It achieves this using an integral perspective ensuring that synergies between impacts are respected and avoiding any double counting.
- **Scale** (denominator): Finite Resources, Science-Based Targets, and Context-Based Metrics. This quadrant evaluates impacts on finite resources based on the understandings that comes from science-based targets. Science-Based targets involves determining and extracting context-based metrics from third party authoritative organisations such as the UN or CDP.
- **Shift** (thresholds and allocation): Values-Based Innovation, Linear to Circular, and Trans-disciplinary. This quadrant represents the real shift that is necessary to achieve thrivability. It takes a multi-disciplinary approach, considering what is of value to society that warrants change or innovation looking to transition society away from traditional approaches towards more circular or regenerative methods. The shift ultimately informs the process that is necessary and sufficient to achieve thrivability.
- **Scope** (aggregation): Entity Model, Strong Sustainability, and Complex Wicked Problems. This quadrant is instrumental in ensuring what is

most relevant is measured (the entity), taking a strong sustainability stance (devoid of monetisation/substitution), keeping in mind the complex wicked nature of the world we live in. Aggregation across scales to occur without double-counting (Rogge 2018).

So how does this all come together? The Systemic Holistic Model (SHM) as enunciated by the 12 Foundational Focus Factors (12FFF) listed across the four quadrants provides the means to identify the most significant factors, at scope and scale necessary and sufficient to make the transition of entity models towards thrivability. This is further elaborated upon in the THRIVE Framework (class) and the THRIVE Platform tool (instantiation) covered in detail in the next two sections and in the appendices. Furthermore ***Figure 4.6***, the Ciambella Chart, offers a visual representation of the above quadrants in the form of the numeric numerator and denominator therein, thresholds and allocations on the periphery, and aggregation through multiple charts at multiple levels of granularity.

A note on missing or imputed values. When it comes to sustainability metrics, several methodologies examined adopting multi-dimensional composite indicator, ignore missing values or impute an average (Saisana & Tarantola 2002). This approach favours those who are taking a harmful stance on a particular topic as it relates to society or nature. It fails to penalize those specific entities based on their negative impacts. Therefore, whilst in the example formulation for the seafood stewardship index no such penalties are applied, the ability of the THRIVE Platform to change formula engine, gives the user the ability to ensure entities are penalised for their wrongdoings.

For examples of technological rules refer to ***Section 7.3*****.** For an illustrative summary of understandings emerging from this study's literature review, do refer to ***Appendix A: The THRIVE Framework***.

4.3. THRIVE Framework (Class)

As a result of the detailed analysis of the literature, numerous expert interviews, discussions and meets over the last five years, the THRIVE Project (organisation) took shape starting in early 2019 alongside the THRIVE framework and THRIVE Platform. **THRIVE** is **T**he **H**olistic **R**egenerative **I**nnovative **V**alue **E**ntity, whereby the approach is:

- Holistic as it takes a top-down systems-wide perspective;
- Regenerative as it aims for the long-term flourishing of entities including enterprises, governments, and individuals;
- Innovative as it examines improvements by entities towards strong sustainability;
- Values-based as it employs a multi-capital, science-based approach;
- Entity-focused, employing a scale-linked approach to entities.

It is understood that entities ought to *strive to thrive on Earth* for their flourishing longevity. The *THRIVE Framework* (design theory) brings together all the underlying concepts explained earlier and integrates them into the robust instantiated model known as the *THRIVE Platform* (practical tool). The design theory incorporates and describes:

- THRIVE framework, providing methodological transparency and universal applicability.
- Sustainability Performance Scorecard (SPS), in dashboard, tabular and graphical form (***Figure 4.6***), together with associated entity / business model.
- Standardised metrics, with uniform units of measure (e.g., GIIN IRIS+ 2019, 2020).
- Numerator performance data, derived from publicly published integrated corporate sustainability reports (e.g., Global Reporting Initiative Corporate Sustainability Reports, Carbon Disclosure Project database).
- Denominator threshold and allocation data (Szekely & Vom Brocke 2017), sourced from global footprint initiatives (e.g., GFN) and

notable international agencies (e.g., GFW, WRI, UNGC within context based on global thresholds and allocations).

- Harmonisation (and normalisation), into a single index (Huang et al. 2015; WBA 2017; Haffar & Searcy 2018) for comparability between entities.
- Weights and aggregation (SPS dashboard levers and controls), to simulate effects owing to changes (Sironen et al. 2014; Greco et al. 2018). The system supports both a weight engine (WF) and user-defined weights.
- Thresholds and allocation calculations using the customizable formulae engine (FE) technology (Mazziotta & Pareto 2015a, 2017). This supports inner and outer thresholds, and context-based impact assessment (***Figure 4.6***).
- Scale-linking (Wahl 2006; Ostrom 2007): essential for meaningful modelling as the sum total of all resources in use must not exceed the available resources. This is true across all material topics and is necessary to enforce strong sustainability.
- Backcasting: whereby the THRIVE framework is built upon the established framework for strategic sustainable development (FSSD), incorporating the formulation of backcasting targets (Robèrt 2009).

The THRIVE framework forms the basis of a class of solutions (Sein et al. 2011) that empirically links the entity model concept with the sustainability performance of entities (França 2013) at each scale-link level (Baue 2019) combining the insights from the social and natural sciences (Shrivastava et al. 2013) with the normative guidance necessary and sufficient to achieve a sustainable future (Upward 2013). These impacts and the related entity model patterns (Lüdeke-Freund, Carroux, et al. 2018) are visually captured and easily compared through Ciambella Charts illustrating the inner and outer limits, impact and allocation as shown in ***Figure 4.6***. These quick visuals exhibit harmonisation through

the application of weights and scale-linking to arrive at the score (or sustainability performance index based on numerator divided by denominator) as shown at the centre of the figure.

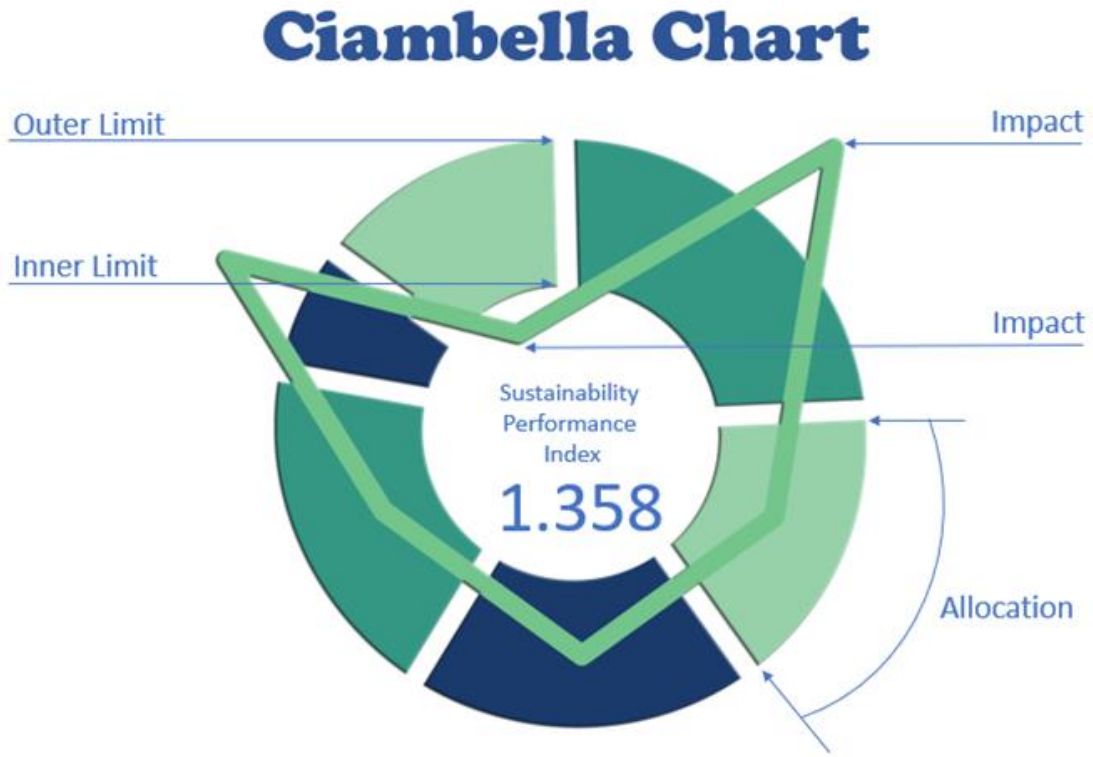


***Figure 4.6**. The Ciambella Chart visual design quickly conveys aggregate performance by incorporating the inner and outer limits (thresholds), allocations (slice size) and impacts.*

4.4. THRIVE Platform (Instantiation)

The construction of the artefact consisted of the ex-ante THRIVE Platform v1.x and the ex-post THRIVE Platform v2. Version 2.04 represents a significant upgrade to the earlier version, both in aesthetics and functionality as well as managing larger datasets and incorporates speed improvements in order to manage these. Unlike v1.x, the THRIVE Platform v2.04 is a multi-user system with a complex and advanced computational formula engine, weight engine and support for choice of material topics. It is also multi-level, thus implementing the research principles developed as part of the 7Cs (Fedeli 2020).

The THRIVE Platform is an online tool available either via the web or as an Android or iOS downloadable app. The pilot ran for four years between 2019-2023 and features several capabilities, with users being able to register and use the service for free. These features include all of the items listed in the framework, except that there is no user profile management, nor nano-level data (level 1) included in the illustrative minimal viable product (MVP) THRIVE Platform v2.0. The purpose of the THRIVE Platform tool is to measure sustainability impacts across scales and link these performances to the associated entity models. It features the sustainability performance scorecard (SPS), with the ability to manipulate the formula engine, and the proprietary Ciambella Charts (***Figure 4.6***). The Infographic feature and user customizable weights are still under development. Whilst the pilot investigation is over, one may log into THRIVE Platform v2 using the TP-demo@strive2thrive.earth account, password "Demo".

4.4.1. Development Lifecycle

Initial thoughts around developing technological rules and then algorithms to implement the THRIVE framework started in early 2019. Shortly thereafter that, it became clear that the effort required to write algorithms and brings these together in a coherent fashion was going to be similar to implementing a computer program. This proved a wise decision as the level of complexity of the framework grew and so too did the required software-based solution.

It was mid-2019 when it became clear that the way sustainability impacts were going to be assessed and conveyed to the reader was an important part of the system. Following some complex manipulations with some spreadsheeting programs, effort switched towards developing a basic desktop program, at first, to display the outcome from any assessments. It was thought that traditional charts were simply not detailed enough. On the one hand there was a need for an instant visual; on the other, there was a richness of data that had to be conveyed in a transparent, uniform and easily comparable way.

This prompted me to develop a software solution in PHP using PostgreSQL. THRIVE Project v1.0 as a prototype served as a proof of concept. It combined many of the basic principles set forth in the THRIVE framework and operates with a minimal amount of read-only data. It is predominantly a single-user system which was showcased live in Jan 2020 in front of an audience of sustainability experts and peers at the Strongly Sustainable Business Model Group meeting.

Following encouraging feedback from a number of experts, including Antony Upward, Bill Baue, Henk Hadders, and even some signs of rivalry by other experts in metrics, further development of the software gave rise to THRIVE Platform v2. This is a far more sophisticated multi-user system, which includes support for date ranges, drill-down into calculations, backcasting targets, advanced presets, a nicer and simpler interface, side-by-side comparisons, as well as cross-platform, Android and iOS App support (***Figure 4.7***). The platform/app may be accessed from https://ThrivabilityMatters.Earth website by registering for a free account using an email address (***Figure 4.8***).



Figure 4.7. *THRIVE Platform App.*
Available from https://ThrivabilityMatters.Earth.
Register at https://platform.strive2thrive.earth.

4.4.2. Datasets

Initial testing was conducted using illustrative data. This is data that was generated internally using a range of random values across within predefined limits across various ranges such as to emulate how the system would behave in those circumstances. Later, towards the end of 2019, further real data was added, to provide comparisons with other reports based on the same primary dataset (Geertz 1973).

The THRIVE Platform is a principally a read only system operating on the dataset assimilated above. It provides the means to illustratively dissect the data to demonstrate the key principles at play from the THRIVE Framework. Key input and output variables are summarised in the table below (***Table 4.1***).



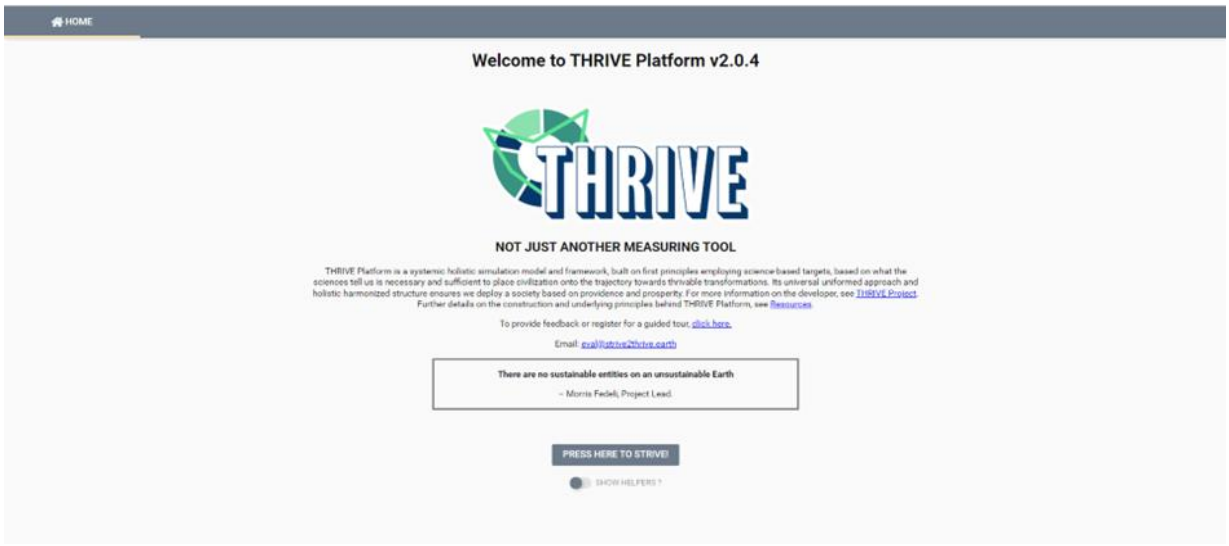


Figure 4.8. *THRIVE Platform v2.04 main log in and banner page.*

Dashboard of Variables

Entity Level:	Choice of level from 1 nano-level through to 7 macro-level ***(Figure 5.2).***
Classification:	Choice of classification system such as GRIs, SDGs or WSSI.
Start Date:	Starting date of data being assessed.
End Date:	Ending date of data being assessed.
Formula Engine:	Choice of formula engine, such as geometric mean, Mazziotta-Pareto, etc.
Weight Engine:	Choice of weight engine, such as WF00 (default), WF01, etc.
Entity:	Entity under consideration. If left blank, then whole sector is assessed.
Score:	Resultant sustainability performance score (SPi).
Rank:	Resulting rank out of the total.

Table 4.1. *Dashboard input and output variables for THRIVE Platform v2.04.*

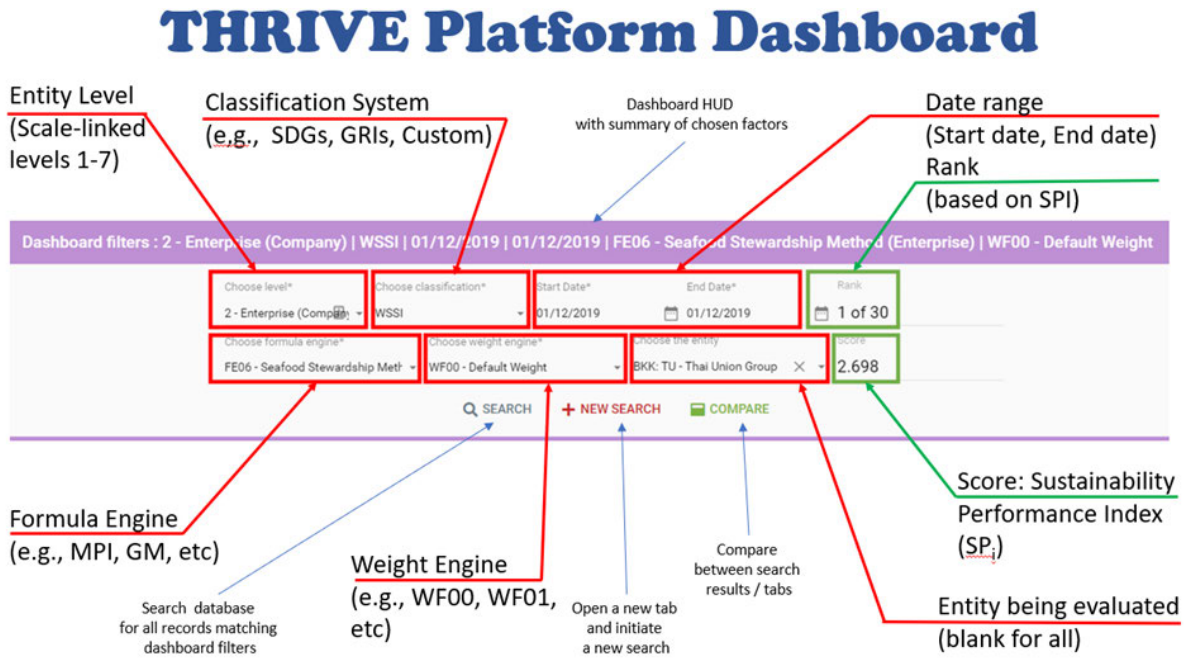


***Figure 4.9**. THRIVE Platform dashboard: highlighting the various areas of the interface. Blue arrows and heading indicate areas of interest. Areas in red are for selection or data entry. Areas in green are outputs.*

LEGEND	**GREEN** are inputs by the user **RED** are outputs from the system

Table 4.2. THRIVE Platform legend descriptions

4.4.3. System Tour

A comprehensive audio-video guided tour of the THRIVE Platform is available here. After registering and logging into the system, going pass the "*Not just another measuring tool*" splash screen, one arrives at the dashboard (***Figure 4.9***). The dashboard consists of a set of six input variables and two key output variables. In all the following figures, key inputs are in green boxes and outputs are shown in red boxes (***Table 4.2***).

Results from queries are shown in the form of a table (***Figure 4.10***) and chart (***Figure 4.11***). Both depict the same data, just in different formats. There is a choice of charts to pick from, however the proprietary Ciambella Charts (***Figure 4.6***) - developed during this thesis – is the most useful in providing an instant picture of how well an entry is performing. In fact, repeated application of this chart can make the user

able to quickly analyse and compare the performance between entities with just a glance of the Ciambella Chart.

This is because Ciambella Charts combine many key characteristics into the one chart, through colour coding and meshing of two charts into one. Furthermore, because Ciambella Charts are normalised and harmonised across the data sets, comparisons are easy to make visually. Ciambella Charts provide instant visual cues as to the inner and outer limits, the allocation, impact, and model employed by the entity under consideration. Further information is then available upon drilling down into a value. For example, one can click on the linked model to find out further details about the same (***Figure 4.12***).

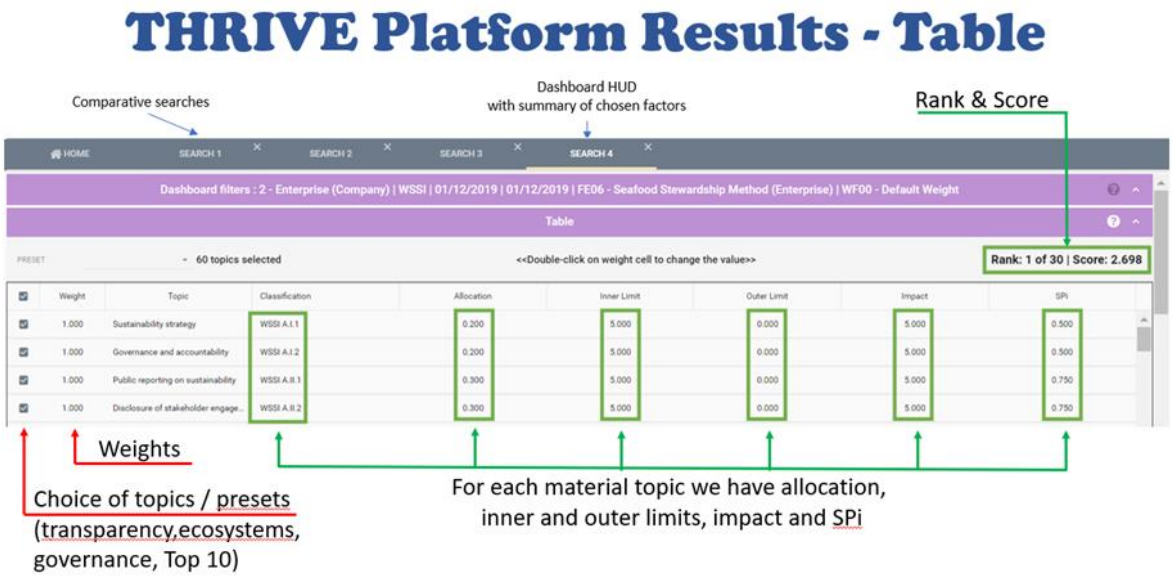


Figure 4.10. *THRIVE Platform Results is a sample of the table outputted from the THRIVE Platform. Areas in red may be manipulated by the user. Areas in green are calculated answers. Other headings are explained in blue text.*

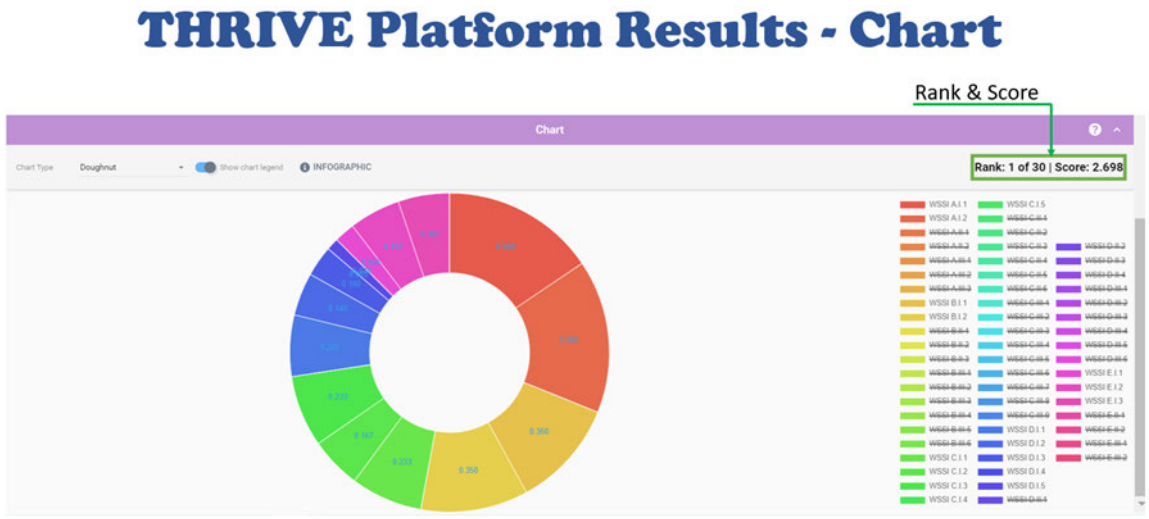


Figure 4.11. *THRIVE Platform Results above is a sample of the doughnut chart outputted from the THRIVE Platform. Areas in red may be manipulated by the user. Areas in green are calculated answers. Other headings are explained in blue text.*



Figure 4.12*. Business model identification and description associated with the chosen entity as per Business Model Patterns by Lüdeke-Freund, Bohnsack, et al. (2018).*

Additionally, beyond choosing different dashboard filters, one may also customize the output (table and chart) by choosing which material topics (See sample for SDGs ***Table 4.3***) to include and which to exclude from a calculation. This can be achieved through a chosen preset or by manually selecting a checkbox for the same. Moreover, one may choose a user-selectable weight to override any preset weight for that material topic (***Figure 4.10***). This feature, together with the choice in formula engine and default weight engine formulations provides for invaluable insights into the effect of each of the material topics on the performance of the entity.

Classification	Topic	Topic Name	Topic	Icon
SDGS	1	No Poverty		
SDGS	2	Zero Hunger		
SDGS	3	Good Health and Well-being		
SDGS	4	Quality Education		
SDGS	5	Gender Equality		
SDGS	6	Clean Water and Sanitation		
SDGS	7	Affordable and Clean Energy		
SDGS	8	Decent Work and Economic Growth		
SDGS	9	Industry Innovation and Infrastructure		
SDGS	10	Reduced Inequality		
SDGS	11	Sustainable Cities and Communities		
SDGS	12	Responsible Consumption and Production		
SDGS	13	Climate Action		
SDGS	14	Life Below Water		
SDGS	15	Life on Land		
SDGS	16	Peace and Justice / Strong Institutions		
SDGS	17	Partnerships to achieve the Goal		

***Table 4.3**. List of Sustainable Development Goals (SDGs) material topics as used by the THRIVE Platform.*

For those wishing to compare and contrast between entities, the system supports multiple comparative searches through a "compare"

function as found on the top dashboard panel (***Figure 4.10***). Additional information about the THRIVE Platform system, including further documentation, audio visual walkthroughs, presentations and related workshops may be found at the https://ThrivabilityMatters.Earth website. You may find a plain English overview of the THRIVE Platform brochures there also (***Figure 4.13***, ***Figure 4.14***).

During the development of the artefact, including the THRIVE Platform several documents and supporting collaterals were produced, including the software specifications, database structures, relationship models, test reports, usage reports, migration documents, user documentation, and other useful links to frequently asked questions, walkthrough video, blogs detailing about the system, large array of presentations, as well as the THRIVE Platform itself. Further details on these are available in ***Appendix B: The THRIVE Platform*** and on the public website https://ThrivabilityMatters.Earth.



Figure 4.13. *Descriptive page taken from the THRIVE Platform brochure. See the actual document in full online at https://ThrivabilityMatters.Earth.*

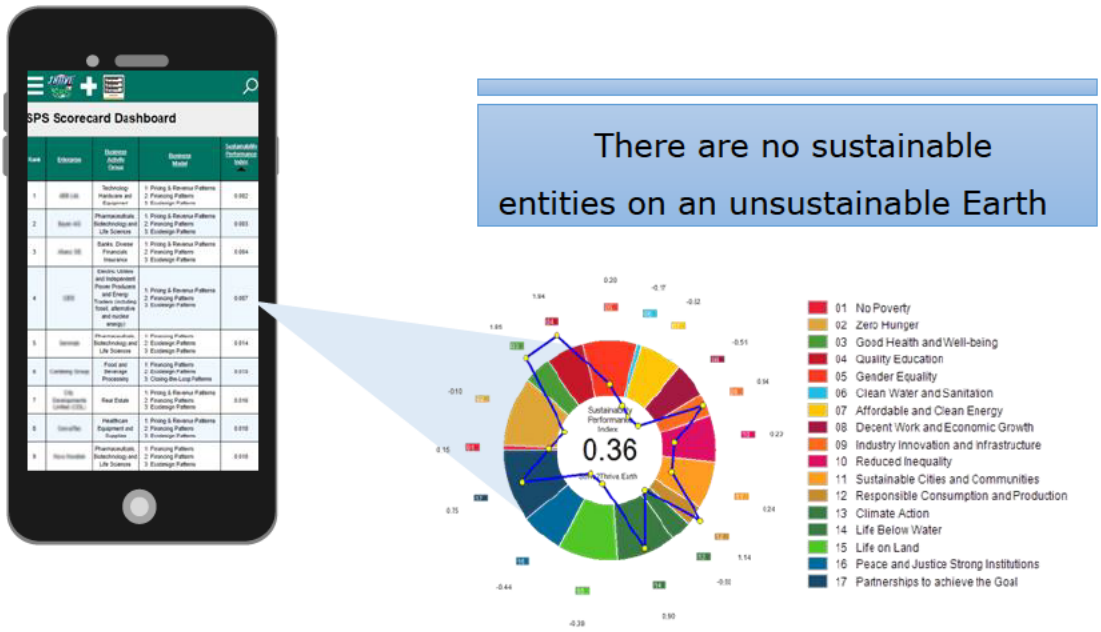


Figure 4.14. *Illustrated example of a Ciambella Chart from the THRIVE Platform tool Android version.*

4.5. Construction

To evaluate the THRIVE Framework, an instantiation of the THRIVE Platform was created incorporating the understandings as illuminated from the literature review. These understandings informed the design and operation of the THRIVE Platform system. For example, the THRIVE Platform invokes a systems and integral thinking perspective, incorporating the concepts of strong sustainability, context-based metrics, and leveraging science-based targets. It is all encompassing when it comes to materiality, conscious of our finite resources and the complex-wicked nature of the world we live in. These are but just a few key aspects that have been incorporated into the THRIVE Platform and what later became known as its formula and weight engine.

Preliminary attempts at understanding the outcome and what was required to explain the various attributes of the system were captured in Microsoft Excel, consisting of a table and chart. It was quickly realised that Excel did not have the ability to perform the complex iterative calculations needed, nor was the graphing facility adequate.

Next attempts shifted to developing technological rules starting with algorithms to capture necessary aspects of the system such as context-based metrics, allocations and thresholds, and the concept of backcasting. Later these algorithms were transferred to Visual Basic code as emphasis was placed on developing the Ciambella Charts (***Figure 4.6****),* exemplifying the output from the system.

This was followed by an advanced database system developed in PostgreSQL v7.x and over time updated to v11.9. This database together with PHP v2.7 code on the back end and Javascript/CSS/HTML, jQuery and DataTables for the front end, gave rise to THRIVE Platform v1.x, a minimal viable product (MVP), aimed at the Enterprise (Company) level. Later this code was backward engineered to support the Industry (Community) level when it was recognised that assessing impact at the various levels was important (Fedeli 2020).

With THRIVE Platform v2 we moved to a multi-user based system with a far more advanced database structure. It was a complete redesign of the data store, and it features complex stored procedures. It was devised this way such that common repeated searches and results could be stored to reduce search time. ExtJS was employed on the front end to incorporate a much nicer look and feel. Additionally, it introduced several features and improvements:

- cleaner and easier to use interface
- support for comparison among search results
- support for date range
- support for multiple entity levels
- support for weight engine
- single screen display of impacts
- larger range of presets
- support for export of infographic
- single entity and aggregate level totals
- collapsible dashboard, table and chart panels

- separate detailed pop-up entity model panel
- user customizable weights
- support for doughnut, polar, and pie charts

4.5.1. Technology Stack

The first implementation of THRIVE Platform v1.x is hosted on a dedicated CentOS Linux release 7.9.2009 (core) system at our Nuremberg server in Germany. The system is hosted on a shared server with unlimited storage and bandwidth. An android and web version are available for download. The website is accessible from https://thrivabilitymatters.earth.

The current version of the THRIVE Platform v2.04 is a multi-user web-based software system that runs under Apache/2.4.52 on a CentOS Linux release 7.9.2009 (core). The system is hosted on a 2 core 4Gb virtual machine (VM) located on a Microsoft Azure node in Sydney, Australia. An android, Apple iOS, and web version is available for download. The website is accessible from https://platform.strive2thrive.earth.

4.5.2. THRIVE Platform v1.x

The THRIVE Platform v1.x is a proof-of-concept construct, aimed at showcasing the key characteristics of how the system would behave. It was borne out of earlier work whereby simple written algorithms and then more complex spreadsheets were used to better understand the critical aspects of how such a system could be made to work. Programmatic approaches led earlier on to versions of the system written in Visual Basic before settling on PHP. In the initial steps of the implementation, I sought to understand entities identified as enterprises (later extended to include others).

Three key input parameters were identified: date, classification, and formula engine (***Figure 4.15***). These variables were input through the dashboard and served as a basis of filtering data and then calculation of the results. Date and classification are used as filters upon the original dataset with the formula engine providing the method of determining how

the sustainability performance score (SPS), expressed as an index, would be determined. This application of the theory assumed the evaluation of impacts at a single point in time, nominally defined by a date/time stamp. Classification refers to the taxonomy for the chosen methodology, such as United Nations Sustainable Development Goals (SDGs), Global Reporting Initiative Standard (GRIS), and so forth. Examples have been shared in ***Figure 4.16*** and ***Figure* 4.17** and will be discussed further shortly.

THRIVE Platform v1.x – Enterprise (Company) Level		
Dashboard	Selection criteria – Enterprise (green)	Date
		Classification
		Formula Engine
Output	Table	Rank
		Stock Code
		Enterprise Name
		Business Model Pattern
		Industry Classification
		SP Score
		Search
Output	Chart	Ciambella Chart
		Presets
		Show/Hide Legend
		Redraw
		Uncheck All
		Check All
		Material topic tick-box(es)

THRIVE Platform v1.x – Industry (Community) Level		
Dashboard	Selection criteria – Industry (yellow)	Date
		Classification
		Formula Engine
Output	Table	Rank
		Industry ID
		Industry Name
		Sector Model
		Country
		SP Score
		Search
Output	Chart	Ciambella Chart
		Presets
		Show/Hide Legend
		Redraw
		Uncheck All
		Check All
		Material topic tick-box(es)
Logout		

Figure 4.15. *THRIVE Platform v1.x onscreen parameters at the enterprise level (top) and industry level (bottom).*

As THRIVE Platform v1.x was the first ever attempt, there were many changes and refinements performed along the way. In particular, it was clear that there was no "one-way" to implement the appropriate formulations applicable for each of the methodologies and approaches in use. A formula engine was devised to address this, allowing for both bounded and unbounded determinations as well as addressing issues of type of scale (linear/non-linear, positive/negative), orientation of scale (increasing/decreasing), and absolute vs relative scales. Furthermore, it

has been determined that the introduction of a formula engine allows for far more sophisticated unforeseen formulations that could never have been thought of before. For example, if examining crop productions, one could use a formula engine that accurately considers the impact of weather patterns as part of the formulation. Although there is no consensus, other correlations could be used either directly or as proxies for the behaviour of social or environmental systems being examined (Zhou et al. 2017).

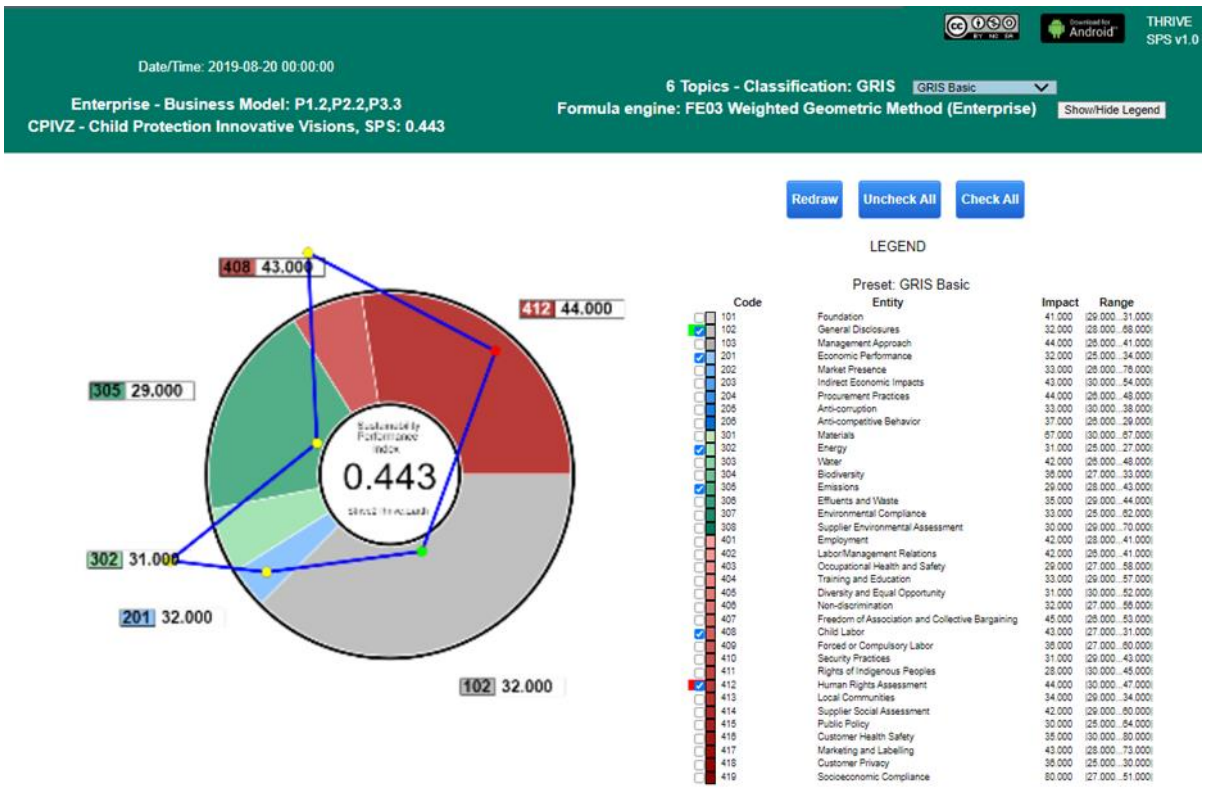


Figure 4.16. *THRIVE Platform v1.x Table and legend for the illustrative enterprise CAPIVZ.*

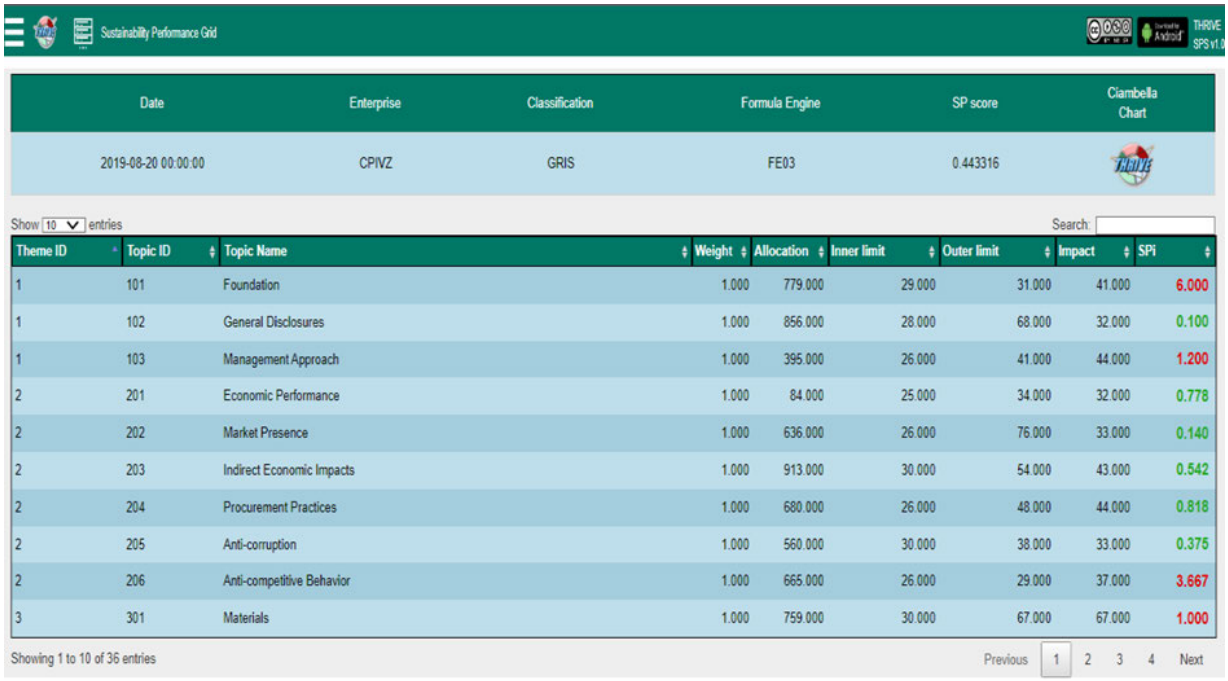


Figure 4.17. *THRIVE Platform v1.x Ciambella Chart and part legend for the illustrative enterprise CAPIVZ.*

The earliest output from THRIVE Platform v1.x was a simple table showing the enterprise stock code, its pre-loaded business model patterns (obtained from a manual analysis), industry classification and Sustainability Performance Score and Rank by way of calculation using the Formula Engine (as illustrated in ***Figure 4.18***). Examples of how these formulations come about, such as FE02, the non-compensatory weighted geometric mean is provided in the ***Appendix E: Reference Tables***. A second output is a list of material topics acting as a legend for custom developed Ciambella Charts (***Figure 4.6****)*. Each material topic can be chosen to be included or excluded from the calculation (as illustrated in ***Figure 4.19***) and thus affects the overall score. Additionally, there is a range of presets available allowing one to pick common arrangement or selection of material topics in set clusters.

Later, as my understanding expanded, and the concept of the 7Cs evolved (Fedeli 2020), this was added to THRIVE Platform v1.x with the introduction of the 'Industry level' as seen in ***Figure 4.18*** and ***Figure 4.19***. The industry level Table and Chart are very similar to the former,

with instead of company shown there is industry, and instead of business model there is (industry) sector model. All other aspects operate in the same way with thus the Sustainability Performance Score representing the industry sector score (see 'S' sector model patterns). The business model patterns were catalogued according to the Lüdeke-Freund, Carroux, et al. (2018) study.

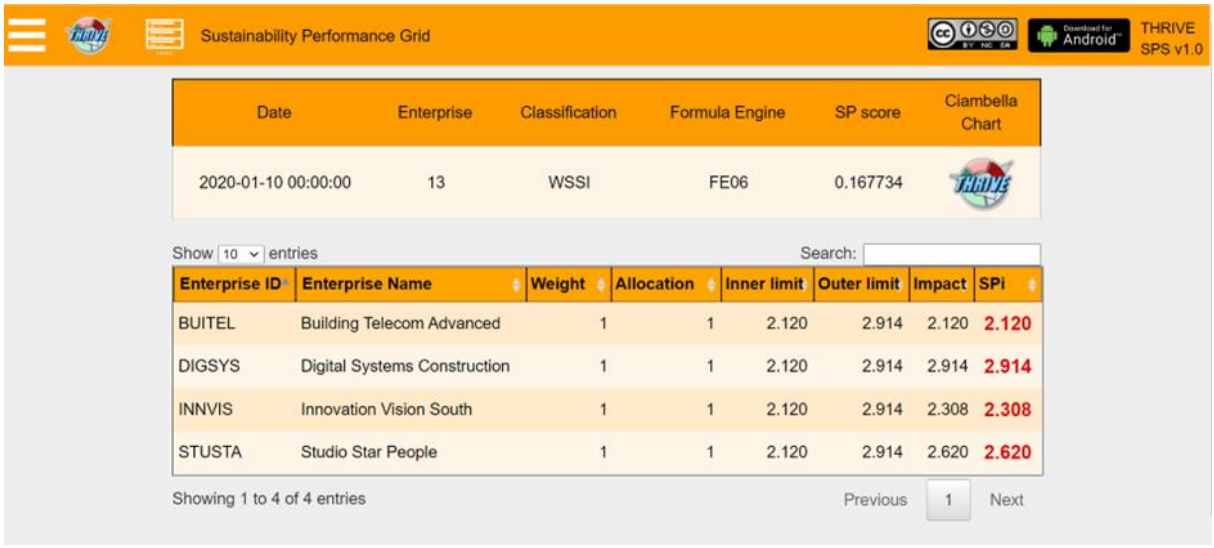


Figure 4.18. *THRIVE Platform v1.x Table and legend for an industry sector.*

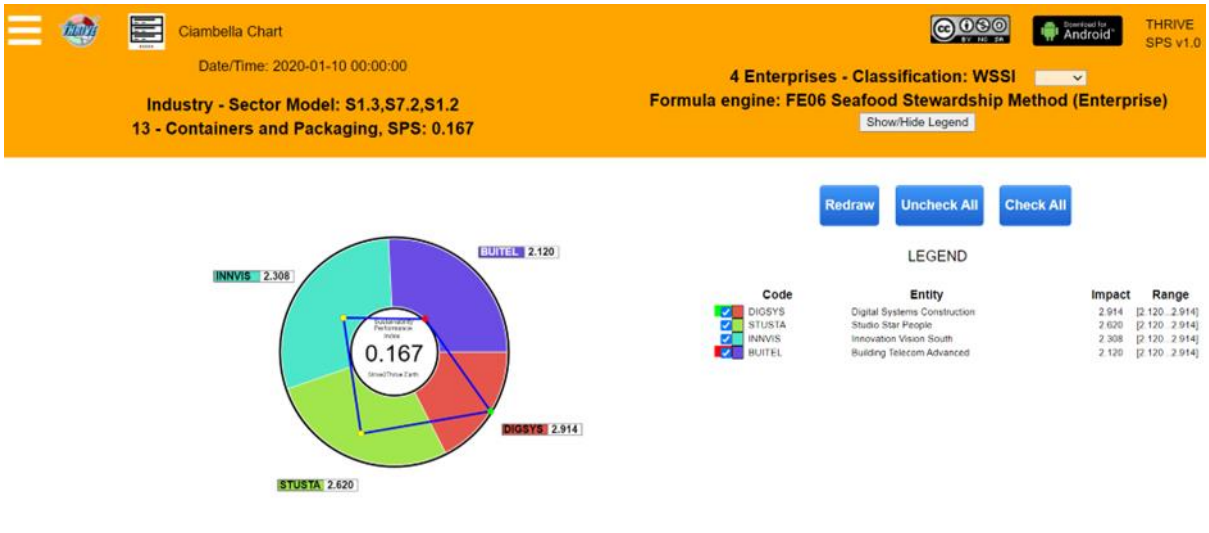


Figure 4.19. *THRIVE Platform v1.x Ciambella Chart and legend for an illustrative industry sector.*

The THRIVE Platform v1.x only caters for these two levels of enterprise (company) and industry (community) and it was at this point that I foreshadowed the need for further 'levels' to be introduced as a means of providing the basis for implementing the broader systemic

changes needed. This led to the *Assailing the 7Cs* study (Fedeli 2020) and became an integral part of THRIVE Platform v2.x. The discoveries made in this study were incorporated into a paper on "*Assessing the sustainability performance of entities: A review and classification of tools, methods, and approaches*" presented, along with my colleague Martin Glinik from THRIVE Project, at the 6th International New Business Model Conference in Sweden (Fedeli & Glinik 2021).

It was also recognised that a better method for business model pattern identification was needed, which ultimately led to the implementation of a machine learning module to detect, identify, (recognize) and categorize (catalog) the business model of organisations as a case in point. The machine learning system was part of a study published by Fedeli and Lüdeke-Freund (2020) and presented at the 5th International New Business Model Conference in the Netherlands. This system is discussed at greater length in the study itself and in the description chapter of this thesis (***Section 4.2.5***), however in brief, it uses machine learning to scrutinize the text of publicly available (audited) sustainability reports and websites, to ascertain the entity model in general or business model in this particular case being used by said (business) entity. The system builds up knowledge of the classification itself using machine learning techniques and is therefore classification agnostic. Whilst any arbitrary classification system could be employed, in this study the 45 patterns identified in the study by Lüdeke-Freund, Carroux, et al. (2018) are used. Florian Lüdeke-Freund personally took part in assisting with the training of the machine learning system and in the review process to ensure the system most closely replicated expectations.



***Figure 4.20**. The sustainable business model pattern taxonomy—list of 45 patterns in support sustainability-oriented business model innovation by Florian Lüdeke-Freund et al. (2018) (shown above over 5 pages).*

For the industry classifications several systems were considered, such as the Global Industry Classification Standard (GICS), the Standard Industrial Classification (SIC), the ILO International Standard Industrial Classification (ISIC), and the GRI Business Activity Groups (BAGS), as

used in the THIRVE Platform (***Figure 4.21***). Being an agnostic platform, however, any of these systems could be employed, without affecting the output of the system.

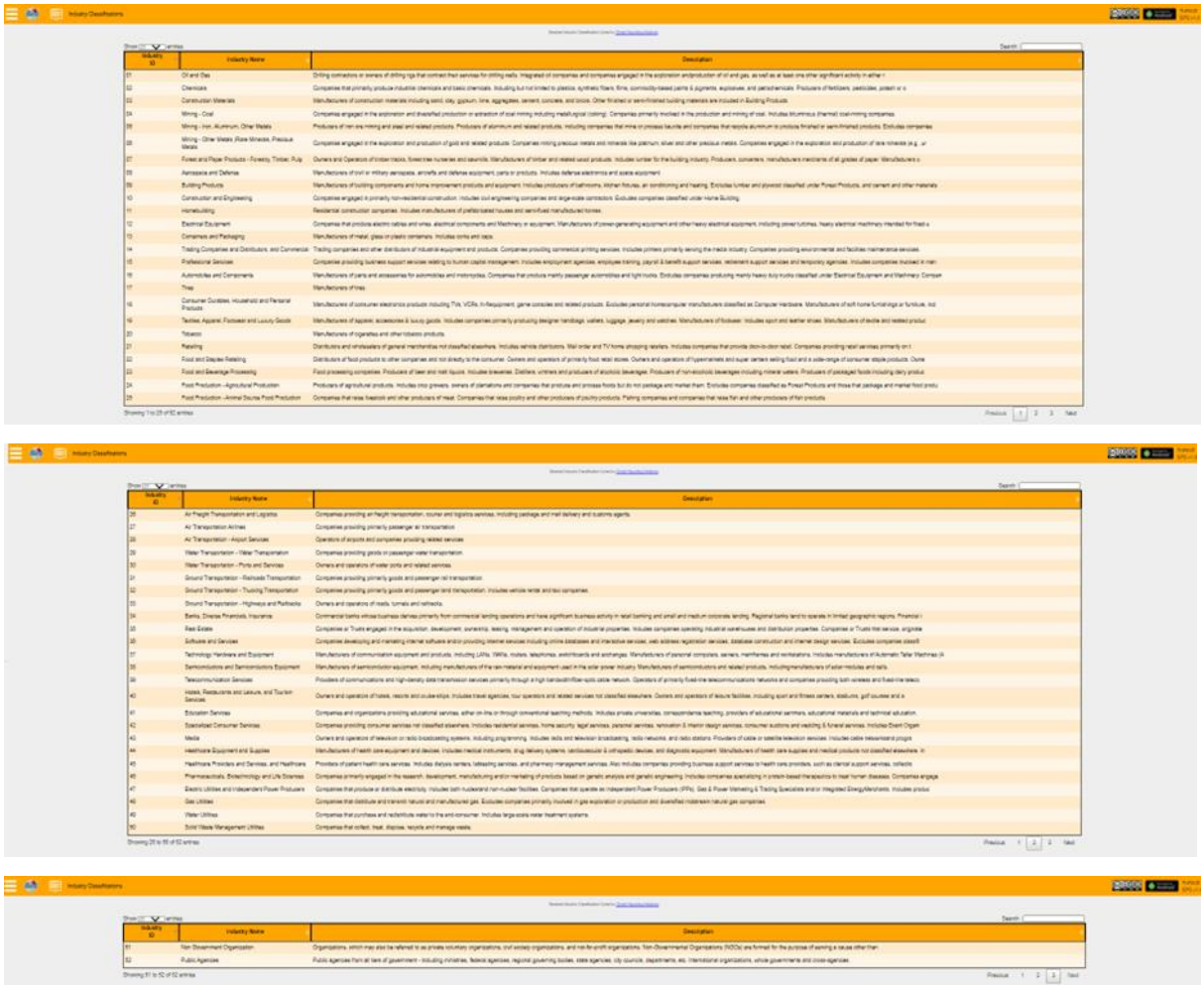


Figure 4.21*. The GRI Business Activity Groups (BAGS), as used in the THIRVE Platform (shown above over 3 pages).*

Similarly, there are a variety of classifications systems or taxonomies for material topics. Some of the most well-known ones are the United Nations Sustainable Development Goals (SDGS) (***Figure 4.23***), the Global Reporting Initiative Standard (GRIS), Corporate Knights, B Corp, Future-Fit and several others. Indeed, the THRIVE Platform is built in such a way that one may define their own. In the example provided for THRIVE Platform v1.x and v2.x there is a sample case loaded in called MCS which is a custom-made taxonomy with just nine material topics. The custom MCS table is replicated in ***Figure 4.22***.



Figure 4.22. *A table of an example set of custom material topics classified as MCS used in the THRIVE Platform v1.x system.*

4.5.2.1. Consider an Example

Continuing with the example earlier in ***Figure 4.16***, we have CPIVZ - Child Protection Innovative Visions, with a Sustainability Performance Score of 0.443. We can see from the output that the evaluation is based on data from the 20th August 2020, and that the chosen formula engine is FE03 Weighted Geometric Method. We also see the enterprise's business models as P1.2, P2.2, and P3.3. In the sample illustration we see that a preset of GRIS Basic is used corresponding to the ticked material topics seen in the legend. ***Figure 4.17*** showcases the outcome of the query as represented in the table through a Ciambella Chart.

Returning to this example we can see the organisation generally scores well on GRI102 Disclosure (closer to bullseye), indicating they generally disclose their impacts, as well as on GRI305 Emissions, signifying they are a low emitter. We can see they do perform in range for GRI412 Human Rights Assessment as their score of 44 is within the acceptable range of 30 (inner limit) to 47 (outer limit). Similarly, for GRI201 Economic Performance they also perform satisfactorily.

However, when we look at GRI302 Energy, and GRI408 Child Labour, we see that their performance is NOT within range and thus not sustainable. Additionally, it is clear what their performance is and to what

extent it is unsatisfactory with the in-range value for GRI302 Energy being 31 with an acceptable narrow window of just 25 to 27, and with a GRI408 of 43 whereby the acceptable range is 27 to 31.



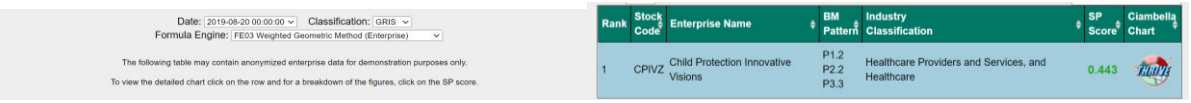
Figure 4.23. *The 17 United Nations Sustainable Development Goals as used in THRIVE Platform v1.x.*

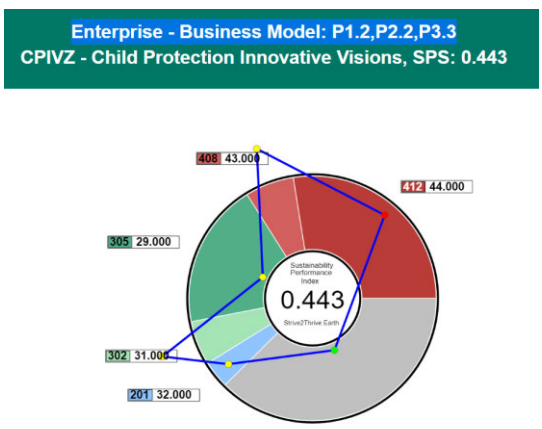
4.5.2.2. Manipulations of Parameters

Next, let's consider changes to the chosen material topic selections. This can be accomplished using presets, or by using the THRIVE Platform v1.x provision for the custom selection of material topics. This makes it easier for the user of the system to manipulate options and visually see the effects by clicking the Redraw button. As shown in ***Table 4.4***, we can see the entity CPIVZ - Child Protection Innovative Visions with a Basic set of GRIs, then with a Simple set, and lastly with a Comprehensive set (details on these sets can be found in the ***Appendix E: Reference Tables***).

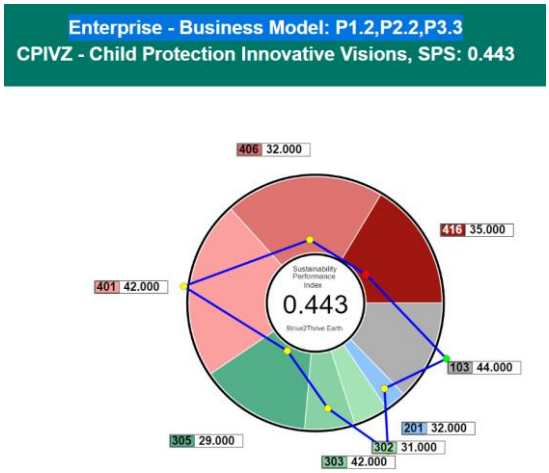
Lastly, there is an example with a custom set using the basic preset and then adding GRI418 Customer Privacy and GRI419 Socioeconomic Compliance. It is observed that on both topics the enterprise performs poorly (out of range). However, by switching to the different formula engine FE07, now there is no out-of-range performance values per se. What we do see is several values towards the outer edge as well as a totally different score of 2.705. This reflects the different formulation being used and highlight how easy it is to display very different scores, using the same impact data, by simply switching the formulation.

It is therefore thought, that in future versions a way to compare results should be provided, as well as a greater range of formulations. This latter point was then divided into a formula engine (same as in v1), a (system) weight engine, and a separate facility to manipulate individual (user) weights on per-material topic basis. Together these become the basis of the next iteration of the THRIVE Platform v2 which is a multiuser system with the ability to specify a date range, undertake comparisons between entities within a level, and the ability to perform score calculations across multiple levels.

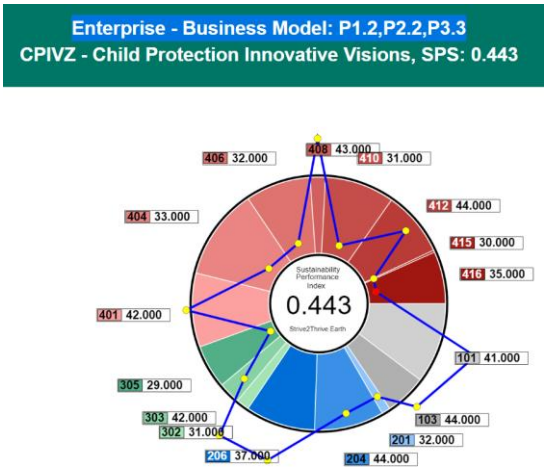




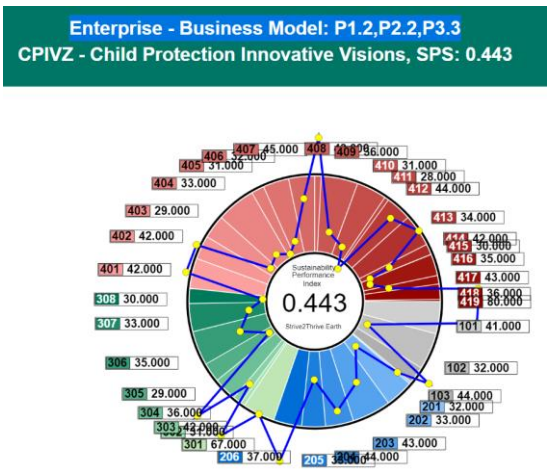
GRI Basic – FE03



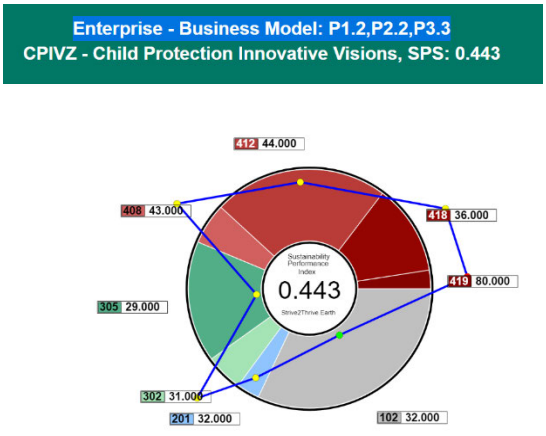
GRI Simple – FE03



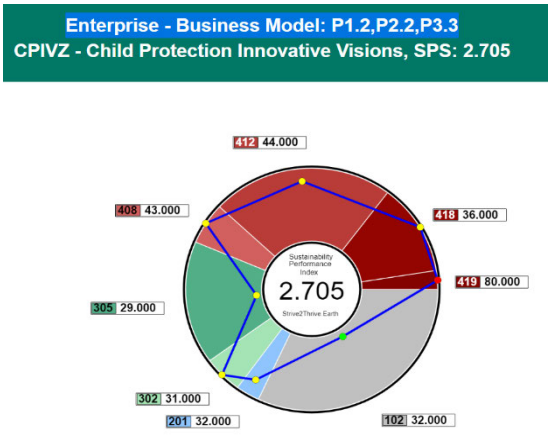
GRI Comprehensive – FE03



GRI All – FE03



GRI Basic + GRI418 + GRI419 – FE03



GRI Basic + GRI418 + GRI419 – FE07

Table 4.4. Ciambella Chart comparison using the parameters shown with a range of material topics. In addition, in the last cell the formula engine was also changed to FE07 (note: the different score).

4.5.3. THRIVE Platform v2.04

THRIVE Platform v2.x consists of a totally new rebuilt engine (*see* ***Appendix B: The THRIVE Platform***). In this version several new features have been added (

Figure 4.24), such that it is:

- Multiuser system with user administration and query history tracking.
- Adds level and date range parameters to the input and improved score and rank calculations.
- Adds a comparison tool allowing entities to be compared, including all entities within a group.
- Add formula and (system) weight engine, as well as user weight manipulation.
- Inbuilt support for backcasting, advanced charting, infographic and a cleaner interface.

THRIVE Platform v2.04		
Dashboard	Selection criteria	Level
	– e.g., Enterprise (purple)	Classification
		From Date
		To Date
		Formula Engine
		Weight Engine
		Entity
		Search
		New Search
		Compare
Output	Rank/Score	Rank
		Score
		Entity Model(s)
	Table	Material topic tickbox(es)
		Weight

		Material Topic
		Classification
		Allocation
		Inner Limit
		Outer Limit
		Impact
		SP(i)
		Preset
Output	Chart	Ciambella/Donut/Pie/Polar Chart
		Show/Hide Legend
		Infographic
		Legend topic on/off
Search(n)		

Figure 4.24. *THRIVE Platform v2.x onscreen dashboard parameters.*

The inspiration for v2.x came from the feedback following the release of the prototype v1.x and subsequent evaluation over a period of 9 months. Early on in v2.x some of the easier requests were incorporated such as the support for additional chart types such as bar chart and doughnut chart. Multi-user and multi-level (scale-linked) capability was added inherently as part of the new design, as well as the simpler and easier to use interface. Query implementation was transferred to the back-end server in the hope of improving performance. The new version implements normalisation, weight distribution, and allocations on the fly.

4.5.3.1. The Redesign

The redesign resulted in making the system far more process intensive and called upon for a rethink in terms of how it may be best implemented. The net result was that later the system was extended to include support for saving queries (as sessions) and included the support for comparisons between query results. This called for splitting the query

table result from the actual sustainability performance score calculation as the latter was far more processing intensive. This was both difficult as well as a confirmation that indeed there is added complexity (a whole order of magnitude higher) involved in taking the systemic approach.

It was discovered that many of the same queries were being run by users and the choice to save common queries as sessions proved a worthwhile decision. The sample database now incorporates over six million queries across 18,000 data points. This could be scaled up using cloud storage services to accommodate a growing number of queries and source datasets.

4.5.3.2. Choice of Weights and Material Topics

Compared to the earlier version, THRIVE Platform v2.x does much of its processing on the back end, allowing for common queries to be retrieved from the database. However, it does provide the user with the flexibility to manipulate weights as well as select a range of material topics they are interested in. As a result, score calculations are also required on the fly on the front end to avoid having to rerun queries on the database and maintain reasonable response times. This is because such queries have an impact on the chart and the scores but does not necessitate retrieving any additional records from the database.

Furthermore, a user of the system can individually select material topics such as energy, education, fair pay policy, or emissions for inclusion in the sustainability performance score or not. They may also do this through a series of presets as illustrated in ***Figure 4.25.***

A user may also choose from a range of weight engines designed to skew the impacts on datasets in a particular way. An example could be to more aggressive on climate action and less so on particular social issues or topics. The choice of weight engine acts as a system-wide preset on weights with certain coefficients preloaded across each of the material topics. The THRIVE Platform v2.x includes four preloaded system-wide weights, namely WE00 Default, WE01 Index, WE02 Purpose, WE03 Transform.

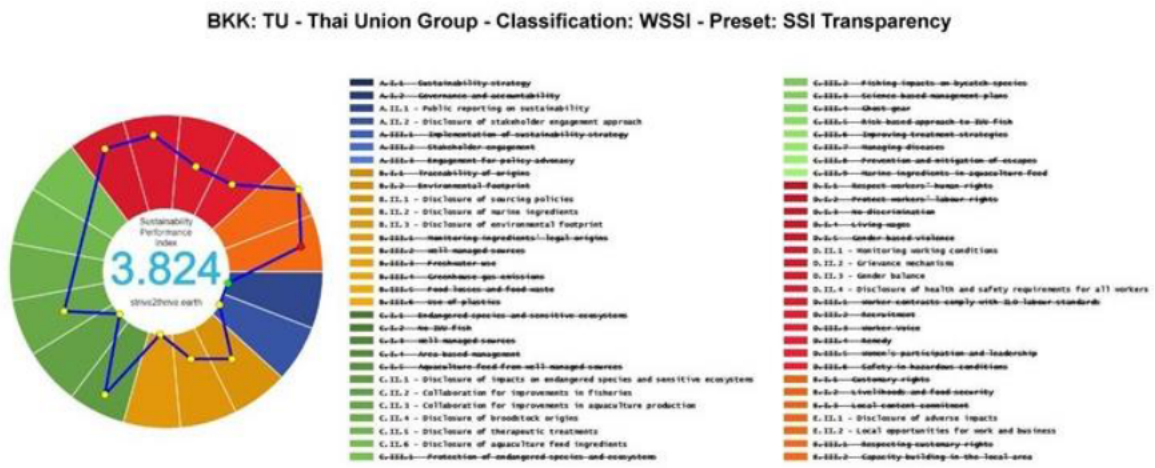


Figure 4.25. *THRIVE Platform v2 query with the example of Thai Union and preset 'Transparency'. Shown are the chosen material topics under consideration as part of this query selection.*

Moreover, individual user weights on a per material topic basis, may be manipulated to see the impact of such changes. These may be set at any value one desires including a negative value or zero. Setting a user weight to zero is in effect the same as deselecting it. Negative weights have the same but opposite effect that positive weights have and are helpful when wishing to offset certain impacts. Entered weights are normalised automatically, meaning they are adjusted to the extent of the permissible range. This is to ensure fair comparisons take place between the various entities being examined.

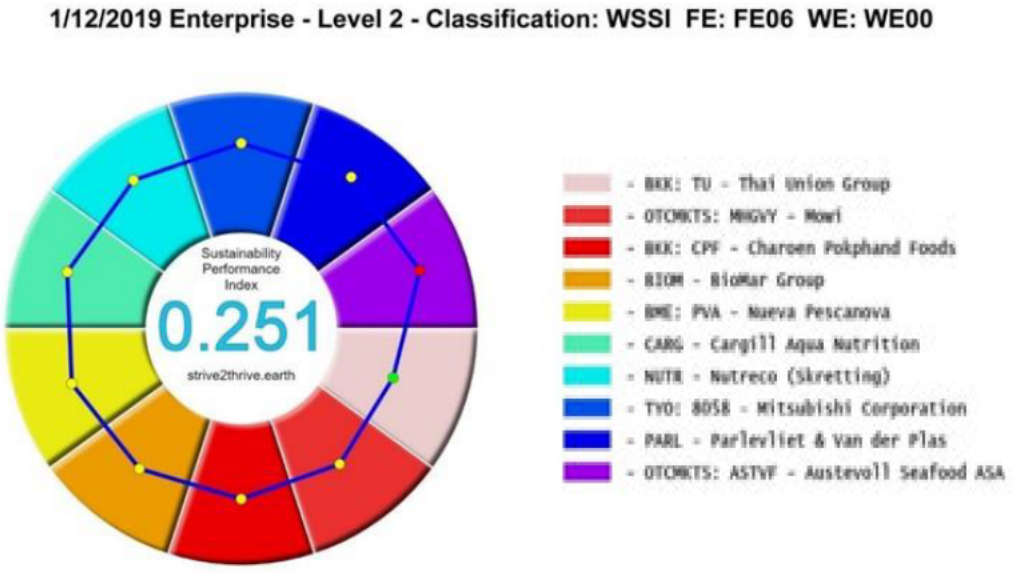
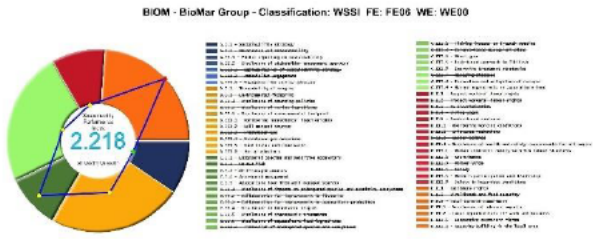
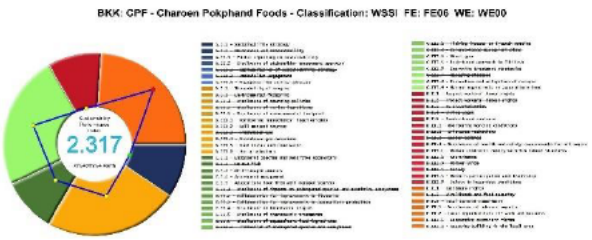


Figure 4.26. *THRIVE Platform v2 query showing an SPS index of 0.251 on an aggregate level-2 comparison across the top-10 enterprises in ranked performance order for the WSSI classification, using formula engine FE06 Seafood Stewardship Index and a default weight engine WE00.*

Thus, show in ***Figure 4.26*** Ciambella chart is the top-10 impact of the entities examined in the seafood industry across the aggregate of level-2 (enterprises) or equivalently level-3 (industry sector). A further breakdown of sustainability performance scores and Ciambella charts (***Figure 4.6****)* with rank for the top 10 enterprises can be seen in ***Figure 4.27***. You will note that on the WSSI scale the impact ranges from 0 to 5 with a score closer to 5 being more sustainable and thus closer to bullseye.



Rank #4: BIOM - BioMar Group



Rank #3: BKK: CPF - Charoen Pokphand Foods



Rank #1: BKK: TU – Thai Union Group



Rank #5: BME: PVA – Nueva Pescanova



Rank #6: CARG – Cargill Aqua Nutrition



Rank #7: NUTR - Nutreco (Skretting)



Rank #10: OTCMKTS: ASTVF Austevoll Seafood ASA



Rank #2: OTCMKTS: MHGVY - Mowi

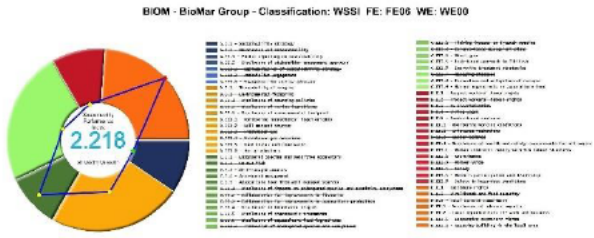


Rank #9: PARL – Parlevliet Van der Plas

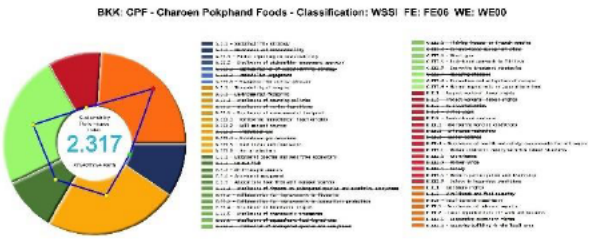


Rank #8: TYO: 8058 – Mitsubishi Corp

Figure 4.27



Rank #4: BIOM - BioMar Group



Rank #3: BKK: CPF - Charoen Pokphand Foods



Rank #1: BKK: TU – Thai Union Group



Rank #5: BME: PVA – Nueva Pescanova



Rank #6: CARG – Cargill Aqua Nutrition



Rank #7: NUTR - Nutreco (Skretting)



Rank #10: OTCMKTS: ASTVF Austevoll Seafood ASA



Rank #2: OTCMKTS: MHGVY - Mowi



Rank #9: PARL – Parlevliet Van der Plas



Rank #8: TYO: 8058 – Mitsubishi Corp

Figure 4.27. *THRIVE Platform v2.x Sustainability performance score Ciambella charts and rank for the top 10 enterprises in the seafood industry based on a default WE00 weight engine (shown alphabetically by stock code).*

4.6. Conclusion

In this chapter the Systemic Holistic Model (SHM) encapsulating the four quadrants of Significance, Scale, Scope, and Shift (4S) are outlined to showcase the 12 Foundational Focus Factors (12FFF) of the THRIVE Framework. These are the necessary and sufficient factors needed to transform an entity towards thrivability as illuminated by the literature. The chapter delves into the complex and trans-disciplinary approach required, across scales, leveraging simulation and machine learning modelling across vast datasets to develop a path forward known as systemic orchestration. It details how machine learning may be used to control for bias and variance and classify entities strategy based on entity model patterns, making predictions using backcasting techniques as informed by the literature. It details how within the ambit of management research one can develop a theory of change based on the exaptation of proven technological rules.

Furthermore, this chapter outlines the THRIVE Framework class and the THRIVE Platform instantiation, providing a tour of the software system and underlying datasets and chosen development lifecycle. Then a specific case study is exposed: that of the Seafood Stewardship Index (SSI) developed in this study and available on a comparative basis with a similar but less detailed version of the same study by the World Benchmarking Alliance. There is an acknowledgement of keystone actors, business model patterns and calculated impacts, showing how these compare to other studies using the same source dataset. The ability to conduct scenario analysis and the easily interpreted visualisation afforded by the Ciambella Charts makes for *experimentation at a distance* as to the effect of changes on thresholds, weights, and formula engine. Importantly, we see the link between strategy or entity model and sustainability performance impact.

CHAPTER 5: EVALUATION

5.1. Background

The development of the THRIVE Framework involved a robust research design process that aimed to ensure both relevance and rigour. The research process incorporated an extensive evaluation of literature and input from experts in the field. The evaluation strategy aimed to determine the utility and fitness for purpose of the artefact (Gill & Hevner 2013). The results of the evaluation demonstrate its potential to contribute to the advancement of knowledge in the field of sustainability, management theory, and the application of design science research.

Specifically, in the first stage, the evaluation required expansive investigation of the field and was targeted towards seeking input from experts with a view to develop sufficient grounding in the field. The second stage was developed around a case study for which there is a comparative evaluation available, albeit, not as detailed. The evaluation was conducted anonymously such that even though the selection was based on a profile list of self-selected experts, there was no pre-selection of respondents. All responses were collated and used in a summative form, with participants given the opportunity to comment further only if they wished.

This document serves to outline the evaluation process adopted, by covering the following (***Figure 5.1***):

- Introduction: purpose to evaluate the THRIVE Framework and THRIVE Platform.
- Methodological approach: Recap on the methodology approach used.
- Research design process: Delphi study followed by a case study.
- Construction: required many steps from pen and paper through to software code.
- Technology Stack: details of the software stack used in the implementation.
- Feature List: list of key features plus extended ones.

- Participant Selection: how sampling and selection took place.
- Evaluation Results: outcome of the evaluation process.
- Evaluation Protocol: based on both the general and situated knowledge.
- Software Evaluation Checklist: for form and function.
- Data Collected / Response Summary: from those providing feedback.
- Presentation / Evaluation Results: summary of the evaluation results.
- Case Study Evaluation: outcome of the case study analysis.
- Summary: overall summary from the evaluation.

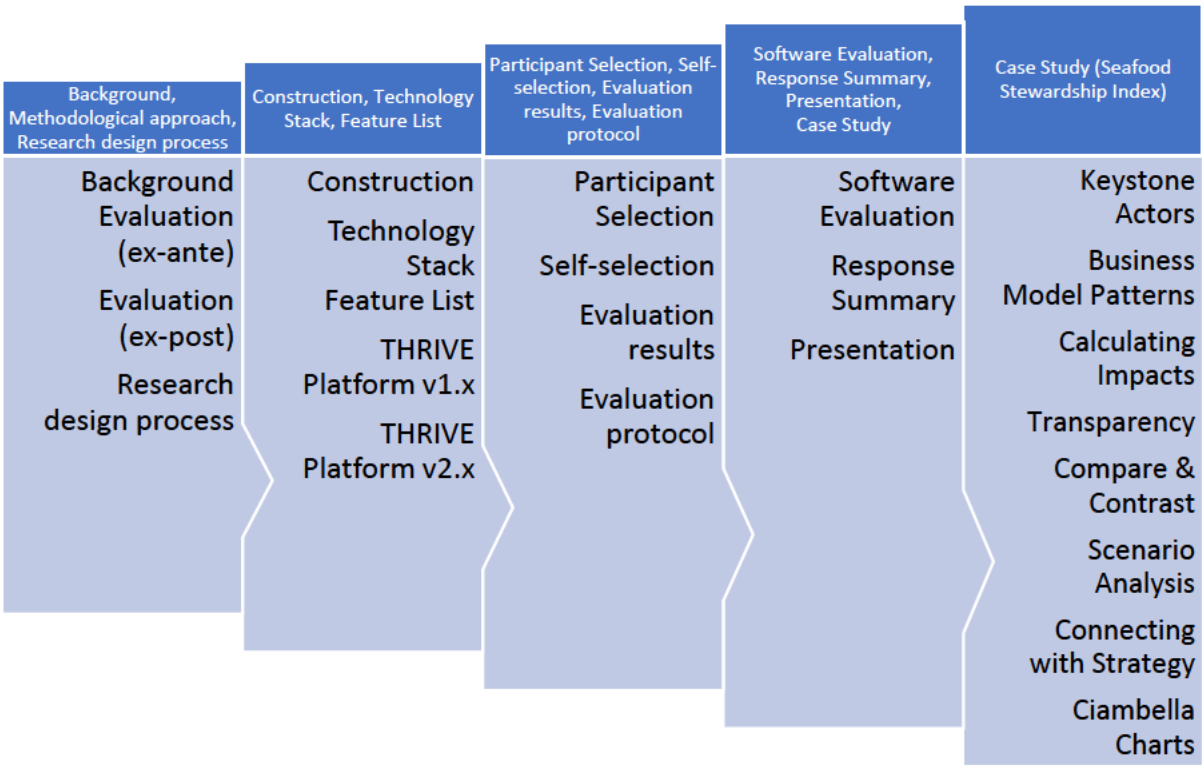


Figure 5.1. Chapter 5 EVALUATION chapter layout.

5.2. Methodological approach

The research design process behind the development of the THRIVE Framework is a comprehensive and iterative approach that lasted for around 28 months during the study design phase. The process included a thorough evaluation of the prevailing literature and input from the sustainability community to ensure relevance and rigor, as the main requirements for design science research (DSR) (Benbasat & Zmud 1999; Hevner et al. 2004; Sonnenberg & Vom Brocke 2012).

The research process is illustrated in ***Figure 5.2***, which represents the descriptive knowledge on the left-hand side and the pre-prescriptive knowledge on the right-hand side. The relevance cycle on the left checks each aspect of the artefact at a practical level to determine if newly found information meets the requirements, and if it is relevant to the problems and opportunities being addressed. On the right side, the rigor cycle evaluates each piece of literature for its significance and value to the overall objective. The combination of rigorous cyclic nature and practical relevance, informed by philosophical theoretical underpinnings, is what makes DSR effective in developing artefacts (Hevner et al. 2004).

This philosophy draws from pragmatists (Aboulafia 1991) who argue that truth and utility are two sides of the same coin, and that scientific research should be evaluated based on its practical implications (Hevner et al. 2004). This idea underlies the paradigm of the 'design sciences', bridging the relevance gap in academic management research by complementing description-driven research with prescription-driven research, resulting in Management Theory (Joan E. van Aken 2004).

The development of the THRIVE Framework followed an iterative design process, incorporating the evaluation of both descriptive and pre-prescriptive knowledge and incorporating input from experts in the field (Pfeffer & Salancik 2003). The DSR methodology used in the study included two key methods: the evaluation of management theory components (Joan E. van Aken et al. 2016) through the Delphi study (Day & Bobeva 2005), followed by a case study (Eisenhardt 1989).

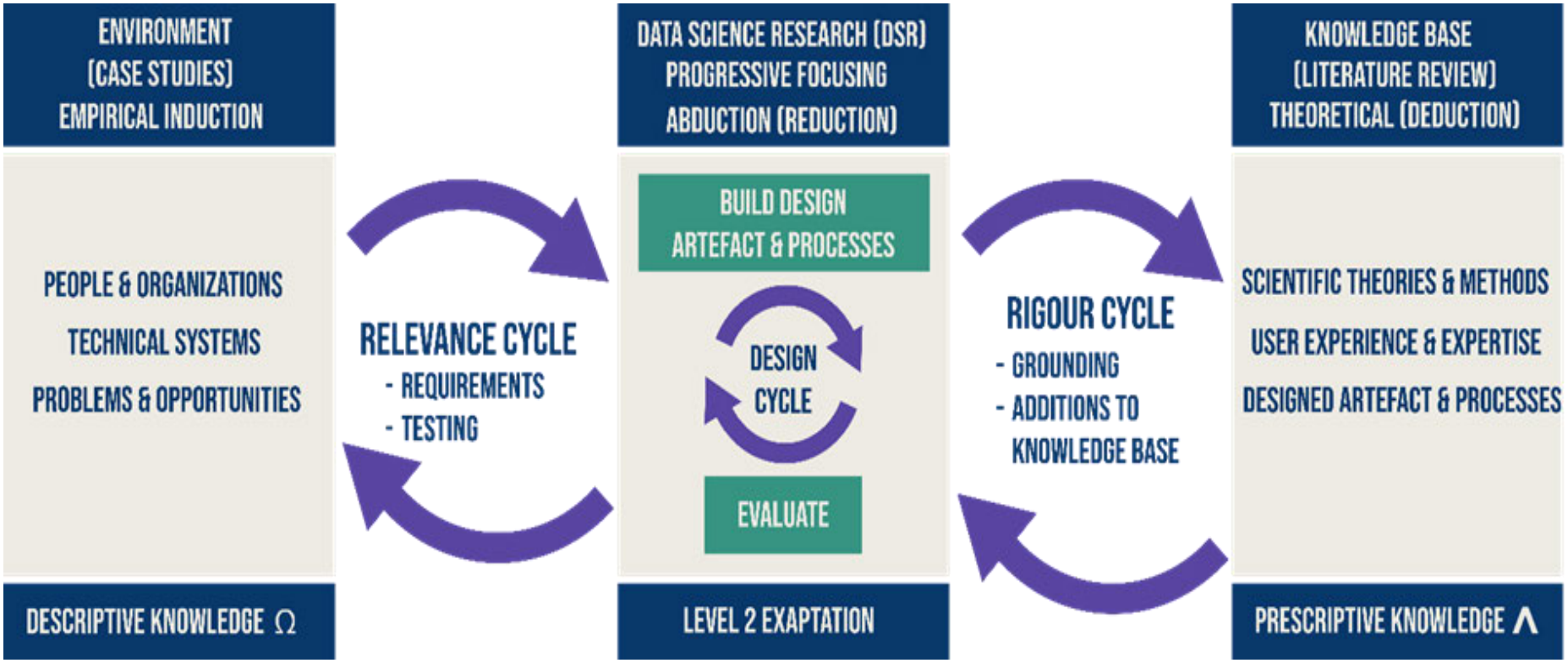


Figure 5.2. *The DSR process created by the author for this study. Adapted from Hevner (2007).*

The research process involved recognising a problem, analysing published literature for ideas, developing a prototype pattern solution, and testing the prototype in practice (Peffers et al. 2008).The Delphi study involved interviewing a small group of experts in the field to gain further insight and inform the development of the THRIVE Framework. The case study involved 30 cases of enterprises within a specific sector that were evaluated based on their business model (BM) and sustainability performance index (SPi). Together, this allowed for the development of technological rules and thus the evaluation of management theory (Joan E. van Aken 2004).

The evaluation strategy used in this study builds on the DSR evaluation framework by Pries-Heje et al. (2008), later expanded by Venable et al. (2012), and articulated by Shrestha et al. (2014). The evaluation strategy aims to determine the utility of the artefact's performance and its fitness for purpose (March & Smith 1995; Gill & Hevner 2013). The evaluation involved two main activities: developing a demonstration and detailed evaluation of the design (Peffers et al. 2008) and conducting a descriptive analysis based on a thorough review of the prevailing literature to include all the necessary and sufficient requirements. The design evaluation method also involved an ex-ante evaluation and an experimental simulation of the instantiated case study (ex-post) (Hevner et al. 2004).

Whilst principally the evaluation concerns itself with the conceptual framework, the THRIVE Platform tool served an important purpose as it allowed to ostensibly illustrate the concepts presented in the THRIVE Framework in an interactive and visual way. It also provided the means to load an actual case study, namely the world Seafood Stewardship Index dataset (WBA 2018) for manipulation and demonstration, thereby showcasing the transparency and illustrating the principles derived during the analysis. The THRIVE Framework and Platform represent the class and instantiation of the THRIVE online web-based software system respectively. The THRIVE Framework was conceived in early 2017 and the

subsequent instantiation THRIVE Platform v1.x (POC) and v2.x (MVP) have been developed since then. Further information available at https://ThrivabilityMatters.Earth.

5.2.1. Evaluation (ex-Ante): Evaluating the design

The ex-Ante evaluation was the result of extensive investigation into the literature locally and abroad and principally preliminary talks with senior experts in the field during conference participations and follow up video sessions. This informed much of the design of the THRIVE Framework and first instantiation in the form of THRIVE Platform v1.x prototype (Released in Jan 2020). This approach offered a coherent alternative way to generate the initial collection of opinions for the Delphi panel through a synthesis of the literature (Day & Bobeva 2005).

5.2.2. Evaluation (ex-Post): Evaluating the artefact

The second evaluation is ex-Post and was thus undertaken during the research post the construction and revision of the artefact. This comprised of semi-structured interviews and served to confirm the overall completeness, usefulness, effectiveness, and soundness of the artefact. This included the THRIVE framework, platform as the minimal viable product (MVP) THRIVE Platform v2.x, and the resulting sustainability performance scorecard (SPS) tables and associated charts (Sep 2020).

5.3. Research design process

Various options were considered. Initially it was thought a survey could serve the purpose, however, given the technical nature of the tool, this was ruled out.

The core goal is to move DSR to more meaningful evaluations of design artifacts for sustainable impacts, design fitness and design utility, and practical usefulness (Gill & Hevner 2013). Best known as the Innovator's Dilemma (Christensen 2005), evolutionary economics shows us the tendency of organisations and economies to stick with designs that have proven useful. (Hevner et al. 2004) state that truth and usefulness are two sides of the same coin. Quality of the design artefact can therefore be improved through a large number of iterations afforded by

making the researcher an active participant in the design of the system (Gill & Hevner 2013).

Next a Delphi study consisting of an evaluation interview was considered, targeting a series of usability criteria following a custom devised CUES protocol addressing **C**ompleteness, **U**sefulness, **E**ffectiveness, and **S**oundness (CUES). These attributes were informed by Sonnenberg and Vom Brocke (2012) balancing the interest of practitioners' interest in usefulness and relevance and researchers' desire for validity and rigour. This approach is based on Venable et al. (2012) evaluation goals for DSR, establishing rigour and relevance as illuminated by Hevner (2007). The evaluation revolved around examining various aspects of the THRIVE Framework and THRIVE Platform and soliciting the response and input of a group of expert participants in relation to the THRIVE Framework's Systemic Holistic Model, the THRIVE Platform, the Ciambella Charts, and FE and WE.

5.4. Sampling / Participant Selection

As part of the Delphi study (Day & Bobeva 2005), and the participant selection step, the contribution of those with expertise in the knowledge domain was sought. This was done in aid of theory generation, evaluation, and generalisation, so as to inform the example underlying technological rules (Joan E. van Aken 2004) attributed to the field of research. Anonymity was ensured between participants, with choice in criteria as identified in ***Table 5.1***.

CRITERIA	CHOICE
Purpose of the study	Evaluation
Number of rounds	Two
Participants	Heterogenous
Mode of operation	Remote
Anonymity of panel	Full – between all members
Communication media	Internet
Concurrency of rounds	Sequential

Table 5.1. *Taxonomy of Delphi enquiry design.*

Sampling of participants was based on purposeful, convenience and maximum variation (Patton 2002; Bansal et al. 2017). List of potential participants was drawn from (approximate sample size shown in brackets):

- LinkedIn followers (19,400+).
- SSBMG/FEI group members (2500+).
- Newsletters: OQCE, PGECR (various).
- R3.0 group members (300+).
- Conference participants (600+).
- Academics at GU, USQ, QUT, UQ, Monash (60+).
- Consumers (120+).
- Colleagues (32+).

Potential participants were either ones that became aware of the THRIVE Project or responded to the blanketed approached via social media and email in the first instance. In some cases, they were followed up by a phone call. In all cases they volunteered to participate at their discretion and hence demographical outcome is the result of self-selection.

5.5. Self-selection

Those potential participants who indicated a willingness to participate were funnelled to the THRIVE Project Priority Program webpage (see ***Appendix D: Study Collaterals***). An evaluation brief, including references to the live artefact and other supporting materials were freely made available there. The formal part of the evaluation lasted around 40min. Those who were willing to provide further commentary were encouraged to do so. Participant details were recorded as they agreed to take part in the evaluation. Therefore, participants self-selected themselves for inclusion, although it was known already that they were regarded as an expert.

5.6. Evaluation Results

Results of the evaluation process was gathered anonymously over the following months. Initial results were presented at forthcoming public events, competitions, and conferences, including the following:

- International New Business Model Conference, Jul 2018.
- Strongly Sustainable Business Model Group Meeting, Jan 2020.
- Circular Economy Forum, Mar 2020.
- r3.0 International Conference, Sep 2020.
- THRIVE Project Presentation, May 2021.
- Thrivability Matters Webinar, Aug 2022.
- EHL University Presentation, Dec 2022.
- TBLI Awards, Jan 2023 (THRIVE Project 2022).

An extensive set of presentations made over time, including links to the presentation materials and audio-visuals wherever available, can be found at the THRIVE Project website (https://ThrivabilityMatters.Org/presentations).

Participants received collated results early, allowing them to check the same before the results were circulated to the wider group above. They were also provided with the opportunity to be identified as contributing to the evaluation process in official materials circulated with the same, if they so desired. We advised participants that we are collaborating with the Flourishing Enterprise Institute (on the Global Thresholds and Allocation Council) and are peers with the r3.0/Sustainable Development Performance Indicators (context-based metrics) for the United Nations Research Institute for Social Development (UNRISD) project and will be sharing our findings with them.

5.7. Evaluation Protocol

Participants evaluated and provided critical feedback on the following:

- THRIVE Framework: THRIVE conceptual framework and components (Artefact) [General Knowledge] [**RQ1**].

- THRIVE Platform: THRIVE online platform including the platform (https://platform.strive2thrive.earth/), producing the ranked sustainability performance scorecard (SPS) table and charts (Instantiation) [Situated knowledge] [**RQ2**].

The evaluation was based on a contracted version of the 12 Foundational Focus Factors called the Systemic Holistic Model (SHM) (***Figure 5.3***). The Systemic Holistic Model brings together the 12 Foundational Focus Factors into the four quadrants of Significance, Scale, Scope, and Shift (4S). Throughout the interview process, participants were exposed to various aspects of the Systemic Holistic Model and asked to comment on the relevance of each of the included factors. Time was taken to ensure there was a good understanding of the terms in use to bridge the gap between the various disciplines. Wherever possible, examples were used, or the participants were encouraged to refer to an adopted term or preferred definition to use. During the Delphi panel interviews we evaluated A and B against the following 4S (Significance, Scale, Scope, and Shift). Below is the template used with '?' referring to a result to be recorded (***Table 5.2***).

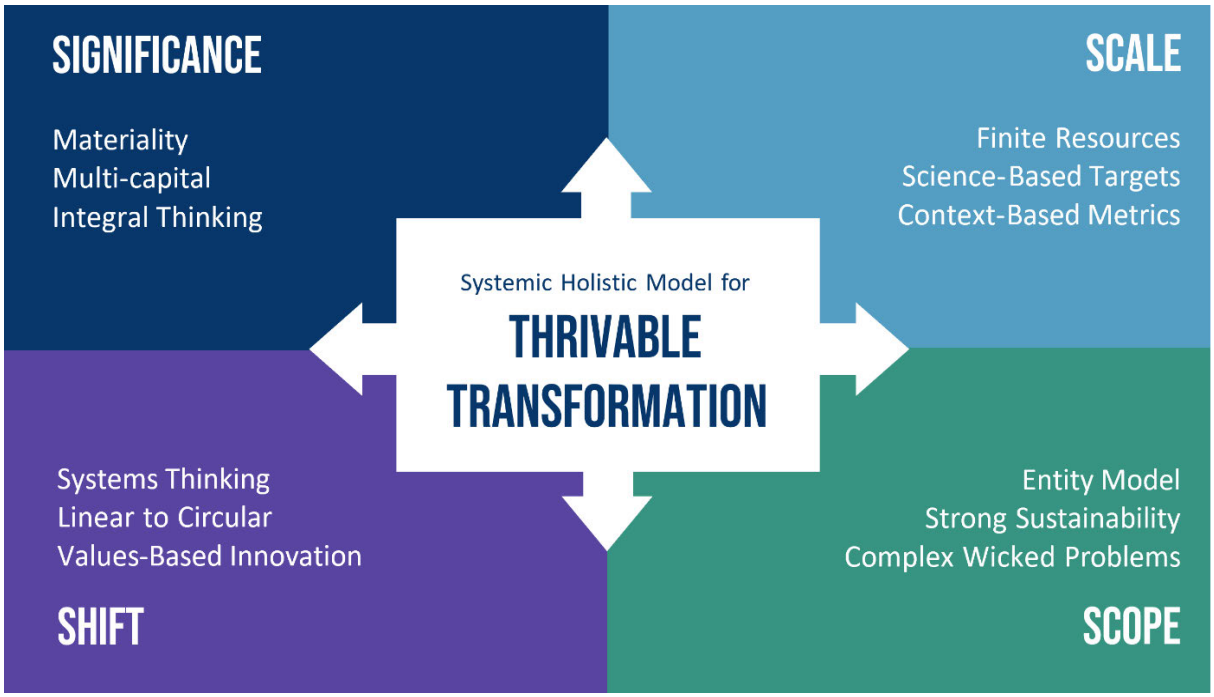


Figure 5.3. The Systemic Holistic Model (SHM) for Thrivable Transformations, showing the four groupings of the foundational focus factors of significance, scale, shift, and scope.

QUADRANT	FOUNDATIONAL FOCUS FACTOR BEING EXAMINED	RESPONSE/ COMMENT
Significance	• Materiality • Multi-capital • Integral Thinking	• ? • ? • ?
Scale	• Finite Resources • Science-Based • Context-Based	• ? • ? • ?
Shift	• Values-Based • Linear to Circular • Trans-disciplinary	• ? • ? • ?
Scope	• Boundary/Entity • Strong Sustainability • Complex Wicked Problems	• ? • ? • ?

Table 5.2. *Delphi interview panel template.*

And individually with each participant against the following **CUES** (***Table 5.3***):

USABILITY CRITERIA	ENCOMPASSING DEFINITION
Completeness	Functionality & Consistency
Usefulness	Utility & Comprehensibility
Effectiveness	Reliability & Flexibility
Soundness	Validity & Ethicality

Table 5.3. *CUES usability criteria used during the evaluation.*

With the following summative evaluand definitions, as shown in ***Table 5.4.***

EVALUAND	REFERENCE
Functionality:	Hevner et al. (2004)
Consistency:	Hevner et al. (2004)
Utility:	Hevner et al. (2004)
Comprehensibility:	Mathiassen et al. (2000) (based on the ISO standard 9126)
Reliability:	Hevner et al. (2004)
Flexibility:	Mathiassen et al. (2000) (based on the ISO standard 9126)
Validity:	Huberman and Miles (2002); Miles et al. (2014); Checkland (1995)
Ethicality:	Checkland and Scholes (1990)

Table 5.4. *List of evaluands and relevant reference.*

The evaluations were short, and the results were anonymised. Evaluations were recorded via skype/zoom, maintaining confidentiality between participants, avoiding any chance of collusion, and ensuring independent responses. The recordings were used for the purpose of accurately collating the responses.

5.7.1. Phase I: Approach

Participants selected came from the following broad, untargeted, use cases, as shown in ***Table 5.5***.

USE CASE	DESCRIPTION
Enterprise leaders/senior management	Encouraging enterprises to do good to do well in pursuing a competitive advantage
Business analysts/ consultants	Providing business analysts with tools to guide enterprise strategies
Academic/private researchers	Assisting researchers to analyze trends and effectiveness of business models for sustainability

Government officers/employees	Allowing government decision makers to forecast the effects of regulatory or legislative actions
Consumers/Public at large	Empowering individuals to actively *stimulate competition* among enterprises

Table 5.5. *Participant selection.*

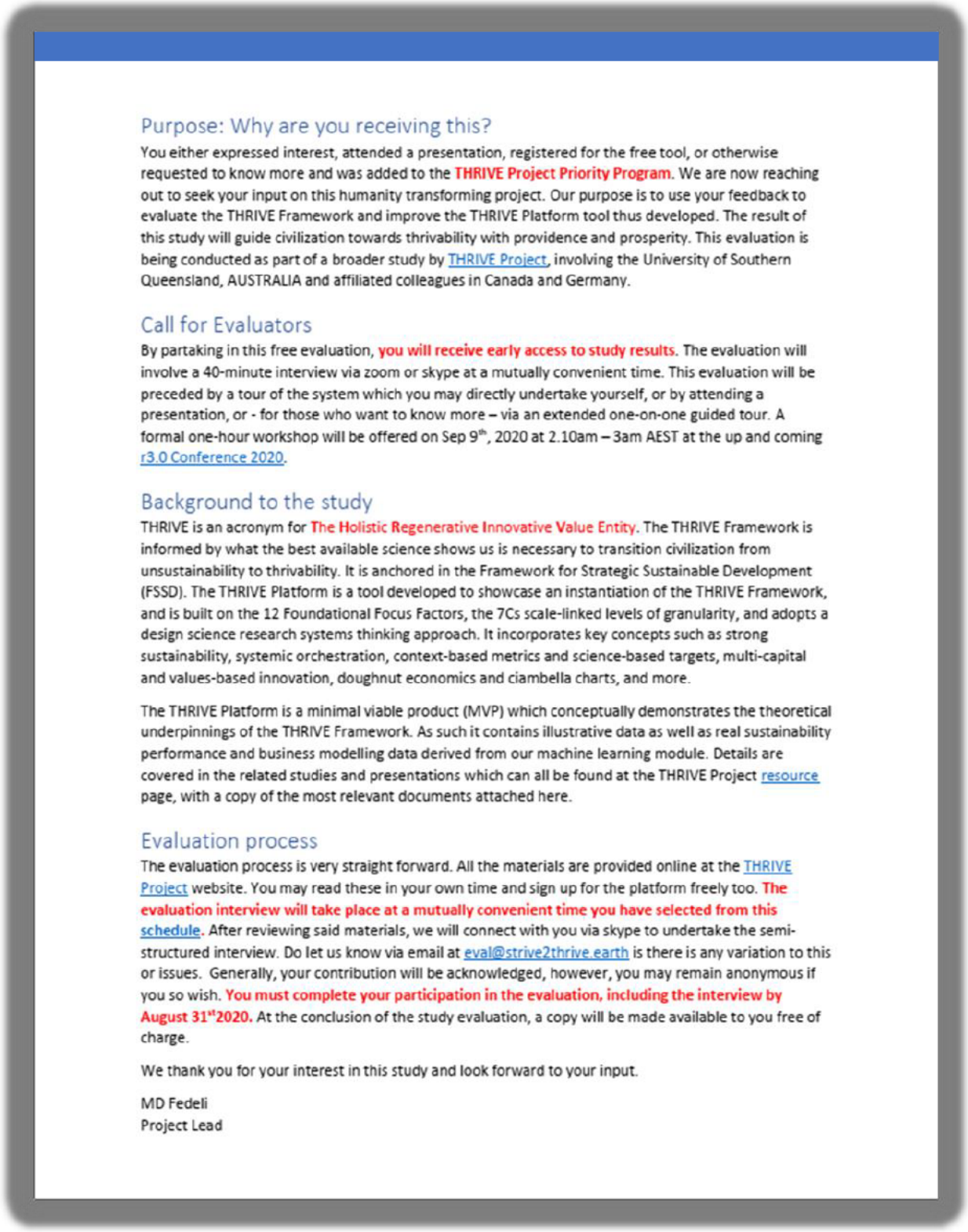
The number of use cases was not targeted. The critical input was collected and recorded. There was time allocated for unstructured comments for those who wished to provide the same, over and above the structured interview.

5.7.2. Phase II: Distribution of materials

All participants were emailed an Evaluation Letter (See below) and provided with the Participant Information Sheet (PIS) and Participant Consent Form (PCF) (see in ***Appendix D: Study Collaterals***). Overview of the study (https://thrivabilitymatters.org/?page_id=8166&preview_id=8166&preview=true) was made available online, outlining the purpose, background, and evaluation process (see below). Links to the THRIVE Platform together with brief descriptions of how it works, and overview videos was provided (see ***Appendix B: The THRIVE Platform***).

5.7.3. Phase III: Evaluation

The evaluation interview was conducted by the researcher. Questions were adjusted to reflect the audience. A series of open-ended questions were asked aimed at finding out specific answers to the following criteria (Searcy 2011). Of most interest is the elaboration of the answers provided. The table shown below (**Table 5.6**) was used as the basis of asking questions to prompt discussion around the artefact.



Purpose: Why are you receiving this?

You either expressed interest, attended a presentation, registered for the free tool, or otherwise requested to know more and was added to the **THRIVE Project Priority Program**. We are now reaching out to seek your input on this humanity transforming project. Our purpose is to use your feedback to evaluate the THRIVE Framework and improve the THRIVE Platform tool thus developed. The result of this study will guide civilization towards thrivability with providence and prosperity. This evaluation is being conducted as part of a broader study by THRIVE Project, involving the University of Southern Queensland, AUSTRALIA and affiliated colleagues in Canada and Germany.

Call for Evaluators

By partaking in this free evaluation, **you will receive early access to study results**. The evaluation will involve a 40-minute interview via zoom or skype at a mutually convenient time. This evaluation will be preceded by a tour of the system which you may directly undertake yourself, or by attending a presentation, or - for those who want to know more – via an extended one-on-one guided tour. A formal one-hour workshop will be offered on Sep 9th, 2020 at 2.10am – 3am AEST at the up and coming r3.0 Conference 2020.

Background to the study

THRIVE is an acronym for **The Holistic Regenerative Innovative Value Entity**. The THRIVE Framework is informed by what the best available science shows us is necessary to transition civilization from unsustainability to thrivability. It is anchored in the Framework for Strategic Sustainable Development (FSSD). The THRIVE Platform is a tool developed to showcase an instantiation of the THRIVE Framework, and is built on the 12 Foundational Focus Factors, the 7Cs scale-linked levels of granularity, and adopts a design science research systems thinking approach. It incorporates key concepts such as strong sustainability, systemic orchestration, context-based metrics and science-based targets, multi-capital and values-based innovation, doughnut economics and ciambella charts, and more.

The THRIVE Platform is a minimal viable product (MVP) which conceptually demonstrates the theoretical underpinnings of the THRIVE Framework. As such it contains illustrative data as well as real sustainability performance and business modelling data derived from our machine learning module. Details are covered in the related studies and presentations which can all be found at the THRIVE Project resource page, with a copy of the most relevant documents attached here.

Evaluation process

The evaluation process is very straight forward. All the materials are provided online at the THRIVE Project website. You may read these in your own time and sign up for the platform freely too. **The evaluation interview will take place at a mutually convenient time you have selected from this schedule**. After reviewing said materials, we will connect with you via skype to undertake the semi-structured interview. Do let us know via email at eval@strive2thrive.earth is there is any variation to this or issues. Generally, your contribution will be acknowledged, however, you may remain anonymous if you so wish. **You must complete your participation in the evaluation, including the interview by August 31st 2020.** At the conclusion of the study evaluation, a copy will be made available to you free of charge.

We thank you for your interest in this study and look forward to your input.

MD Fedeli
Project Lead

Figure 5.4. *Evaluation letter sent to all participants evaluating the THRIVE Framework and Platform.*

USABILITY CRITERIA	ENCOMPASSING DEFINITION	QUESTION PROMPTERS....
Completeness	Consistency	**C1** Does the THRIVE Framework provide for repeatable outcomes? • Are all key elements well integrated? • Are you confident in the results?
	Functionality	**C2** Does the THRIVE Dashboard offer enough functionality to meet the sustainability performance scorecard objective? • Are the control options enough to compare the sustainability performance of enterprises? • Are you able to choose the taxonomy and level (scale) of evaluation?
Usefulness	Utility	**U1** Does the THRIVE Framework serve its intended purpose in evaluating the sustainability performance of enterprises? • Would you use such a tool based on the THRIVE framework? • Do the strongly sustainable ranked scoring provide guidance for transformation?
	Comprehensibility	**U2** Does the THRIVE Dashboard provide clarity on how it achieves this purpose? • Are the choice and use of levers clear? • Are the tables and charts helpful?

USABILITY CRITERIA	ENCOMPASSING DEFINITION	QUESTION PROMPTERS....
Effectiveness	Reliability	**E1** Does the THRIVE Framework provide trustworthy and dependable performance measures? • Are the data sources clear? • Are the comparisons meaningful?
	Flexibility	**E2** Does the THRIVE Dashboard provide a range of worthwhile options during its use? • Are the choices in taxonomy, unit of measure and levels useful? • Are the choices in material topics and presets of value?
Soundness	Validity	**S1** Does the THRIVE Framework assess the sustainability performance of enterprises? • Is the THRIVE framework representative of the sustainability performance of enterprises? • Does the framework provide a fair comparison?
	Ethicality	**S2** Does the THRIVE Framework provide an ethical outcome? • Is the design reputable and trustworthy, given its holistic integrated imperative? • Is the approach ideal, given its transparent, open, public platform design?

Table 5.6. *Reference table of usability criteria used in the assessment for this study.*

5.7.4. Phase IV: Collation of responses

All interviews were audio-video recorded using skype/zoom. These recordings were not transcribed, however, were reviewed to extract answers to each question and summarised. These summarised answers were collated into groups to reflect each of the 4S (Significance, Scale, Scope, and Shift). A summary of these responses can be found in the table below (***Table* 5.8**), together with a summary of basic demographics (***Table 5.7***). Note that during the interview, respondents were given latitude to pick whichever entity more closely matches their needs and in all cases that included at a minimum an enterprise.

	Total emails	***Total reads***	***Total appointments***	***Total interviews***
General Response	*330*	*90.33%*	*9*	*8*
	Researchers	*Academics*	*Students*	*Consultants*
Respondent* (may overlap)	*3*	*5*	*3*	*5*
	Framework	*Platform*		
Predominant Interest	*4*	*4*		
	Europe	*America*	*Asia*	
Location	*6*	*1*	*1*	
	Yes	*Do not know*		
Wants to use THRIVE Platform	*5*	*3*		
	Advisor	*Tribe*	*Kept Informed*	
Wants to join THRIVE Project* (may overlap)	*1*	*1*	*4*	

Table 5.7. *Summary of demographics pertaining to the Delphi panel participants.*

Usability criteria	Responses…
C1: **C**ompleteness Consistency Does the THRIVE Framework enable repeatable outcomes?	P1: Yes *P2:* Mostly, however, finds the concept of a strongly sustainable agnostic platform as a contradiction. P3: Thought not so, raised several seemingly shortcomings. P4: Yes, thinks all are approaches are much the same. P5: Yes. P6: Yes. P7: Assumes so. P8: Yes.
C2: **C**ompleteness Functionality Does the THRIVE Dashboard offer enough functionality to meet the sustainability performance scorecard objective?	P1: Not sure. P2: Not sure. Believe we need a degrowth perspective. P3: Generally, however concerned at the rigidity around the hierarchical approach. Need to be identify context. P4: Yes. Would like to see more visualisations. P5: Probably, however believes there is no use for government. P6: Yes. P7: Yes. P8: Do not know.
U1: **U**sefulness Utility Does the THRIVE Framework serve its intended purpose in evaluating the sustainability performance of enterprises?*	P1: Yes P2: Yes, however finds integrated reporting not significant factor. P3: Maybe, is not convinced. P4: Yes, loves the transparency. P5: Yes. P6: Yes. P7: Yes. P8: Yes. Provided assumptions are explained.

Usability criteria	Responses…
U2: **U**sefulness Comprehensibility Does the THRIVE Dashboard provide clarity on how it achieves this purpose?	P1: Not sure. P2: Yes. P3: Yes, although some areas as per above need further reason as to why these are assumed. P4: Yes, is familiar with similar tools. P5: Yes, but thinks the interface is poor, wants links to past studies and more onscreen comparisons. Should have a different interface for each user. P6: Mostly. Wanted explanation of each aspect. P7: More interested in cross-sectional data. P8: Yes.
E1: **E**ffectiveness Reliability Does the THRIVE Framework provide trustworthy and dependable performance measures?	P1: Yes. P2: Yes, although we need to do more. P3: Unsure. P4: Yes. P5: Largely but doubts all rules are implemented. P6: Yes. P7: Yes. P8: Yes. Should integrate a source management system.
E2: **E**ffectiveness Flexibility Does the THRIVE Dashboard provide a range of worthwhile options during its use?	P1: Yes. In fact, maybe too many options make it confusing. P2: Appears so, however wonders about the mechanism for governance and how to enforce across the 7Cs. P3: Yes. P4: Yes, maybe too many. P5: Yes. P6: Yes, thinks so. Suggests a scale aggregator engine? P7: Should simplify the tool. P8: Generally, could have more customisation.

Usability criteria	Responses...
S1: **S**oundness Validity Does the THRIVE Framework assess the sustainability performance of enterprises?*	P1: Yes. P2: Yes. P3: Assumes so. P4: Yes. P5: Yes, although again, sees no application for governments. P6: Yes. P7: Yes. P8: Yes.
S2: **S**oundness Ethicality Does the THRIVE Framework provide an ethical outcome?	P1: Seems so. P2: They think so. P3: Yes. Assumptions need to be specified. P4: Yes. P5: Debatable, wanted specific info on source datasets on individual basis. P6: Yes. P7: Yes. P8: Yes, would caution about saying so though. Need to be clear with definitions.

Table 5.8. *Summary of responses from Delphi panel participants.*

Here are excerpts from the comments made by the Delphi panel participants during the interviews, that was the basis of inspiring the THRIVE Platform v2.x and further refinements of the THRIVE Framework. In square brackets is their core area of interest: the THRIVE Framework or the THRIVE Platform. Further details on responses are available from the ***Appendix D: Study Collaterals***. Responses have been annotated for clarity starting with a '#'.

P1 [THRIVE Framework]:

- Tension between the pillars, suggesting more emphasis on integrated reports. #Integrated Reports renamed to the more expansive term Integral Thinking.
- Short term most startups aim for financial profitability before embracing sustainability. How to reconcile with the approach taken

by the framework. #The framework aims for long-term thrivability rather than merely breakeven sustainability.

- Major interest is in introducing a self-assessment tool for would be entrepreneurs and startups. #Future version of the Platform could be modified to accommodate this.

P2 [THRIVE Framework]:

- Like the Platform/tool to be used by MBA students in their study. #Future version of the Platform could be modified to accommodate this.
- In some places, like Netherlands, environmental sustainability has been translated into law - Active Civil Society. #Baking the TF into the fabric of society if one of the goals of this approach at scale across the 7Cs.
- Integrated reporting may not be as significant a factor as the THRIVE Framework makes it out to be. #Was replaced by Integral Thinking in v2.x

P3 [THRIVE Framework]:

- Questions a hierarchy of scale? Why are multi-nationals under community? #Multi-nationals can affect local communities and the scales above.
- Why not allow users to choose their own hierarchy? => Great idea, could lead to a 'scale engine'? #A future version of the Platform could do this. There is no intrinsic limitation as to where the boundary between scales lies, although the adopted scale has been informed by literature.
- Likes to see older, original reference used, e.g., for complex wicked problems, C Churchman 1967 rather than Russell Ackoff 1971. #References were updated to reflect earlier seminal authors. On the flip side some reviewers opted seeking more recent references instead.

P4 [THRIVE Platform]:

- Finds most methods very similar. #A detailed investigation (Fedeli & Glinik 2021) into the difference between the available established approaches, methods, and tools showed there was no other approach linking entity models to sustainability performance.
- Not interested in business model or strategy. #OK. Yikes.
- Suggest interface is poor and system should be built for a specific user base. #Platform v3.x has this feature where the interface can be customised to suit different target groups.

P5 [THRIVE Platform]:

- Would be interested in comparisons between methods eg SDGS vs GRIS on the same company/industry. #Platform v2.x has this feature.

- Need more intuitive interface, better links, charts, and tables. User defined skins? #Platform v2.x has this feature and even v3.x has extended this concept further.
- More intuitive interface and references to source datasets. => Great idea, allow us to develop links to external providers. #Possible. We have been in talks with WikiRate.

P6 [THRIVE Platform]:

- In charts use colour codes like red for less sustainable and green or blue for more sustainable. #Done in Platform v2.x.
- Gamification? => Excellent idea and pursued by THRIVE Project. #A work in progress by the THRIVE Project organisation.
- Consider a 'scale aggregation engine'? => Gave rise to all-entities search in TP v2.04. #Impelmented in Platform v2.x.

P7 [THRIVE Framework]:

- Very interested with the connection with business model patterns. #As we do.
- Vast datasets, load cross-sectorial data. #As we can do. Provide the data sets.
- Make the tool simpler to use. #Experts want sophistication, end users want simplicity. Platform v3.x has been skinned to accommodate all.

P8 [THRIVE Framework]:

- Suggest integrating a source management system => Great idea for future version. #Platform v4.x?
- Interested to take on an advisory role as we design/develop our next iteration of THRIVE Platform. #Part of our team.

5.8. Software Evaluation Checklist

The THRIVE Platform artefact was developed 'in-house' by the researcher. Details of the technology stack, design elements, development cycle, and software testing, are covered in more detail in the ***Appendix B: The THRIVE Platform***. The checklist used by the researcher is reproduced below.

☑ **Objectives**

- ☐ The software supports the needs and objectives.
- ☐ The objectives of the software are documented.
- ☐ The objectives match goals and mandated standards.

- ☐ Activities and evaluations are matched to the objectives.
- ☐ The software fills a need not addressed by other software solutions.

☑ **Target Audience**

- ☐ The software matches the five identified target groups.
- ☐ The layout includes the parameters identified in the study.

☑ **Usability**

- ☐ Hardware and software requirements are available.
- ☐ The software is easy to use by someone versed in sustainability metrics.
- ☐ The user can navigate through the software relatively easily.
- ☐ There is a walkthrough video explaining how the software works.
- ☐ There is user documentation and basic online help.
- ☐ Technical support is provided online via the web.

5.9. Data Collected / Response Summary

Extracted answers and narratives were consolidated into a response summary table across each respondent group and then all respondents. This serves as the basis for the evaluation in the discussion section of the thesis. Complete Delphi panel responses may be found in the Evaluation Interview Responses in the ***Appendix D: Study Collaterals***.

In the previous section we collated responses. Here, we offer an overall summary in table format (***Table 5.9***).

USABILITY CRITERIA	RESPONSES…
C1: **C**ompleteness Consistency Does the THRIVE Framework enable repeatable outcomes?	C1: Generally, respondents thought that the THRIVE Framework did enable a repeatable outcome. There were however a few concerns, with one respondent stating that these types of tools are much the same, whereas another perceiving a strongly sustainable and agnostic platform as a contradiction.

USABILITY CRITERIA	RESPONSES…
C2: **C**ompleteness Functionality Does the THRIVE Dashboard offer enough functionality to meet the sustainability performance scorecard objective?	C2: There was a mixed reaction here with many unsure as to whether enough functionality is offered through the dashboard to meet the objective. One was concerned about the rigidity around the hierarchical structure, another was keen to see a degrowth perspective, with yet another looking for more visualisations.
U1: **U**sefulness Utility Does the THRIVE Framework serve its intended purpose in evaluating the sustainability performance of enterprises?*	U1: Most agreed, with one pleased to see transparency in the data and another specifying all assumptions to be explained. Another stated that integrated reporting is not a significant factor.
U2: **U**sefulness Comprehensibility Does the THRIVE Dashboard provide clarity on how it achieves this purpose?	U2: Most respondents were in agreement. Some were familiar with similar tools. Some asked for greater explanation of any assumptions, with yet another looking for cross-sectional data. Finally, one thought the interface was very poor, suggesting we commission an UX/UI designer.
E1: **E**ffectiveness Reliability Does the THRIVE Framework provide trustworthy and	E1: Most thought so. One suggestion was to integrate a source management system, with another remarking that they doubt all rules are implemented.

USABILITY CRITERIA	RESPONSES…
dependable performance measures?	
E2: **E**ffectiveness Flexibility Does the THRIVE Dashboard provide a range of worthwhile options during its use?	E2: Whilst overall the sentiment was positive, there were a myriad of suggestions for improvement. Some thought it was confusing, with too many options, and another wondered about how any recommendations would be implemented. A further respondent suggested simplifying the tool and another asked for more customisation. Lastly, there was a suggestion to implement a user-defined scale aggregator engine.
S1: **S**oundness Validity Does the THRIVE Framework assess the sustainability performance of enterprises?*	S1: Almost unanimous yes, although one respondent could not see an application for governments.
S2: **S**oundness Ethicality Does the THRIVE Framework provide an ethical outcome?	S2: Most thought 'yes' with one wanting more specific info for each dataset and others asking for clarity around definitions and assumptions.

Table 5.9. *Summary of evaluation responses following the Delphi panel interview.*

Thus, overall feedback, findings, and/or suggestions for further development include:

1. Admirable attempt at contextualising, normalising, and providing a uniform, universal approach.
2. Include references to dataset sources and/or direct integration with third party providers.

3. Allow loading of personalised datasets for training purposes and scenario analysis.
4. Develop interface to accommodate multiple types of users from different target segments.
5. Opportunity to develop a scale aggregation engine.
6. Gamification of the service at the individual user level to speed up adoption.

5.10. Presentation / Evaluation Results

Results of the evaluation process were gathered anonymously and presented over subsequent months at conferences, workshops, webinars and at other major events, including at the following:

- 2020 Strongly Sustainable Business Model Group Meeting (Canada)
- 2020 International New Business Model Conference (Netherlands)
- 2020 r3.0 International Conference (Netherlands)
- 2020 Circular Economy Forum (Australia)
- 2021 THRIVE Tribe Webinar (Australia)
- 2021 International New Business Model Conference (Sweden)
- 2022 THRIVE Framework Presentation (Australia)

Participants received collated results early before them being released publicly. Further collaborations with the Flourishing Enterprise Institute and others have taken place. In particular, the THRIVE Framework has informed the sustainability metrics field through its collaboration with r3.0 (the Global Thresholds and Allocation Council) on the sustainable development performance indicators for the United Nations Research Institute for Social Development (UNRISD) projects. Specifically, the THRIVE Framework/Platform has been cited as "*a key data platform for further disseminating implementation of the indicators!*" (Bill Baue, r3.0, USA, May 2022) (Baue 2022).

5.11. Case Study (Seafood Stewardship Index)

It has been estimated that wild-caught seafood will be non-existent by the year 2048 (Schorr 2022), if current unsustainable practices are to

continue as '*business-as-usual*' (Pariona 2017). Worth noting that beyond its nutritional properties, fish and seafood has a lower carbon footprint than other animal production systems, contributing to the income and indirect food security of more than 10% of the world's population in much of the developing and emergent countries (Merino & Williams 2015).

As part of this study the author examined in detail the seafood industry which operates within the ambit of one of our largest global commons. This industry was chosen as there are corresponding analysis by other groups that may be used as a comparison and because of its significance. A third of the world is either directly or indirectly supported by this industry with two thirds of its produce being over consumed or depleted (Hardin 2009). Therefore, it has a significant impact on the sustainability of all life forms on this planet. Examples of direct and indirect dependence and effects on sustainability are:

- Seafood as a source of food for coastal communities (in underdeveloped nations)
- Seafood as a consumer staple in the developed world
- Fisheries impacts on the environment (trawlers and nets at sea)
- Factories in and around seaports
- Abusive labour practices towards workers
- Wastage of the produce during seafood packing phase
- Cold storage (with associated GHG emissions)
- Transportation costs (with associated GHG emissions)
- Wastage of the produce during food preparation phase
- Wastage after preparation and plating

Further details on the Seafood Stewardship Index Case study are found in ***Appendix B: The THRIVE Platform***. The specific steps are:

1. Find raw audited nominal data for the seafood industry
2. Acquire related denominator data that is context-based
3. Develop list of top 30 keystone actors
4. Load into the THRIVE Platform and calculate impacts

5. Identify suitable business model taxonomy
6. Acquire publicly audited sustainability reports
7. Analyse relatedly lists of business models
8. Outcome: transparency, granularity, scenario analysis
9. Showcase "at-a-glance" Ciambella Chart impact diagrams

5.11.1. Keystone Actors

As a result, a detailed evaluation of the top 30 keystone (Osterblom et al. 2015) actors in this industry were undertaken as part of this study, in order to, provide a practical example of the application of the THRIVE Platform. The keystone actors were selected from Osterblom et al. (2015) study and have been listed below (***Table 5.10***).

During the evaluation, the following information was collected for each entity. The enterprise stock symbol name with the associated industry code as defined by the business activity group of '25' (***Table 5.11***, ***Appendix E: Reference Tables***). The CEO, chairperson, and address details. Also noted is the ownership (Private, public, or state funded), revenue, and captured the entity's icon or logo as well as some descriptive text about its mission. A table summarising these is shown below (***Table 5.12***).

enterprise_id	enterprise_name	hqcountry	ownership	revenue
OTCMKTS: ASTVF	Austevoll Seafood ASA	NO	PUBLIC	2186
BIOM	BioMar Group	DK	PUBLIC	1263
BUMB	Bumble Bee Foods	US	PRIVATE	955
CARG	Cargill Aqua Nutrition	US	PRIVATE	2140
BKK: CPF	Charoen Pokphand Foods	TH	PUBLIC	1917
COOK	Cooke	CA	PRIVATE	1339
KRX: 006040	Dongwon Group	KR	PUBLIC	3163
FCFC	FCF Co., LTD.	TW	PRIVATE	1000
TSE: HLF	High Liner Foods	CA	PUBLIC	956
TYO: 1301	Kyokuyo	JP	PUBLIC	2123
LABE	Labeyrie Fine Foods	FR	PRIVATE	1040
TYO: 8002	Marubeni Corporation	JP	PUBLIC	1900
TYO: 1333	Maruha Nichiro	JP	PUBLIC	7158
TYO: 8058	Mitsubishi Corporation	JP	PUBLIC	3400
OTCMKTS: MHGVY	Mowi	NO	PUBLIC	3694
TYO: 1332	Nippon Suisan Kaisha (Nissui)	JP	PUBLIC	5707
NYSE: NOMD	Nomad Foods	GB	PUBLIC	800
BME: PVA	Nueva Pescanova	ES	PUBLIC	1134
NUTR	Nutreco (Skretting)	NL	PRIVATE	2543
PACI	Pacific Seafood Group	US	PRIVATE	1370
PARL	Parlevliet & Van der Plas	NL	PRIVATE	848
REDC	Red Chamber Group	US	PRIVATE	2575
ROYA	Royal Greenland	GL	STATE-OWNED	1005
OTCMKTS: SALRY	SalMar	NO	PUBLIC	1044
SHAN	Shanghai Fisheries Group Co., LTD.	CN	STATE-OWNED	1038
BKK: TU	Thai Union Group	TH	PUBLIC	3752
TRID	Trident Seafoods	US	PRIVATE	2400
TRIM	Tri Marine Group	US	PRIVATE	1050
WALE	Wales Group (Sea Value & Sea Wealth)	TH	PRIVATE	896
TYO: 2874	Yokohama Reito (Yokorei)	JP	PUBLIC	940

Table 5.10. *List of keystone actors considered in the Seafood Stewardship Index study. The first column is the ticker symbol and the last is revenue in USD millions.*

25 Food Production - Animal Source Food Production	• Companies that raise livestock and other producers of meat. • Companies that raise poultry and other producers of poultry products. • Fishing companies and companies that raise fish and other producers of fish products.

Table 5.11. GRI Business Activity Group descriptions.

enterprise_id
enterprise_name
industry_id
model
ceo
chairman
hqstreetaddress
hqtownsuburb
hqstate
hqpostcode
hqcountry
last_updated
description
icon
ownership
revenue

Table 5.12. *List of entity information as stored in the THRIVE Platform database' MVP architecture.*

5.11.2. Business Model Patterns

The business model of the entity was derived at using machine learning – a form of artificial intelligence – techniques. We first examined the freely available information from each of the entities in question. These generally consisted of sustainability reports, but often required corroboration by checking with other sources such as:

1. Business strategy / plan including mission / vision statement - in report or presentation format - perhaps contained in literature designed for employees, customers, suppliers, partners.
2. Recent annual report, including an operational update (facts, operational metrics and full financial reports – P&L, Balance Sheet), plans (strategic, tactical), and challenges / opportunity.
3. Applications for grants or investments (e.g., a business plan). Typically, these documents contain both overview and details of the enterprise.

4. Applications for awards and recognition – whether won or not. These often require a comprehensive description of the enterprise and how it is different.

5. Recent management status reports and management accounting reports. Of value is reporting of status, revenues and costs by product, service, activity, or organisational unit.

6. GRI report or presentation (or any other internal measurement or external reporting of environmental / social goals and results such as Future Fit Business Benchmark).

7. B-Labs B-Impact Assessment survey and any presentations or reports from this process (or any other NGO audit of your operation).

8. Environmental policy and plan.

9. Social policy and plan (including. issues of locality, distributional equity, etc.).

10. Purchasing policy and plan (including identification of strategic supplier or retail partnerships, outsourcing arrangements etc.).

11. Human resource policy, manual and plan (ethics, hiring, fair-pay policy, termination, job sharing, pension, benefits, employee share ownership, etc.).

12. Investor policy (who can own shares).

13. Governance structure (e.g., who decides what: BOD and its sub-committees, transparency, external directors, co-op members). Some of this might be included in your articles of incorporation (for-profit or not-for-profit), shareholder agreements, investor agreements etc.

14. Marketing plan (e.g., identification of target customers, value propositions, channel strategy, relationship strategy).

15. External audit reports, management plans, presentations, reviews or reports on any or all of the following topics: supplier assessments, carbon inventory, energy conservation/efficiency audit, product / service life cycle assessment - including plans for re-manufacturability; closed-loop product design, etc. Other reports include raw materials, work-in-process, finished goods toxicity and sustainability

standards certification details (e.g., Living Futures Institute Living Product Challenge certification, Cradle-to-Cradle certification, etc.), manufacturing and other operational waste toxicity [solid, liquid, gases], packaging, water use, financial / operations internal-audit, and documentation from ISO9000, ISO14000, ISO26000, ISO50000 audits / reviews.

16. Any other plans, reports, summary presentations which may be of help in understanding the business model and its evolution.

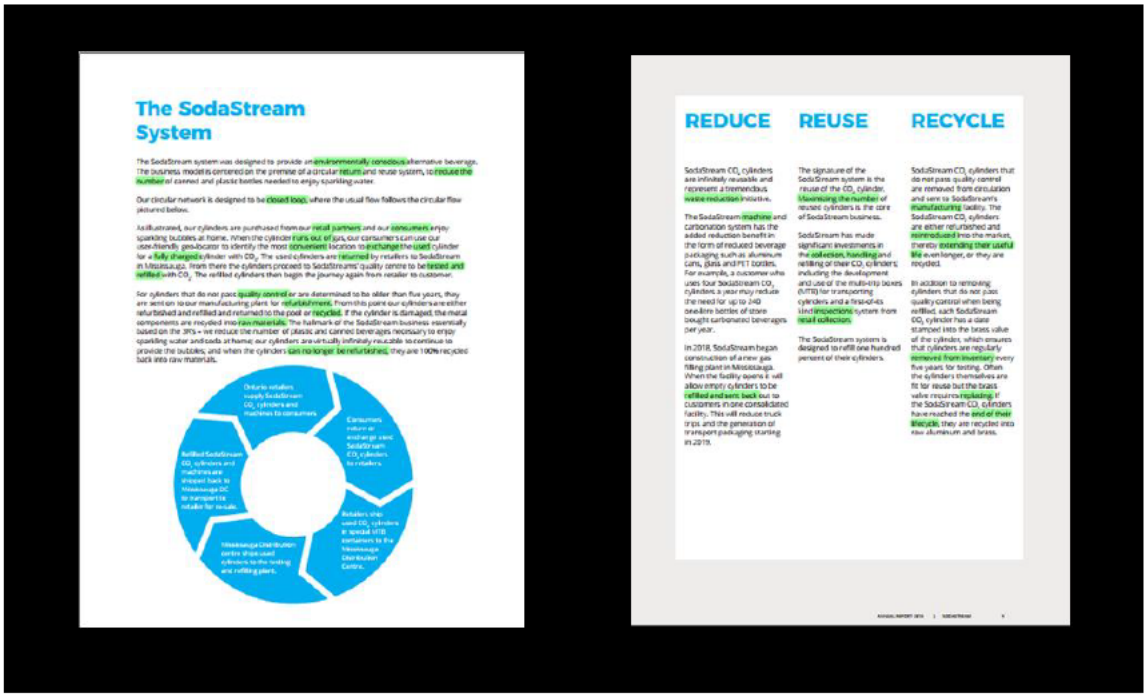
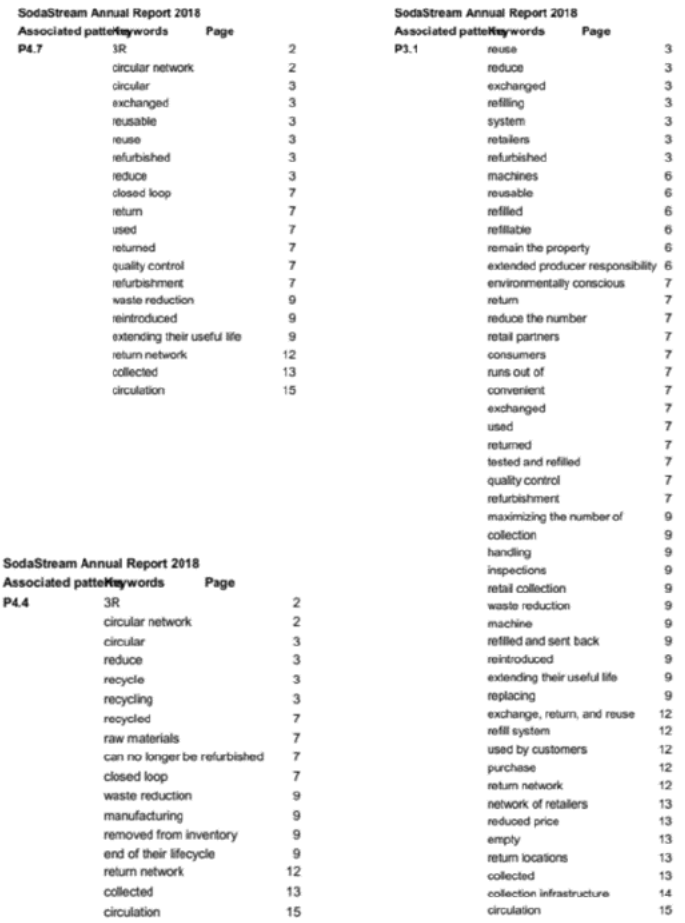


Figure 5.5. *Sample pages from the 2018 Soda Stream Sustainability Report, showing the highlighted text used as labels in the keyword analysis when the training set was being developed.*



SodaStream Annual Report 2018

Associated pattern	Keywords	Page
P4.7	3R	2
	circular network	2
	circular	3
	exchanged	3
	reusable	3
	reuse	3
	refurbished	3
	reduce	3
	closed loop	7
	return	7
	used	7
	returned	7
	quality control	7
	refurbishment	7
	waste reduction	9
	reintroduced	9
	extending their useful life	9
	return network	12
	collected	13
	circulation	15

SodaStream Annual Report 2018

Associated pattern	Keywords	Page
P3.1	reuse	3
	reduce	3
	exchanged	3
	refilling	3
	system	3
	retailers	3
	refurbished	3
	machines	6
	reusable	6
	refilled	6
	refillable	6
	remain the property	6
	extended producer responsibility	6
	environmentally conscious	7
	return	7
	reduce the number	7
	retail partners	7
	consumers	7
	runs out of	7
	convenient	7
	exchanged	7
	used	7
	returned	7
	tested and refilled	7
	quality control	7
	refurbishment	7
	maximizing the number of	9
	collection	9
	handling	9
	inspections	9
	retail collection	9
	waste reduction	9
	machine	9
	refilled and sent back	9
	reintroduced	9
	extending their useful life	9
	replacing	9
	exchange, return, and reuse	12
	refill system	12
	used by customers	12
	purchase	12
	return network	12
	network of retailers	13
	reduced price	13
	empty	13
	return locations	13
	collected	13
	collection infrastructure	14
	circulation	15

SodaStream Annual Report 2018

Associated pattern	Keywords	Page
P4.4	3R	2
	circular network	2
	circular	3
	reduce	3
	recycle	3
	recycling	3
	recycled	7
	raw materials	7
	can no longer be refurbished	7
	closed loop	7
	waste reduction	9
	manufacturing	9
	removed from inventory	9
	end of their lifecycle	9
	return network	12
	collected	13
	circulation	15

Figure 5.6. *The manual categorisation of business model patterns for Soda Stream as taken from their Annual Report in 2018 at the pages listed.*

Following the identification of the relevant documents above, an initial training set was compiled by our expert Florian Lüdeke-Freund using five sample organisations with detailed sustainability reports. This served as our seed for training the rule set (***Figure 4.3***). The relevant documents were highlighted as depicted with Soda Stream in ***Figure 5.5*** and sample categorisation shown in ***Figure 5.6***. This was seen as the best way by the expert to categorize each organisation according to its business model pattern.

These were then fed through the constructed machine learning system to identify patterns of interest that matched certain keywords found in the documentation with known business model patterns (BMP) (***Table 5.13***). The result was that for each entity there was a match to a degree with a known business model pattern. Those in the 90% quartile were then used as a basis of an identification. An example of this match is

shown for the company Soda Stream as undertaken by our expert Florian Lüdeke-Freund (**Table 5.13**).

BMP ID	Name	Group	Context	Source
P1.1	Differential Pricing	Pricing & Revenue Patterns	Base of the Pyramid (BoP) and low-income groups in both developed and developing countries are often excluded from consumption due to price barriers.	Clinton & Whisnant, 2014
P1.2	Freemium	Pricing & Revenue Patterns	Pertains mostly to software or web-based services such as social networks, but also to traditional products and services such as healthcare.	Clinton & Whisnant, 2014
P1.3	Innovative Product Financing	Pricing & Revenue Patterns	Forms of leasing and renting are becoming increasingly popular in the renewable energy industry. Also, low-income groups are able to purchase goods they otherwise could not afford.	Clinton & Whisnant, 2014
P1.4	Subscription Model	Pricing & Revenue Patterns	Green- or social start-ups that enter new markets are often in need of reliable revenue streams and customer relationships.	Clinton & Whisnant, 2014
P2.1	Crowdfunding	Financing Patterns	Typically, traditional financing requires convincing investors and banks based on expected cash flows. This is often impossible when it comes to sustainability innovations.	Clinton & Whisnant, 2014
P2.2	Microfinance	Financing Patterns	Traditional banks tend to decline loans to base of the pyramid and low-income groups because of high transaction costs and a lack of collateral and credit history.	Clinton & Whisnant, 2014

P2.3	Social Business Model: No dividends	Financing Patterns	Base of the pyramid and low-income groups, both in developed and developing countries, are often excluded from consumption possibilities due to price barriers or because offerings for these groups do not exist.	Michelini & Fiorentino, 2012
P3.1	Hybrid model / Gap-exploiter model	Ecodesign Patterns	There is a growing need of reducing the use of virgin, finite resources and diminishing waste and pollution, in particular when it comes to complex products that use critical resources such as rare earths.	Planing, 2015
P3.2	Maximise material productivity and energy efficiency	Ecodesign Patterns	Because of increasing threats to human health and natural ecosystems there is a growing need of reducing the use of finite resources and diminishing waste and pollution.	Bocken et al., 2014
P3.3	Product Design	Ecodesign Patterns	There is growing pressure on most industries to improve eco-efficiency and effectiveness in products, e.g. due to societal and political expectations for products that support a circular economy.	Kiørboe et al., 2015
P3.4	Substitute with renewables and natural processes	Ecodesign Patterns	Because of increasing threats to human health and natural ecosystems there is a growing need of reducing the use of finite resources and diminishing waste and pollution.	Bocken et al., 2014
P4.1	Co-Product Generation	Closing-the-Loop Patterns	In the current industrial economy, opportunities to leverage wasted and underutilised resources (e.g., materials, energy, capacities, assets) are overlooked as companies tend to focus on their main products only.	Albino & Fraccascia, 2015

P4.2	Industrial Symbiosis	Closing-the-Loop Patterns	In the current industrial economy, opportunities to leverage wasted and underutilised resources (e.g., materials, energy, capacities, assets) are often overlooked, partly because their potential cannot be exploited by single organisations.	Beltramello et al., 2013
P4.3	Online Waste Exchange Platform	Closing-the-Loop Patterns	In the current industrial economy, opportunities to leverage wasted and underutilised resources (e.g., materials, energy) are often overlooked, partly because their potential cannot be exploited by single organisations. Connecting waste producers and users becomes crucial.	Albino & Fraccascia, 2015
P4.4	Product Recycling	Closing-the-Loop Patterns	There is a growing need of reducing the use of virgin, finite resources and diminishing waste and pollution. There is also a need to look for new input sources due to increasing resource scarcities.	Planing, 2015
P4.5	Remanufacturing / Next Life Sales	Closing-the-Loop Patterns	There is a growing need of reducing the use of virgin, finite resources and diminishing waste and pollution. Products that have been used often still have use value for others, but in some cases they need to be completely overhauled or even decomposed and re-manufactured.	Planing, 2015
P4.6	Repair	Closing-the-Loop Patterns	There is a growing need of reducing the use of virgin, finite resources and diminishing waste and pollution, in particular when products have the potential to be repaired or maintained.	Kiørboe et al., 2015

P4.7	Reuse	Closing-the-Loop Patterns	There is a growing need of reducing the use of virgin, finite resources and diminishing waste and pollution. Products that have been used often still have use value for others, in particular when they are still working.	Kiørboe et al., 2015
P4.8	Take Back Management	Closing-the-Loop Patterns	Because of increasing threats to human health and natural ecosystems there is a growing need of reducing the use of virgin, finite resources and diminishing waste and pollution. Managing take back systems for products, parts or base materials can support circular economy models.	Bisgaard et al., 2012
P4.9	Upgrading	Closing-the-Loop Patterns	Fast-moving markets and technological developments lead to shorter product life with regard to actuality of version, aesthetics etc.	Planing, 2015
P5.1	Green Supply Chain Management	Supply Chain Patterns	There is growing pressure on companies to be more transparent and efficient, e.g., in terms of using natural resources and avoiding risks and harms to their supply chain partners and customers.	Bisgaard et al., 2012
P5.2	Inclusive Sourcing	Supply Chain Patterns	A lack of attention to the livelihood of local suppliers by large corporations can often result in a decline in both economic and social value.	Clinton & Whisnant,2014
P5.3	Micro Distribution and Retail	Supply Chain Patterns	Base of the pyramid and low-income consumers tend to make small, but frequent purchases. These customers are often not reached by major suppliers, both in terms of outlets and product or service formats.	Jenkins et al., 2011

P5.4	Physical to Virtual	Supply Chain Patterns	Green and social start-ups need less costly and scalable distribution systems. As customers become comfortable with online shopping, switching from brick and mortar to virtual channels becomes an option.	Clinton & Whisnant, 2014
P5.5	Produce on Demand	Supply Chain Patterns	Aligning supply and demand is particularly challenging for new types of offerings, which can result in excess material in the production cycle and inefficient use of scarce financial resources.	Clinton & Whisnant, 2014
P5.6	Shorter Supply Chains	Supply Chain Patterns	There is growing pressure on companies to be more transparent and efficient, e.g., in terms of using natural resources and avoiding risks and harms to their supply chain partners and customers.	The Crowd & Fishburn, 2014
P6.1	Buy One, Give One	Giving Patterns	Base of the pyramid and low-income groups, in both developed and developing countries, are often excluded from particular forms of consumption due to price barriers or because markets for these groups do	Clinton & Whisnant, 2014
P6.2	Commercially Utilised Social Mission	Giving Patterns	Some social groups are excluded from consumption possibilities due to price barriers or because offerings for these groups do not exist.	Dohrmann et al., 2015
P7.1	Building a Marketplace	Access Provision Patterns	Base of the pyramid and low-income groups, in both developed and developing countries, are often excluded from particular forms of consumption due to price barriers or because markets for these groups do often not exist.	Clinton & Whisnant, 2014

P7.2	e-Transaction Platforms	Access Provision Patterns	Approximately 3.5 billion people worldwide lack access to financial services because institutions face high transaction costs and complex logistics to reach the poor, especially in remote areas, due to the cumbersome nature of securely transporting and distributing cash. Providers of other goods and services that require distribution infrastructure and payment mechanisms share this challenge.	Jenkins et al., 2011
P7.3	Experience-Based Customer Credit	Access Provision Patterns	Traditional banks tend to decline loans to base of the pyramid and low-income groups because of high transaction costs and a lackof collateral and credit history.	Jenkins et al., 2011
P7.4	Last-Mile Grid Utilities	Access Provision Patterns	Some people are not connected to basic supplies because they live in remote areas with a lack of infrastructures or belong to the base of the pyramid and low-income groups.	Jenkins et al., 2011
P7.5	Value-for-Money Degrees	Access Provision Patterns	The costs for higher education, e.g. university degrees, can consume a considerable share of a families' income. Higher education is essential for professional careers, but base of the pyramid and low-income groups often do not have access to higher education.	Jenkins et al., 2011
P7.6	Value-for-Money Housing	Access Provision Patterns	A home is the biggest investment most people ever make and they have to be convinced it is worth the commitment, which can feel risky. Lower-income groups are often not able to invest in own homes and build up capital and financial security.	Jenkins et al., 2011

P8.1	Expertise Broker	Social Mission Patterns	Some social groups are denied help or sidelined because of a lack of understanding for their particular situation.	Zeyen et al., 2014
P8.2	Market-Oriented Social Mission	Social Mission Patterns	Some social groups are difficult to engage as productive workforce, although they wish to, e.g. because of a lack of skills or labor markets for these groups do not exist.	Dohrmann et al., 2015
P8.3	One-Sided Social Mission	Social Mission Patterns	Base of the pyramid and low-income groups are often excluded from particular forms of consumption due to price barriers or because markets for these groups do not exist.	Dohrmann et al., 2015
P8.4	Social Business Model: Empowerment	Social Mission Patterns	Base of the pyramid and low-income groups, both in developed and developing countries, are often excluded from business and income opportunities due to a lack of skills and business organisations dedicated to these groups.	Michelini & Fiorentino, 2012
P8.5	Two-Sided Social Mission	Social Mission Patterns	Two-sided platforms are an effective means to match suppliers and users of products and services. This approach is not only applicable to traditional online platforms such as search engines, but also to social businesses.	Dohrmann et al., 2015
P9.1	Pay for Success	Service & Performance Patterns	The development of new products or services to solve fundamental ecological or social problems, such as investing in a new drug, can be too risky for clients to do it based on their own resources.	Clinton & Whisnant, 2014

P9.2	Product-oriented Services	Service & Performance Patterns	Replacing established and/or complex products, or technologies in a broader sense, is challenging due to several barriers to their diffusion. In particular providers of eco-friendly technologies have to find ways to make their offerings attractive.	Planing, 2015
P9.3	Result-oriented Services	Service & Performance Patterns	Replacing established and/or complex products, or technologies in a broader sense, is challenging due to several barriers to their diffusion. In particular providers of eco-friendly technologies have to find ways to make their offerings attractive.	Planing, 2015
P9.4	Use-oriented Services	Service & Performance Patterns	Replacing established and/or complex products, or technologies in a broader sense, is challenging due to several barriers to their diffusion. In particular providers of eco-friendly technologies have to find ways to make their offerings attractive.	Tukker, 2004
P10.1	Cooperative Ownership	Cooperative Patterns	In today's business world, the shareholder model is still the norm and managers' main responsibility is to meet the expectations of shareholders without giving equal weight to other stakeholders' interests.	Clinton & Whisnant, 2014
P11.1	Sharing Business	Community Platform Patterns	When a product or other asset is not used very often, when it is expensive or not fully proven (e.g., e-mobiles), many consumers are not willing to purchase it. Individual and exclusive ownership also means that more resources must be used to satisfy consumers' needs.	FORA, 2010

Table 5.13. *Business Model Patterns (BMP) as identified by Ludeke Freund et al. (2018) with additional descriptive text as used in this study.*

5.11.3. Calculating Impacts

We then calculated impacts using the methods described above in the THRIVE framework. There are six key variables which include a) the entity level, b) industry (sector) or enterprise (individual), c) the date range (from, to), and the d) classification system (e.g., GRIs, SDGs, WSSI, etc), as well as the e) formula engine, and f) weight engine. A sample for the Global Reporting Initiative GRI Standard is provided here in **Table 5.14** (additional examples can be found in the ***Appendix E: Reference Tables***). Importantly then one can choose from a range of formula engines (FE) and weight engines (WE) which define how the calculations take place. The resulting sustainability performance index (SPi) and ranking with respect to all other entities in the group is prominently featured in the dashboard (***Figure 5.7***).

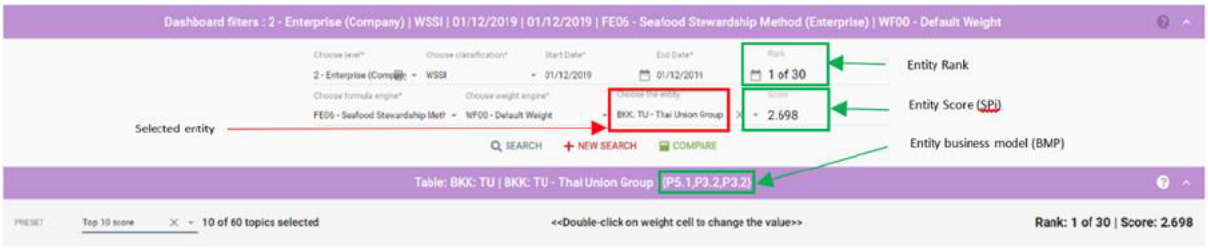


Figure 5.7. *Input dashboard for the entity BKK: TU Thai Union for Dec 2019 showing the calculated SPi and ranked score of position #1 out of 30.*

Class ID	Topic ID	Topic Name	Topic Colour	Theme ID
GRIS	101	Foundation		FOUNDATION
GRIS	102	General Disclosures		FOUNDATION
GRIS	103	Management Approach		FOUNDATION
GRIS	201	Economic Performance		ECONOMIC
GRIS	202	Market Presence		ECONOMIC

GRIS	203	Indirect Economic Impacts		ECONOMIC
GRIS	204	Procurement Practices		ECONOMIC
GRIS	205	Anti-corruption		ECONOMIC
GRIS	206	Anti-competitive Behaviour		ECONOMIC
GRIS	301	Materials		ENVIRON
GRIS	302	Energy		ENVIRON
GRIS	303	Water		ENVIRON
GRIS	304	Biodiversity		ENVIRON
GRIS	305	Emissions		ENVIRON
GRIS	306	Effluents and Waste		ENVIRON
GRIS	307	Environmental Compliance		ENVIRON
GRIS	308	Supplier Environmental Assessment		ENVIRON
GRIS	401	Employment		SOCIAL
GRIS	402	Labor/Management Relations		SOCIAL
GRIS	403	Occupational Health and Safety		SOCIAL
GRIS	404	Training and Education		SOCIAL
GRIS	405	Diversity and Equal Opportunity		SOCIAL

GRIS	406	Non-discrimination	SOCIAL
GRIS	407	Freedom of Association and Collective Bargaining	SOCIAL
GRIS	408	Child Labor	SOCIAL
GRIS	409	Forced or Compulsory Labor	SOCIAL
GRIS	410	Security Practices	SOCIAL
GRIS	411	Rights of Indigenous Peoples	SOCIAL
GRIS	412	Human Rights Assessment	SOCIAL
GRIS	413	Local Communities	SOCIAL
GRIS	414	Supplier Social Assessment	SOCIAL
GRIS	415	Public Policy	SOCIAL
GRIS	416	Customer Health Safety	SOCIAL
GRIS	417	Marketing and Labelling	SOCIAL
GRIS	418	Customer Privacy	SOCIAL
GRIS	419	Socioeconomic Compliance	SOCIAL

Table 5.14. Sample Global Reporting Initiative (GRI) classification system as used in this study.
Source: The Global Reporting Initiative website https://globalreporting.org
with topic colour swatches added by this study.

Comparing with results reported elsewhere, we chose the same purported technique (formula engine FE06, weight engine WF00) with the same datasets. In this case, we use the Seafood Stewardship Index method and a default weights – commitment, transparency, performance - (***Figure 5.8***) across the same 30 keystone enterprises identified earlier. The result across the sector is as shown (***Figure 5.9***). This measures favourably with what is offered up by the likes of the World Benchmarking Alliance (WBA) (***Figure 5.10***) using the same weighted approach (***Figure 5.8***) as defined in the WBA methodology (WBA 2018). However, unlike other methodologies, the THRIVE Platform can also provide an overall sector value of 0.251. Furthermore, the ability to drill-down and manipulate weights and formula engines offers a level of transparency and experimentation not found elsewhere. This is significant as most organisations do not reveal their methodology nor share their original datasets. Citing impacts without the reliance on context-based metrics (Haffar & Searcy 2018) detracts from the validity and thus usefulness of these results. This is further elaborated below.



Figure 5.8. *WBA's weighted approach to commitment, transparency, and performance within the seafood industry.*

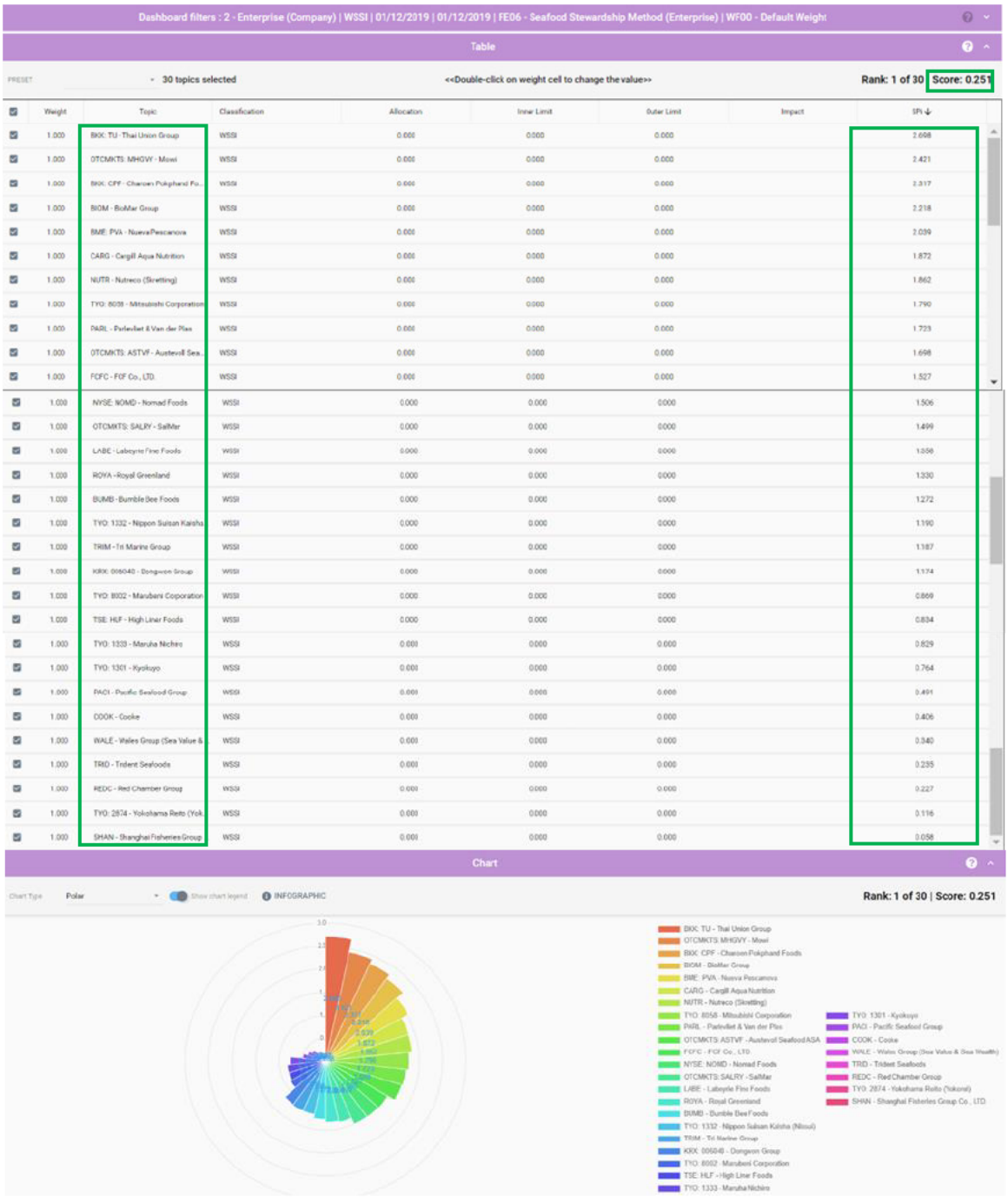


Figure 5.9. *Sustainability Performance Index for top 30 keystone actors in the seafood industry (ranked performance).*


Seafood Stewardship Index
Ranking
Companies
Methodology
About
1 Thai Union Group 2.70 / 5
2 Mowi 2.42 / 5
3 Charoen Pokphand Foods 2.32 / 5
4 BioMar Group 2.22 / 5
5 Nueva Pescanova 2.04 / 5
6 Cargill Aqua Nutrition 1.87 / 5
7 Nutreco (Skretting) 1.86 / 5
8 Mitsubishi Corporation 1.79 / 5
9 Parlevliet & Van der Plas 1.72 / 5
10 Austevoll Seafood ASA 1.70 / 5
11 FCF Co., LTD. 1.53 / 5
12 Nomad Foods 1.51 / 5
13 SalMar 1.50 / 5
14 Labeyrie Fine Foods 1.36 / 5
15 Royal Greenland 1.33 / 5
16 Bumble Bee Foods 1.27 / 5
17 Nippon Suisan Kaisha (Nissui) 1.19 / 5
- Tri Marine Group 1.19 / 5



Figure 5.10. *Comparative Seafood Stewardship Index as produced by the WBA (2018).*

5.11.4. Transparency

The case study evaluation came about after the Delphi study was completed and offered another dimension to add to the findings from the first. Whilst the first were viewed as rather qualitative, wide-ranging, subjective findings, those emanating from the case study are seen as more quantitative and objective insights. This adds a richness to the study, or an additional dimension, whereby it is understood that "*knowledge cannot be divorced from the uses to which it is put*" (Redclift 1998). The case study also facilitated the exposure to some of the flaws and shortcomings present in the offerings of other commercial third-party

providers, such as transparency, original sources of data, and consistency of methods used. The THRIVE Platform includes an actual empirical case study as part of the Delphi stage model. This facilitates a comparison between the actual results given by the THRIVE Platform and an assessment of the same by other means. In particular, the THRIVE Platform has been loaded with the World Seafood Stewardship dataset. A summary of the results is shown below (***Figure 5.11***).

Worth noting, however, that the results given by the THRIVE Platform are far more specific and detailed, providing a level of transparency not found elsewhere. This is one of the features of the THRIVE Platform whereby one can investigate the source of the results obtained. Additionally, there is the opportunity to experiment with the formula engine and weight engine to see what in those cases are the likely impacts. For example, one could test the implications of changes in tariffs, taxes, or legislation. One may choose to include or exclude certain material topics or apply a different weight engine to view the implications of the same. See **CHAPTER 4: ARTEFACT DESCRIPTION** for details.

5.11.5. Compare & Contrast

As we contrast the two results, one can see that those produced by the THRIVE Platform are to a higher degree of accuracy (3 decimal places), but otherwise the same results as those shown by the WBA. This replicability of the results from two separate studies supports the formula and weight engine construction. More importantly, one can manipulate the formula engine and the weight engine to produce a variety of results corresponding to one's desired interest in the same. One can drill down and uncover the basis behind each impact assessment, and thus uncover the underlying method of calculation.

As a case in point, within the THRIVE Platform, one can drill down and look deeper into how the calculation came about. This level of transparency is critical to an accurate assessment and is typically not offered or available with other approaches or systems (Nardo, Saisana,

Andrea Saltelli, et al. 2005). Looking more closely at the table in ***Figure 5.11***, one may note:

Weights: this field allows for the user to adjust weights over and above the system defined weights which are used by for formula engine in all calculations. In the case of the seafood stewardship index this is taken to be the default value of one. When omitting a material topic in a calculation (no check box), this has the same effect as applying a weight of zero and thus results in the omission of that topic from the calculation. This is compatible with ensuring calculations are within the normalised range of values.

Allocations: for each material topic and allocation may be made to ensure that the sum total of all allocations does not exceed 100% of all available resources. This is important to ensure that all calculations are context-based.

Inner limit: for each material topic an inner limit is provided to ensure a minimum social floor is maintained. In the case of the Seafood Stewardship Index, this value is 5 as all data points have been normalised to be between 5 and zero to reflect the WBA methodology.

Outer limit: for each material topic an outer limit is provided to ensure a maximum environmental ceiling is maintained. In the case of the Seafood Stewardship Index, this value is zero as all data points have been normalised to be between 5 and zero to reflect the WBA methodology.

Impact: this is the nominal value of an impact on a resource. In the case of the seafood stewardship index, this value can only be between 5 and zero, meaning it is a normalised figure that cannot extend out of the normal range. Whilst in principle this sound like a good way to go about things, it does assume that there can be no negative impacts and thus unfairly favours certain entities.

Sustainability performance index (SPi): this is the result of the calculations using the supplied inner limit and outer limit parameters, allocation and the associated formula engine and weight engine to derive the sustainability performance score given the impact value.

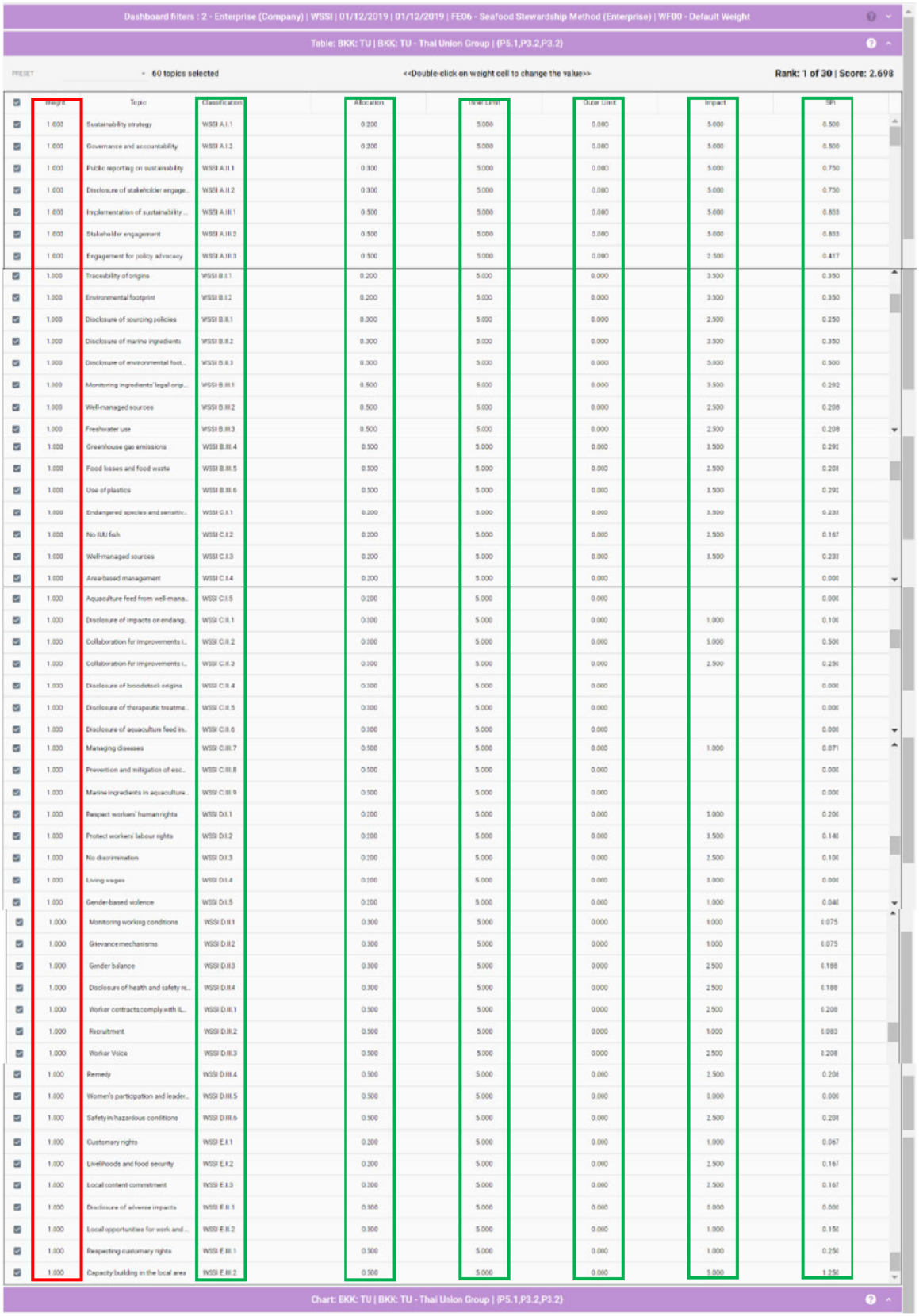


Figure 5.11. *List of the 60 material topics for the classification WSSI for the entity BKK: TU Thai Union.*

5.11.6. Scenario Analysis

With reference to ***Figure 5.12*** therefore one can change the formula engine to be the FE03 geometric mean and now find that BKK: TU Thai Union is in seventh position instead. This highlights how the methodology, including choice of formula and weight engine, can all contribute to totally different outcomes. The use of the geometric mean rather than the arithmetic mean is the correct way to compare normalised benchmark results (Fleming & Wallace 1986). Furthermore, as typically most entities conduct assessments in isolation of one another, based on their own internal assumptions and methods, it is easy to see how most of these results are rather meaningless when viewed from a systems perspective. At best these standalone calculations may be seen as relative to themselves (like prior year performance).

Thus, there is a real need for comparisons to take place relative to the norms placed by the social and natural world we live in, i.e. strongly applied within context. The THRIVE Platform provides this uniform universal approach by applying a consistent formulation across each of the entities with respect to these boundaries. If we are to make our way towards a thrivable future, the identified trajectory will be the result of this consistent commensurate approach across all relevant material topics.

Similarly, one can undertake scenario analysis by purposefully skewing certain figures to suit. For example, what would be the implication under adverse climate conditions, higher COVID penetration rates, or alleviation of certain social ills. Weights can be used to modify specific topics only and either in a positive or negative way and to a greater or lesser extent.

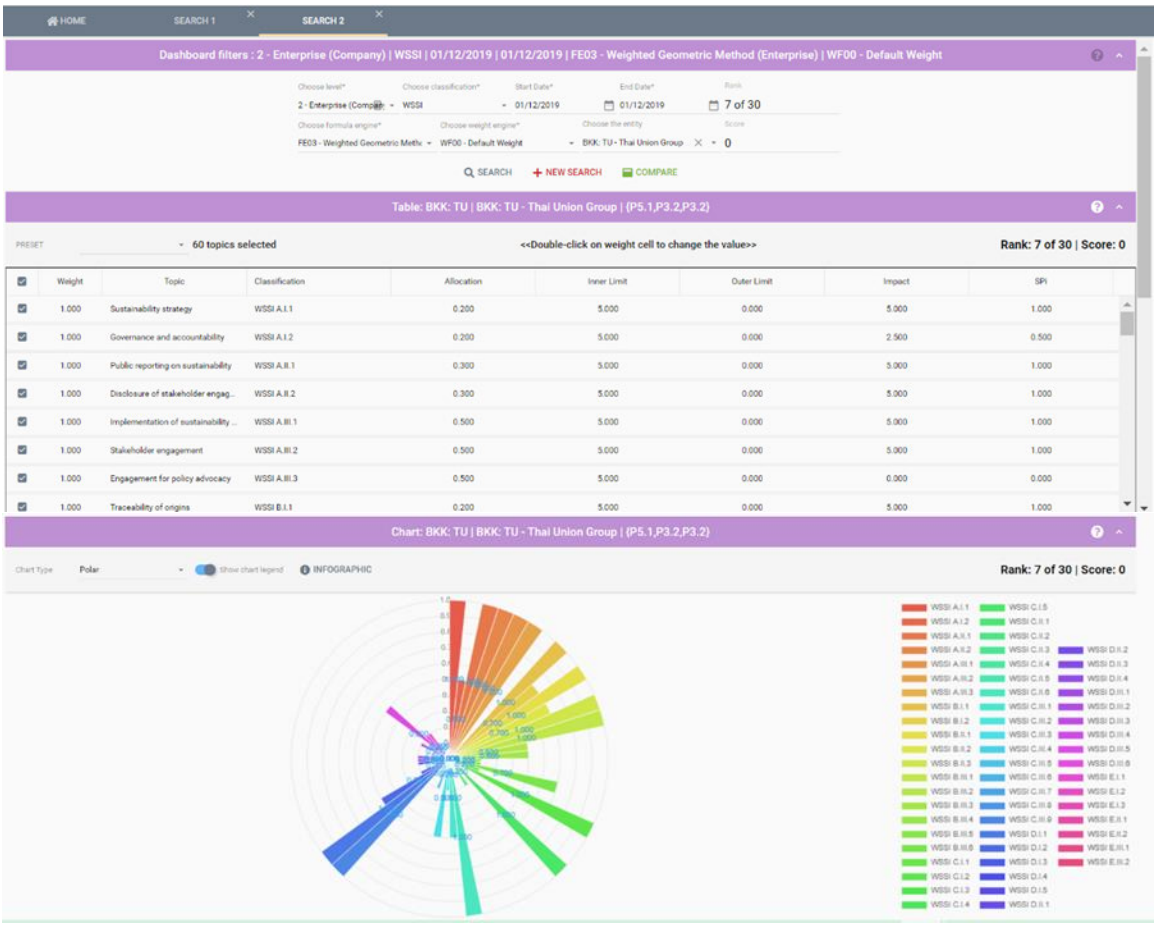


Figure 5.12. *Seafood stewardship index calculation for BKK: TU Thai Union using the formula engine FE03 geometric mean, placing the entity in seventh position.*

5.11.7. Connecting with Strategy (Entity Models)

One of the key strengths of the THRIVE Platform is that it connects sustainability performance (impact) with the actual strategy employed by the entity in question. In this case we are categorising the business strategy by its business model pattern (BMP) as outline by Florian Lüdeke-Freund. Linking actual impacts to actual business model is a unique approach rarely explored and provides the ability to show how certain strategies are more sustainable than another.

The process of identifying the BMP was undertaken using machine learning, a branch of computer science called AI. Using predictive analytics, it is able, within a certain degree of accuracy, model the factors that give rise to a particular 'matching' business model. In this case the system was able to identify up to three business model patterns per entity

under examination, by reviewing a range of documents as explained above. Specifically, the identified patterns for each entity are shown in the ***Table 5.15*** below.

We can see a range of common business model patterns such as P5.1 and P3.2 were exhibited by the sector as a whole. The identified patterns are listed in order of priority from left to right. In some cases, only one pattern or two patterns were identified, in which case the pattern is repeated. This may be due to the nature of the entity (and therefore strategy employed) or at times because there was insufficient information disclosed as to the strategies employed by the entity.

Furthermore, noteworthy, is that the identified pattern only relates the areas covered in their reports and supporting documentation and therefore may only be exemplary of the most significant aspects of the entity rather than its greatest contribution. This can therefore skew the results and be a contributing factor to the greenwashing of said results. The assumption made is that the data provided in their reporting is exemplary, indicative of and exhaustive of their actual processes and strategy.

5.11.8. Ciambella Charts

The design of the Ciambella Charts (***Figure 4.6****)* devised during the development of this study helps, at a glance, in quickly identifying the sustainability impact of an entity. This allows for quick comparisons also. They consist primarily of a scatter or radar type chart on top of a doughnut chart. They are very visual and instantly recognizable. They were devised specifically for this study.

entity_id	entity_name	model_id
OTCMKTS: ASTVF	Austevoll Seafood ASA	{P5.1,P5.1,P5.1}
BIOM	BioMar Group	{P3.4,P5.1,P3.2}
BUMB	Bumble Bee Foods	{P5.1,P3.2,P3.2}
CARG	Cargill Aqua Nutrition	{P5.1,P3.2,P3.2}
BKK: CPF	Charoen Pokphand Foods	{P5.1,P5.6,P5.2}
COOK	Cooke	{P5.1,P5.6,P5.6}
KRX: 006040	Dongwon Group	{P5.1,P5.1,P5.1}
FCFC	FCF Co., LTD.	{P1.1,P7.1,P1.2}
TSE: HLF	High Liner Foods	{P5.1,P3.2,P3.2}
TYO: 1301	Kyokuyo	{P5.1,P3.2,P4.1}
LABE	Labeyrie Fine Foods	{P3.3,P5.6,P3.2}
TYO: 8002	Marubeni Corporation	{P3.2,P5.1,P3.4}
TYO: 1333	Maruha Nichiro	{P5.1,P3.2,P4.1}
TYO: 8058	Mitsubishi Corporation	{P5.1,P3.4,P3.4}
OTCMKTS: MHGVY	Mowi	{P5.1,P3.2,P3.4}
TYO: 1332	Nippon Suisan Kaisha (Nissui)	{P5.1,P3.2,P4.4}
NYSE: NOMD	Nomad Foods	{P5.1,P3.3,P3.2}
BME: PVA	Nueva Pescanova	{P5.1,P3.2,P3.2}
NUTR	Nutreco (Skretting)	{P5.1,P3.2,P3.4}
PACI	Pacific Seafood Group	{P5.6,P3.2,P4.1}
PARL	Parlevliet & Van der Plas	{P5.1,P3.2,P3.2}
REDC	Red Chamber Group	{P5.1,P4.7,P4.7}
ROYA	Royal Greenland	{P3.2,P5.1,P3.4}
OTCMKTS: SALRY	SalMar	{P5.1,P3.2,P3.2}
SHAN	Shanghai Fisheries Group Co., LTD.	{P8.3,P1.2,P10.1}
BKK: TU	Thai Union Group	{P5.1,P3.2,P3.2}
TRID	Trident Seafoods	{P5.1,P4.1,P5.6}
TRIM	Tri Marine Group	{P5.1,P3.2,P3.2}
WALE	Wales Group (Sea Value & Sea Wealth)	{P5.1,P5.1,P5.1}
TYO: 2874	Yokohama Reito (Yokorei)	{P5.1,P3.4,P3.4}

Table 5.15. *List of top three business model patterns for each entity as identified by the machine learning process in evaluating the 30 keystone actors in the seafood industry.*

5.12. Conclusion

Overall, the evaluation once set up was straight forward. Eight respondents engaged in the individual evaluation session and provided feedback as required. They represent a cross section of the expert community and therefore were representative of what we sought to achieve. The ex-post evaluation was undertaken over a period of four

months, from the time it was conceived and then implemented, and the results collated and shared back anonymously with the group.

With the case study we have seen over 200 users of the system to date. We have since received interest from various groups to use the THRIVE Platform and the understandings from the THRIVE Framework in their works also. For example, universities have sought to use a demonstration version of the Platform as part of their teaching and have asked if they may refer to the THRIVE Framework as part of their teaching program. All feedback from those using the system has been captured and considered for future implementation in subsequent versions of the system.

Key learnings included the recognition of the importance of the THRIVE framework to various stakeholder groups, the addition of features to the THRIVE Platform for future versions, and future collaborations with United Nation's research groups. Generally, over time we have seen wider adoption of some of the principles described as the 12 Foundational Focus Factors by various individuals and international organisations operating in this space, thus confirming the usefulness of the THRIVE Framework and THRIVE Platform tool.

CHAPTER 6: DISCUSSION

6.1. Background

This study developed and tested a framework to assess the strong sustainability performance of entities and in particular organisational business models. This was achieved through a comprehensive review of the literature, followed by the design of a framework incorporating the 12 Foundational Focus Factors and the development of the platform in line with design science principles. The operationalized artefact was reviewed by a panel of experts, including academics, researchers, and analysts.

In this chapter we will discuss the key aspects of the study in relation to business or more broadly entity models, sustainability metrics, and thus sustainable entity models – models that a posteriori were found to be more sustainable than others as identified in the case study of the Seafood Stewardship Index. We will also discuss aspects of the THRIVE Platform and go over each of the 12 Foundational Focus Factors within the Systemic Holistic Model. Lastly, we will present a range of sample design principles.

Given the conceptual nature of the study, the emphasis was placed on ensuring the rigour of the construct (the artefact) and its usefulness, although an empirical evaluation of the global seafood industry was also undertaken. These results were further elaborated upon and delivered in the whitepaper, *Seafood Stewardship Index: Evaluating the strategies and sustainability performance of keystone actors in the seafood industry* (THRIVE Project 2023). The use of DSR ensures robustness, rigour, and the ability to iterate, with evaluations conducted on design ex-ante and on the artefact ex-post (Sonnenberg & Vom Brocke 2012), as well as the result of the sample Seafood Stewardship Index case study (***Appendix B: The THRIVE Platform***).

Furthermore, in the case of climate change, we know that systemic change is necessary to avoid "*overshoot"* (Borucke et al. 2012) and achieve "*drawdown"* (Hawken 2017) by mitigating the climate crisis

(Messerli et al. 2019). Ryan (2008) argues that the level of reduction required in greenhouse gas emissions points to the need for rapid systemic change in business systems, as the traditional management paradigm is inherently limited in its ability to address ecological degradation effectively (Shrivastava 1995), with traditional business models (BMs) exacerbating the problem (Stubbs & Cocklin 2008). DiSegni et al. (2015) conclude that when enterprises invest in corporate social responsibility initiatives, they are likely to achieve cost reductions, improved quality, flexibility, improved delivery as well as overall performance. This study demonstrate how we can measure the sustainable impact of business or more generally entity models relative to the nested holonic ecosystem which govern how our planet works (Riedy 2007; Victor 2018).

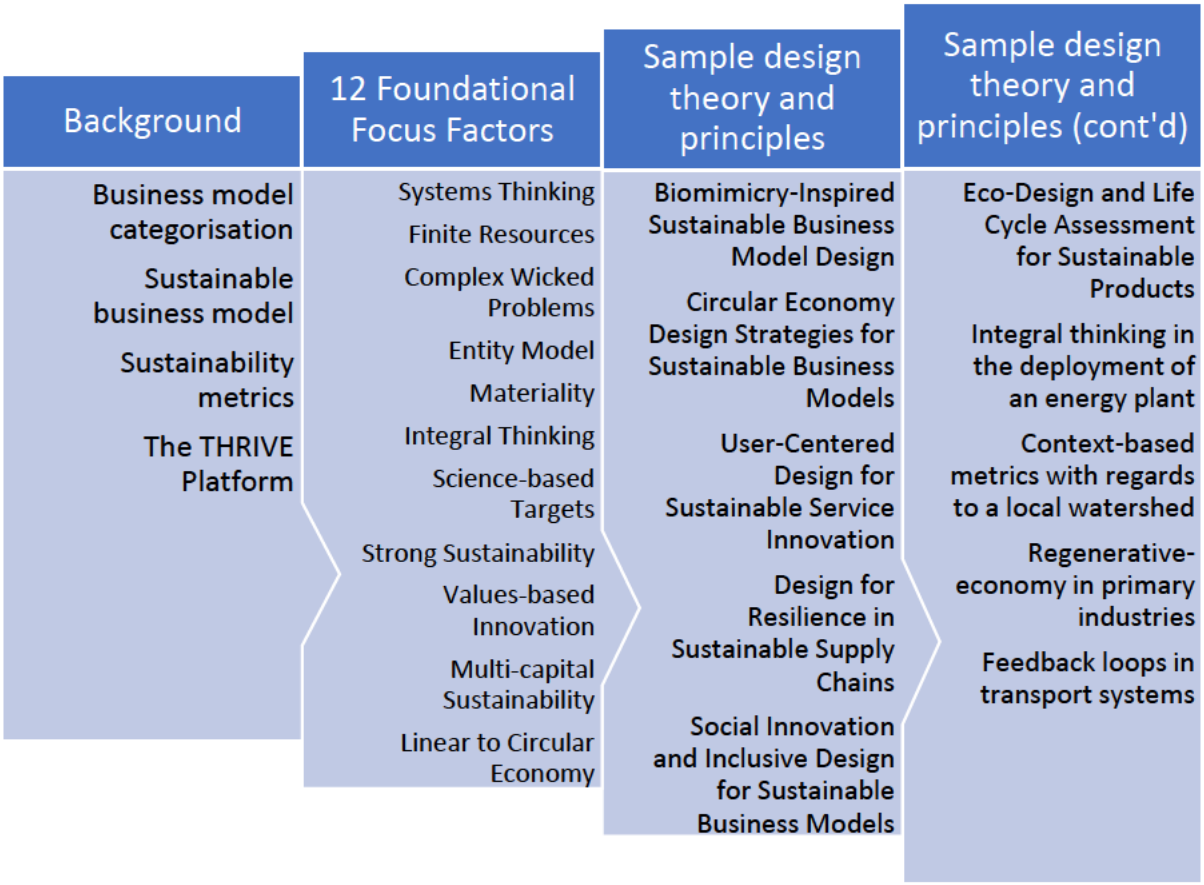


Figure 6.1. Chapter 6 DISCUSSION chapter layout.

The structure of this chapter is such whereby we revisit the key concepts, discuss the 12 Foundational Focus Factors, consider sample design theory and principles, as well as draw the connection between management theory and derived technological rules (***Figure 6.1****)*.

6.1.1. Business model categorisation

In assessing the strong sustainability performance of organisational business models, it is important to know how a business model is defined and how changes to, indeed innovations of, the business model leads to new business models. Studies were reviewed that examined the plethora of business models available, looking to identify a method of classifying the same and in doing so pinpointing a particular group known as "sustainable business models". Several studies have examined business models "inside-out" through a process of decomposition, looking closely at the "*why*" of the underlying business logic included within (value creation, destruction, etc.). In this study, the analysis deliberately took the "outside-in" viewpoint of analysing the "*what*", since the approach was holistic, with the business model treated as a black-box, whereby one is assigning quantitative impacts to designated business model categories. This approach leveraging machine learning and AI assisted in identifying categorial entity model patterns in support of sustainable development (Di Vaio et al. 2020).

6.1.2. Sustainable business model

When employing a weakly sustainable approach, historically researchers generally asserted that any advance on the concept in the realm of sustainability (such as green supply chain, recycling, fairer social practices, etc.) immediately qualified an enterprise's business model as being a sustainable business model. However, by taking a strong sustainability stance, one must identify if these "improvements" are indeed enough, thus invoking an assessable, contextualised measurement of impacts within normative performance (França et al. 2017). This requires an understanding of resource availability, resource use,

thresholds, allocations, and normative impacts. In other words, this requires a quantitative assessment relative to finite resources.

Very few datasets and methodologies in use in industry include science-based and context-based metrics (Bjørn et al. 2017), treating resources as endless and hence are devoid of a strongly sustainable approach. This study has revealed that in principle the evaluators agreed with a strongly sustainable approach and reverted to using weakly sustainable insights only when citing a lack of sufficient context-based data and uniformity in the application of the strongly sustainable context principle.

6.1.3. Sustainability metrics

To be meaningful within the context of this study, sustainability metrics require the quantitative evaluation of impacts within normative ranges – i.e. a strongly sustainable approach (Neumayer 2010b). In this study, datasets were used where there was a comparative set of results available – namely, the World Benchmarking Alliance (WBA) evaluation of the Seafood Stewardship Index (WBA 2018). Results using the THRIVE Platform tool were shown to be congruent, and indeed more accurate (with a higher level of precision). Moreover, the transparency on offer by using the THRIVE Platform tool did not go unnoticed by senior commentators such as Bill Baue, a United Nations contributor and researcher, who stated that THRIVE's agnostic formulation engine "*with the ability to load different formulations [and methodologies] and test against one another….is stronger than what the WBA is doing as you are more assuredly applying context*" (Bill Baue, researcher with r3.0 and UN RISD). The reference to context here is critical (*see* **Section2.6.8 Context-based Metrics**), as the WSSI approach merely assumed all impacts were within a known *normative* range (WBA 2018), when in fact the THRIVE Platform can also determine impacts out of the *normative* range. The assumption that the measured impacts are [within] normative [range] is a false one as explained in ***Section 2.6.8*** on Context-based Metrics.

6.1.4. The THRIVE Platform

The decision to implement a case study through the THRIVE Platform software tool was a very useful one, in retrospect, as it brought many of the theoretical aspects of the study to life in a practical tangible and visual way, thereby demonstrating replicability (Brendel et al. 2021). The FE and WE proved invaluable in showcasing how to address incongruency between methodologies, methods, assumptions, and criterions, and how someone could be easily deceived into believing an action is sustainable even if not so. The use of custom materials topics together with flexible FE and WE formulations provided explanatory power as to how different methodologies operating on the same dataset can produce a wide range of outcomes. The addition of scenario comparisons through the multiple search tab in THRIVE Platform v2.x was also a useful outcome from the feedback received. The Platform provided valuable insights in terms of processing speeds as well, highlighting the extra orders of magnitude required to process under different formulations of the FE & WE. During the development phase it was indeed discovered that choice of formulations greatly affecting response times based on the extra layer of complex computations needed. A statistician and computational software designer were brought in to assist with this.

6.2. The 12 Foundational Focus Factors

This study explored the Systemic Holistic Model and its components, the 12 Foundational Focus Factors. This study discussed some of the key implications across each of the factors. It should be noted that the factors are interconnected and thus may affect one another.

6.2.1. Systems Thinking (formerly Trans-disciplinary Systems Thinking)

Given the complex, trans-disciplinary nature of the field, the Systemic Holistic Model (SHM) solution offered in this study through the THRIVE Framework and Platform tool ensures that users of the system can illustrate past performance and simulate future impact. The THRIVE framework is informed by the most recent understanding in the natural

and social sciences, including geology, physics, chemistry, biology, space science, material sciences and many more, seen all as nested systems within the greater ecosystem (Marcus et al. 2010). By using advanced IT systems incorporating cloud computing, big data, predictive analytics, and machine learning, the THRIVE Platform offers users the opportunity to bring together the datasets necessary to inform the process of simulating the sustainability of entities in real time. Furthermore, users of the system are given the opportunity to manipulate variables through dials and levers to ascertain dynamically the impact of key changes to inputs on the overall impact. This compares favourably with traditional studies whereby a static table summary of results is provided. Furthermore, machine learning can deal with vast datasets in a systemic way, something which outstrips the abilities of individuals to perform alone (Mehrabi et al. 2019; Rolnick et al. 2019).

6.2.2. Finite Resources

The THRIVE Platform provides a useful basis of indication of true (quantitative) sustainability impacts across all enterprises, sectors, and regions. Whilst, as was outlined in the literature review, several sustainability metrics abound, most concentrate at the enterprise or perhaps sectoral level, with only a handful offering broad appeal on material topics such as in the case of CO_2 emissions. Yet a holistic scale-linked approach across all levels is essential if scientists are to measure the impact of society, as a whole, on the planet Earth. The need for holonic multi-level perspectives is a key finding that emerged as the study moved from building the THRIVE Platform v1 to v2, something first identified in the Fedeli and Glinik (2021) study. This enforces strong sustainability as well as the Context-based Metric principles discussed elsewhere. Importantly, this top-down approach is what ensures that the sum of the parts is within the whole and counteracts the prevalent bottom-up approaches to date where one consistently ends up with results that allow segments of the population to use far more than the

resources available or their fair share (e.g., see the Global South) (Rekker et al. 2022).

6.2.3. Complex Wicked Problems

All evaluators agreed that we live in a world facing several complex wicked problems. Developing solutions to our present everyday challenges requires a large investment in time and effort, with no guarantee of success (Lazarus 2008). However, the latest offerings from the world of machine learning and AI does provide the opportunity to experiment and see the effects of what might be before it becomes a reality. As one makes a seemingly positive change in one area, one may be counter-intuitively making a negative change elsewhere. AI is uniquely able to apply human reasoning at scale, thus foreseeing outcomes before they become a reality (Lee et al. 2019). Simulated environments, acting as digital twins, offers real-time virtual replicas of physiological and biological entities and thus the opportunity to experiment 'at a safe distance' the impacts of socio-technical and socio-ecological systems (Tzachor et al. 2022).

Given the interconnectedness between actors, the THRIVE Platform provides the opportunity for undertaking "*What-If*" scenario-analysis before exposing society to the risk of potentially exterminating civilisation from the Earth. This is the grander picture, and it will require the manipulation of large datasets, a task very feasible within the near term with an exponential growth in computer storage and processing power through cloud computing, quantum computers, and big data analytics (Hajiheydari et al. 2019).

6.2.4. Entity Model

No enterprise operates in isolation. By necessity, it relies on a supply chain and a distribution chain for its products and services. Thus, when assessing the sustainability performance of an enterprise, it is necessary to measure the impact of an enterprise in relation to its greater ability to make such an impact (Zott et al. 2011). For example, an enterprise may choose where its supplies come from (provenance), or

how they are produced and delivered. It may even outright boycott unsustainable suppliers, and thus directly choose to make more sustainable choices. Measuring organisational impact with reference to its organisational "business model" ensures improvement to the sustainability integrity of its delivery/supply chain.

The ability to measure sustainability performance scientifically within context is a pre-requisite of, and hence at the heart of, strongly sustainable performance measurement. This was unanimously supported by all reviewers and evaluators as the ideal. Typically, however, many, if not almost all, sustainability reports consist of "*numerator accounting*" whereby only the numerator is reported. Whilst several reviewers were aware of this, some were not, and indeed rejected the notion, stating that such reporting does not constitute sustainability performance at all, but merely nominal reporting. This is exacerbated by the fact that in many cases the figures reported are simply relative to previous reports (self-referential), and in no way constitute an objective assessment of impacts relative to demonstrated, science-based thresholds and allocations (United Nations 2022b). It is worth noting that, under this approach, even "improvements" may not be deemed enough, with reported percentages and ratios being very misleading.

6.2.5. Materiality

Material topics represent the actual areas of interest being investigated in relation to an enterprise or entity. These may include energy, water usage, pollution, gender equality, employee training and financial performance. There is a plethora of readily available and understood sustainability taxonomies such as the SDGs, GRIs and FFBB, and methodologies such as SBTi, to name a few. In most instances, these are rather proprietary and non-standardised in their approach, allowing an enterprise deliberately or accidentally to greenwash their performance (Jacobs & Finney 2019). On the other hand, the use of triple or authentic materiality implies context-based sustainability (metrics). Failing to

incorporate context, as mentioned earlier, is just one way to distort the effects of impacts.

Another way to distort these effects is simply achieved by not including what would be perceived as negative or unsatisfactory results. Hence the need to report on the same set of topics openly and transparently throughout, as enforced by the THRIVE Platform, and noted by the evaluators as a prerequisite and a key point of differentiation compared with other past approaches. This is to be expected given that historically the bottom-up approach of aggregation was at play. Lastly, uniformity, as was explained earlier, is essential to effect fair and meaningful comparisons when discussing sustainability performance. Thus, the universal systemic approach offered by the THRIVE Platform through the procedural application of its formula and weight engine gives users the ability to manipulate parameters and to conduct "*what if*" analysis whilst at the same time ensuring uniformity and transparency in approach. As was observed by several of the evaluators, this is not something that has ever been available before, and as was remarked by senior experts, provides the basis of comparing among the many available taxonomies and methods.

As was reported by several experts, until now the ability to choose formula engines independent of metric taxonomies has not existed. Typically, the two are offered as a specific black-box bundle, making it difficult if not impossible to understand the inner workings of the same. A notable exception is the Science-based Targets initiative (SBTi), which offers seven choices of formulations (*SBTi Criteria and Recommendations* 2018). Noteworthy, joining the THRIVE Project board in 2021 has been pre-eminent expert in the field of SBTi research, Dr Anders Bjørn, author of the 2017 study "*Is Earth recognized as a finite system in corporate responsibility reporting?*" (Bjørn et al. 2017) writing specifically to the issue of context and with extensive knowledge on formulation. This article and related studies support the intrinsic need for context-based metrics and a formula engine consistent with design thinking.

6.2.6. Integral Thinking (formerly Integrated reporting)

During the evaluation, it was noted that some championed the integrated reporting approach (<IR>) offered by the likes of the IIRC (Kılıç & Kuzey 2018). Whilst still short of the mark, as explained in the literature review, this approach does make attempts at multi-capital reporting (IIRC 2013). Here this study is more interested in the integrated reporting and the "*integral thinking"* concept in general. Some evaluators thought that integrated reporting was too narrow and not deserving of being elevated to the level of a foundational focus factor, with the broader integral thinking concept overshadowing it. Although the IIRC have now merged with other allied bodies, the <IR> (cf. XBRL) concept still has a considerable way to go, notably in addressing context-based metrics and material topic universality (Ogata et al. 2018). A switch to the "*integral thinking*" passim occurred thereafter in this study.

6.2.7. Science-based Targets

Although there are a few organisations that evaluators referred to working in this field such as the CDP, SBTi, and others, generally these organisations target just a few key resources such as water, emissions, energy, and the like. Much more work is necessary to get a full picture and data quality is always a concern with associated assumptions and limitations. Many focus largely on decarbonisation at the global level which ought to be just one of several topics under consideration. Crucially, there is an appreciation for the need to measure impact at other levels, such as cities and bioregions with current methods largely ineffective (Graymore et al. 2008; Hawkins et al. 2023). However, there is a newly formed group, the Global Threshold and Allocation Council (GTAC), that is aspiring to develop global guidelines for an approach to cover all industries at all levels over the coming years. These thresholds and allocations will then serve as the basis to determine back cast targets across enterprises, sectors, bioregions, and more. It is early days with the likes of the United Nations Research Institute for Social Development,

r3.0, World Benchmarking Alliance, Centre for Sustainable Organisations, and others involved including THRIVE Project as a founding member.

For example, as representative of the THRIVE Project and an Academic Alliance member, this author study's input is seen as critical to the conceptualisation, development, deployment and delivery of the mission on determining fair and just global thresholds and allocation standards and developing polices to enforce the same for the prosperity of humanity on this planet. The THRIVE Framework was incorporated into a study submitted to the UN RISD in 2022 on "Thresholds of Transformations". In the recommendation section of the draft report the THRIVE Platform was noted as "*a key data platform provider for further disseminating implementation of the [sustainability] indicators*" (https://sdpi.unrisd.org/wp-content/uploads/2022/12/wp-2022-1-sdpi-synthesis-report-baue-thurm-1.pdf).

6.2.8. Context-based Metrics

During the evaluations there was an appreciation for the context-based metrics concept, although some were not aware of it as it was disguised under "*numerator accounting*". Growing out of the need for determining a just and fair future for all, context-based metrics is the realisation than in a strongly sustainable world one cannot generate continuous growth, wealth, and abundance from finite resources. The method whereby an entity goes about capturing their specific approach and assumptions or criteria is known as the metric. Context-based metrics therefore is a nuanced metric that ensures context is captured (McElroy 2019). Any determination that is not determined in this way is rather meaningless as it cannot be used in a comparative way (Baue 2019). To comparatively interpret impacts in a fair and just way, a universal and unified approach as entrenched in the underlying foundations of the THRIVE Framework and the THRIVE Platform software is necessary.

6.2.9. Strong Sustainability

In applying a strongly sustainable approach from the outset, the long-term aim is to ensure that all entities in this world are sustainable, and hence requires all enterprises to be so too. Whilst this is largely undisputed among the broader field, as well as by those who undertook the evaluation, the consensus is that the process of going from unsustainable to sustainable is a gradual one, and therefore even enterprises that may claim to be sustainable are by necessity dependent upon others that may well be unsustainable. This is compounded by enterprises that greenwash their results. Enforcing strong sustainability by design in the THRIVE framework ensures that greenwashing may not occur as the technological rules are baked into its design. This is an imperative for those who believe that society may have already gone past many of its tipping points (O'Riordan & Lenton 2013), thus seeking a precautionary approach (Waldron et al. 2008; Willard et al. 2013) expressed by way of its formulations is foundational to the THRIVE Framework/Platform.

6.2.10. Values-based Innovation

As was expressed in the previous section, how is society to determine what are the material topics of interest? How is society to value what is important? The literature points to shared value creation and globalisation, with mixed opinions about the effectiveness of the latter. Generally, evaluators were silent on this topic, although much evidence points to existing approaches generally employing a variety of "*cherry picking*" methods. When evaluating taxonomies, it is worth noting that many enterprises are for-profit and funded by various bodies and shareholders with their own political agenda. It could well be said that aiming for global shared value creation among competitors may be a tall order (Breuer & Lüdeke-Freund 2016). Until the mindset of our senior global leaders moves towards the spirit of collective cooperation and collaboration rather than contentious, challenging competition, society may well continue to squabble over the very finite resources available.

6.2.11. Multi-capital Sustainability

The notion of measuring the sustainability performance of enterprises is certainly not new and can even be found in the stock market in the FTSE4Good and the Dow Jones Sustainability Index (DJSI). However, for the most part, this has revolved around measuring financial or economic performance, just one of the three pillars of sustainability. The need to measure also social and environmental performance, and indeed the intersection of all three, has been highlighted for decades (Vanclay 2004). However, more and more scholars agreed that this is not enough, and hence the concept of multi-capital accounting has entered the vernacular (McElroy & Thomas 2015). This concept is extended by considering a range of material topics (materiality) within each of the broader multiple capitals as detailed in the CHAPTER 4: ARTEFACT DESCRIPTION. Thus, the THRIVE Framework captures both the multi-capital as well as the multiple material topics that are needed to assess impacts at scale.

6.2.12. Linear to Circular Economy

Perhaps the circular economy is an overused concept, given that there is plenty of recent literature to show that moving from the linear to the circular economy is not enough. Current literature suggests that the steady-state economy may be the short-term solution until one can resolve some of our more pressing issues, however, those in the degrowth camp disagree (Hickel et al. 2022). Evaluators and experts alike have stated that we will need to re-engineer society and business to be more sustainable by design, rather than seeing us addressing the sustainability challenge by simply "*tacking on*" another approach, department, or venture. In other words, sustainability – and arguably hence thrivability – will need to be built into the very fabric of society rather than being seen as an afterthought, as it is largely now. The best minds from economist to physicist are debating this. What we do know is that there are a plethora of ideas and no easy solutions in sight (Hölscher et al. 2018).

In several sectors, for example, there is no pressing need to source primary resources from the ground if the effort were made to recycle what is already in use. If society insist, though, as a civilisation to continue the make, use, dispose consumeristic model, and commit used resources to waste and landfill, then we are just inevitably depleting the planet, and negatively affecting the restorative capacity and regenerative ability of the resources that we need to survive as a species. This will, in due time, end the course of humanity as we know it.

6.3. Sample design theory and design principles

This study developed a framework useful in providing guidance towards the development of technological rules connecting design theory and design principles (Joan E. van Aken 2004). To recap, design theory, as articulated by Jones and Kijima (2018), converges design thinking and systems thinking providing a robust approach to intricate problem-solving. It integrates ideation and iterative prototyping with a holistic comprehension of complex systems. Ackoff (1981) idealised design introduces the concept of transcending constraints for transformative solutions. Meadows (1998) expands systems thinking through systemic modelling and intervention; Senge (2006) adds dynamics; and Fuller (2008) lays the foundation around trans-disciplinary design. This fusion, rooted in historical and theoretical foundations, positions design theory as pivotal for multifaceted problem-solving as found in this study.

Furthermore, design theory, as articulated by Gregor and Jones (2007), amalgamates viewpoints including differentiation between "*Management Theory*" and "*Organisation Theory*" (Joan E. van Aken 2004), highlighting prescriptive and descriptive knowledge respectively. Simon (1969)'s stance emphasizes design theory's role in defining optimal conditions for goal achievement. Joan E. van Aken (2004) notion of "*technological rules*" offers actionable directives like "*If you want to achieve Y, then you must do X*", guiding complex design scenarios. Walls et al. (1992) reinforces the distinction between scientists' identification

and designers' shaping. This synthesis elucidates design theory's essence, providing a profound framework for effective design practices.

This study’s design approach is an exaptation, meaning that the technological rules found elsewhere can be shown to apply here, or alternatively, there is a precedent in other disciplines, industries, or at other scales. Here are some examples:

- **Example 1: Biomimicry-Inspired Sustainable Business Model Design**

Businesses employ biomimicry to emulate nature's strategies, creating products that are both efficient and resilient. According to Benyus (1997), this approach integrates innovative natural solutions into business design, fostering sustainability.

- **Example 2: Circular Economy Design Strategies for Sustainable Business Models**

Designing products and supply chains with circular economy principles, such as modular, durable and recyclable, is pivotal for minimising waste and resource consumption. Stahel (2019) emphasizes that this design strategy aligns economic growth with sustainability objectives by decoupling wealth from resource consumption.

- **Example 3: User-Centred Design for Sustainable Service Innovation**

Incorporating user perspectives in the design process leads to services that promote sustainability. Leifer and Meinel (2016) contends that the design process "starts with empathy for the user", ensuring greater resonance with user needs and values.

- **Example 4: Design for Resilience in Sustainable Supply Chains**

Applying design principles to supply chains enhances their resilience against disruptions, contributing to sustainable operations. Elkington (2012) highlights that resilience is the new sustainability, reinforcing the importance of infusing resilience-focused design into supply chain management.

- **Example 5: Social Innovation and Inclusive Design for Sustainable Business Models**

Inclusive design and social innovation address pressing societal challenges within business models. Papanek (1984) underscores that design should be an instrument of social change, indicating how involving diverse stakeholders and considering social dimensions can contribute to sustainable development.

- **Example 6: Eco-Design and Life Cycle Assessment for Sustainable Products**

Eco-design, encompassing life cycle assessment, guides the creation of environmentally friendly products. McDonough and Braungart (2010) emphasizes that design must be inspired by nature's systems, highlighting the significance of considering the entire lifecycle to minimize environmental impacts and enhance product sustainability.

Other examples extolled by various researchers and organisations without formal precedents include:

- **Example 7: Integral thinking in the deployment of an energy plant**

Applying integral thinking in sustainability involves holistically addressing environmental, social, and economic dimensions. For instance, when designing a renewable energy project, integral thinking considers ecological impacts, community engagement, and long-term economic viability, ensuring a comprehensive and balanced approach to sustainable development.

- **Example 8: Context-based metrics concerning a local watershed**

Context-based metrics in sustainability quantifies performance relative to specific environmental and social contexts. For instance, a company's water usage is evaluated not just against a general benchmark, but in relation to local watershed availability and societal needs. This approach ensures more accurate sustainability assessments

and targeted improvements aligned with local conditions, fostering responsible resource management and societal well-being.

- **Example 9: Regenerative-economy in primary industries**

A regenerative economy focuses on restoring and enhancing natural systems while fostering economic growth. For example, in agriculture, adopting regenerative practices like cover cropping and rotational grazing not only increase soil health and biodiversity but also contribute to resilient rural economies by reducing input costs, increasing yields, and creating local employment opportunities, embodying a holistic and sustainable approach to economic and ecological prosperity.

- **Example 10: Feedback loops in transport systems**

Feedback loops in sustainability refer to the cyclical interactions between elements in a system that amplify or dampen outcomes. In urban planning, improved public transportation can create a positive feedback loop: reduced car usage lowers emissions, which improves air quality and health, subsequently encouraging more people to use public transport, thereby further reducing emissions and congestion. This reinforcing cycle fosters sustainable urban mobility and environmental well-being.

Lastly, worth noting, that the author here is the representative at THRIVE Project for GTAC (Global Threshold and Allocations Council). This is a worldwide group comprised of the UN, r3.0, WBA, Project Drawdown, and 21 other bodies who have been specifically brought together to develop these design principles. Whilst this is still work-in-progress, there have been ongoing meetings since 2021, and the first draft of the guidance documents is being released later this year. Additionally, we have seen the implementation of some of the THRIVE Framework principles by a number of organisations, including their use in the UN RISD Authentic Assessment initiative in collaboration with r3.0 (United Nations 2022b). As an Advocation Partner THRIVE Project and I regularly contribute to blueprint research, writing, and editing, discovery sessions, workshops and conferences.

6.4. Methodological limitations and innovations

A range of methodological limitations were identified as per ***Table 6.1*** and include a lack of generalizability, bias data sources, oversimplification, lack of longitudinal data, narrow perspective, constrained analysis, varying policy context, lack of credibility and objectivity, and resource availability. Wherever possible, these were considered and addressed in this study with relevant references indicated in said table below.

In terms of methodological innovations and associated potential applications in future research, these may include, but not limited to better ways of controlling for bias, adaptive systems integration, the use of multi-disciplinary frameworks, the integrating regenerative economics principles, enhanced stakeholder engagement, leveraging AI for predictive analytics, improved evaluation techniques, and new sustainable governance models ***Table 6.2***.

6.5. Conclusion

This study aimed to develop and assess a framework for evaluating the strong sustainability performance of entities, particularly organisational business models. It involved an extensive literature review, design of the framework incorporating 12 Foundational Focus Factors, and the development of the platform using design science principles. Experts, academics, and researchers reviewed the resulting operationalised artefact, together with an empirical evaluation of keystone actors in the global seafood industry (Osterblom et al. 2015).

This study emphasised the need for systemic change to mitigate the climate crisis and related ills to achieve sustainability. Traditional business models are seen as contributing to ecological degradation, necessitating rapid systemic change in business systems. Emphasising a strongly sustainable approach, this study focused on quantitatively assessing sustainable impacts of business models within normative performance ranges. In categorising business models, the study took an "*outside-in*"

viewpoint, analysing the "*what*" rather than the "*why*" of employed business logics. In a largely quantitative study, with the help of AI, it categorically assessed entity models against impacts. Sustainable entity models were defined as ones that go beyond mere sustainability improvements, and are anchored in radical innovation, incorporating contextualised measurements (metrics) of impacts within normative ranges in, for example, cities or urban settings (Huang et al. 2015).

Key Concept	Custom Limitation	Reference
Scope and Generalizability	The study's focus on particular case studies may limit generalizability.	Kiron et al., 2017; LeBlanc & DeRose, 2016
Data Sources and Availability	Reliance on specific data sources may introduce bias.	Fogelberg et al., 2017; IRIS, 2019
Interdisciplinary Challenges	Integrating diverse fields can be complex and lead to oversimplifications.	Meadows, 2008; Senge, 2006
Temporal Constraints	The study's timeframe might not capture some long-term impacts.	IRIS, 2019; IPCC 2018; IPCC 2023
Methodological Rigor	The methodological approach may lack rigour in certain areas, introducing subjectivity.	KPMG, 2020
Stakeholder Engagement	Limited engagement with diverse stakeholders could result in a narrow perspective.	Schaltegger et al., 2016; Stubbs & Cocklin, 2008
Theoretical Framework	Reliance on specific theoretical frameworks might constrain analysis.	Fogelberg et al., 2017
Policy Context	The dynamic nature of policy environments might not be fully accounted for.	Porter & Kramer, 2011; Ostrom, 2010
Ethical Considerations	Ethical considerations in data collection and analysis might pose limitations, affecting the study's credibility and objectivity.	Breuer et al., 2018
Practical Implementation	The feasibility of implementing the proposed methodologies in real-world settings might be limited due to practical constraints such as resource availability.	UNE, 2011; Guinée et al., 2011

Table 6.1. *A range of methodological limitations of this study.*

Key Concept	Custom Innovation	Reference
Better ways of controlling for bias and removing it through the generation of alternatives benefiting AI/ML systems	Requires consistent generation of valid alternatives, with AI/ML adaptation based on diversified datasets.	Olsen (2007); Shrivastava & Guimarães-Costa (2016); Donnellan (2019)
Adaptive systems integration for resilience in sustainability projects	Incorporating real-time data adaptation to improve project outcomes under unpredictable environmental changes.	Jones, P. & Whitehead, M. (2018). Systems Resilience in Complex Environmental Projects. *Environmental Systems Journal*, 22(3), 197-210.
Multi-disciplinary frameworks bridging climate science and economic modeling	Aligning cross-domain methodologies to enhance integrated assessment models (IAMs) for sustainable policy formulation.	Peterson, T., & Williams, K. (2017). Integrated Models for Sustainable Economics. *Climate Policy Review*, 10(2), 75-92.
Integrating regenerative economics principles into mainstream financial modeling tools	Developing hybrid models that account for both traditional metrics and regenerative ecosystem indicators.	Jackson, T. (2016). *Prosperity Without Growth: Foundations for the Economy of Tomorrow*. Routledge.
Enhanced stakeholder engagement strategies for global sustainability initiatives	Employing participatory approaches combined with digital platforms for decentralized decision-making.	Chambers, R. (2019). *Participatory Approaches in Development: The Evolution of Concepts and Methods*. Routledge.
Leveraging AI for predictive analytics in regenerative agriculture	Innovating decision-support systems to include diverse environmental factors and local knowledge inputs.	Fernandez, A., & Bailey, C. (2020). AI in Agroecosystems: From Predictive Analytics to Sustainable Practices. *Journal of Agricultural Science*, 45(4), 339-354.
Improved evaluation techniques for social impact projects using thrivability metrics	Introducing adaptive evaluation frameworks that dynamically adjust to changing social priorities and project phases.	Costanza, R., & Daly, H. (2021). Metrics for a Thrivable Future: Rethinking Evaluation in the Age of Sustainability. *Ecological Economics*, 180, 106868.

Sustainable governance models integrating local communities into global frameworks	Designing governance mechanisms that link grassroots participation with top-down policy directives, ensuring local context alignment.	Ostrom, E. (2018). *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge University Press.

Table 6.2. *A range of specific methodological innovations of this study.*

The THRIVE Platform software tool, was instrumental in visualising and simulating sustainability impacts and offering insights into the different outcomes from various methodologies such as while formulating the FE & WE. The 12 Foundational Focus Factors were explored, and including systems thinking, finite resources, complex wicked problems, entity models, materiality, integral thinking, science-based targets, context-based metrics, strong sustainability, values-based innovation, multi-capital sustainability, and the linear to circular economy transition (***Figure 3.1***).

The Systemic Holistic Model, the overarching concept that includes the 12 Foundational Focus Factors, allows users of the THRIVE Platform to simulate future performance based on past performance and thus predict future impacts using advanced AI machine learning techniques (Rolnick et al. 2019; Patnaik 2020), big data analytics, and cloud computing (Ikonomakis et al. 2005; Ganguli et al. 2022)(*See* **CHAPTER 4: ARTEFACT DESCRIPTION**). The approach ensures a comprehensive understanding of resource use and impacts in a universal, unified, and systemic way. The study emphasised the importance of assessing sustainability performance at the entity level in relation to its greater ability to impact and influence upstream and downstream (supply and distribution) chains. The THRIVE Platform enabled transparency and uniformity in the assessment, preventing greenwashing and providing a holistic holonic scale-linked approach (Fedeli & Glinik 2021)(*see* ***Section 2.6*** **Foundational Focus Factors**).

The evaluators saw that implementing the concept of context-based metrics ensures objective assessments of impacts relative to science-based thresholds and allocations, allowing for fair and meaningful comparisons of sustainability performance. Although unclear how this could be achieved in practicality, this aspect of the theoretical foundations was reported to be sound. Overall, the study aimed to set the foundations for moving individuals, businesses, and society at large towards strong sustainability by ensuring that entities such as enterprises adopt sustainable practices. The emphasis on multi-capital sustainability and the transitioning from a linear to a circular economy were seen as critical steps in achieving a thrivable world (Lewandowski 2016).

In this chapter, examples of design theory and design principles were shared. The study seeks to find answers to a class of questions centred around which entity models are more sustainable than others and thus more conducive towards placing humanity back onto the trajectory towards thrivability.

CHAPTER 7: CONCLUSION

7.1. Background

This study addresses which strategies (entity models) for measuring sustainability performance are effective and which are not, across the 7Cs (Fedeli 2020). It provides an outside-in framework where the internal business logic need not be known. Using a black-box approach and AI, ex-post assessments are conducted based on measurable impacts and entity model identification. The AI-driven analysis delivers fast and scalable insights, revealing that input parameters, more than data sets, significantly affect performance measurements.

The research highlights a lack of objective quantitative measures linking entity models to sustainability. By applying systems thinking and leveraging AI and NLP on large datasets, this study identifies models associated with sustainability and provides a foundation for transitioning towards thrivability. Sustainability impact assessments focusing on outcomes rather than theory or outputs (Adams et al. 2012) allow relative performance comparisons within specific contexts (Hajkowicz 2006), including non-market environmental and social attributes (Milkoreit 2022) that cannot be easily quantified into monetary units (Tiwari et al. 1999). Experimental evidence shows transformative social tipping points are emerging in sustainability (Missimer 2015; Centola et al. 2018; Taconet et al. 2021).

The transparent evaluation of business SPIs within their ecosystem levels the playing field, pushing organisations to refocus and re-engineer their models based on their societal and environmental impacts (Searcy 2011; European Academies Science Advisory Council EASAC 2016). This "*survival of the fittest*" approach, linking BMI/SBM to performance (SPI), offers businesses and competitors a strong comparison base, fostering competition that benefits both society and the environment (Oppenheim et al. 2017; WBA 2017). Measurement is key to effective management,

and the THRIVE Framework and Platform ensures entities measure what truly matters most (Bansal & Song 2017).

This nuanced insight helps leaders shift organisational culture towards innovation strategies aligned with sustainable societal and environmental outcomes while maintaining value (Kurucz et al. 2017). As we advance toward tri-impact integrated reporting (IR) (Lydenberg et al. 2010; Lai et al. 2017), AI, big data, predictive analytics, and real-time sensors these will enable transparent, global, real-time sustainability reporting. This would close the loop on impact assessments, finite resources, and the regenerative or circular economy (Webster 2015; Geissdoerfer et al. 2017).

This study introduces the blueprint in the THRIVE Framework and a demonstration tool, the THRIVE Platform. The blueprint aids entities, such as those investing in corporate social and environmental responsibility, in achieving cost reductions, improved product/service quality, flexibility, delivery, and overall performance (Famiyeh 2017). It does so by providing access to technological guidelines proven to be more sustainable. The urgency for action is clear — there's no sustainable business in an unsustainable world (Thurm & Baue 2018c). Despite 90% of executives recognising sustainability's importance, only 60% of enterprises have a strategy in place (Kiron et al. 2017). Some argue that executive compensation should be linked to sustainability performance (Burchman & Sullivan 2017).

This chapter is set out as follows. The contributions made by the study are briefly revisited, making a reference to the key constructs developed during this study. The details and practical examples (mostly at the enterprise level) of how this study addresses the gap identified in the introduction are outlined. The relevant existing theory are referred to where appropriate and how this study solves the problem addressed by the research questions are illustrated. ***Figure 5.1*** provides a layout of the chapter.

7.2. Contribution

This DSR study advances knowledge (Drechsler & Hevner 2018) by developing the Systemic Holistic Model (*Figure 7.2*) with 12 Foundational Focus Factors (*Figure 2.21*), tested for relevance and rigour via the Seafood Stewardship Index case. It introduces level-2 nascent theory and artefacts that clarify the link between entity models (similar to strategy) and sustainability performance. Using machine learning, it is the first to quantify the relationship between categorical entity models and sustainability impacts. Building on the Framework for Strategic Sustainable Development (FSSD) (Broman et al. 2017) through backcasting, it guides entities towards greater thrivability.

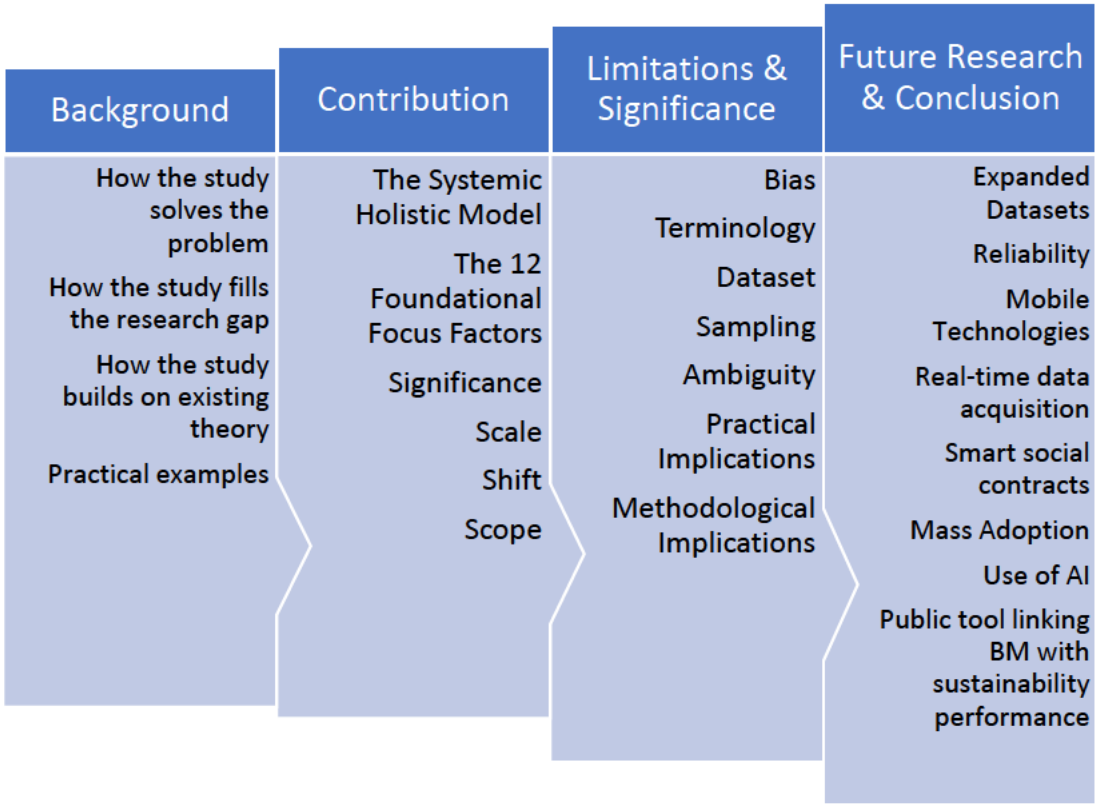


Figure 7.1. Chapter 7 CONCLUSION chapter layout.

This study uniquely links quantitative sustainability performance with categorical sustainable business models. It applies these models at various entity levels such as companies, bioregions, or countries. An entity is broadly defined as a structured group of individuals (creatures),

either localised or extending across borders. For companies, this includes collectives, cooperatives, firms, institutions, and multinationals, whether profit-driven or not. Other categories include sectors, portfolios, and funds. The literature review revealed several studies focused on designing ex-ante sustainable business models (França 2013; França et al. 2017). However, these models lack empirical validation, leaving uncertainty about what truly makes a business model sustainable. Conceptual analysis by disaggregation also introduces risks (Upward 2013).

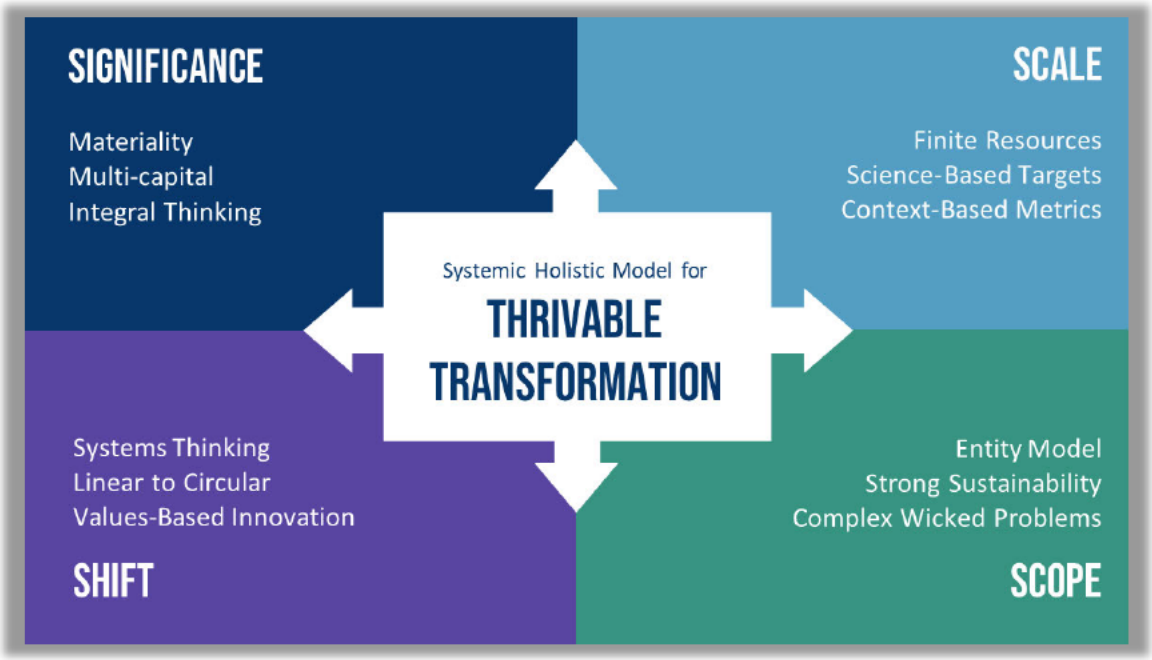


Figure 7.2. *The Systemic Holistic Model (SHM) shows the four quadrants of significance, scale, shift, and scope.*

This study is among the first to link empirical performance with theoretical business model design and assessment, laying the foundation for business transformation. Sustainability challenges act as catalysts for business model innovation (Evans, Vladimirova, et al. 2017; Foss & Saebi 2018a). Uniquely, this research introduces a framework supporting sustainability-driven business model innovation, alongside an information systems tool that steers humanity towards thrivability. The process, detailed in ***Section 4.2.6*** as "*systemic orchestration*" emerges from applying the Systemic Holistic Model (SHM) through this information systems solution.

The SHM comprises four quadrants covering each of the 12 foundational focus factors detailed in the artefact design. These are grouped and arranged as follows:

- Significance (numerator): Materiality, Multi-capital, and Integral Thinking;
- Scale (denominator): Finite Resources, Science-based Targets, and Context-based Metrics;
- Shift (thresholds and allocation): Values-based Innovation, Linear to Circular Economy, and Systems Thinking; and
- Scope (aggregation): Entity Model, Strong Sustainability, and Complex Wicked Problems.

This arrangement elicits the four key components of numerator, denominator, thresholds and allocation, and aggregation that are necessary for a transparent, scalable measurement system towards strong sustainability enabling thrivability. Leveraging science-based targets and context-based metrics, the THRIVE Platform sustainability performance score articulates a composite performance score as the aggregate of numerator over denominator times allocation across each material topic (see ***Appendix B***). A summary of the four quadrants follows.

7.2.1. SIGNIFICANCE: Materiality, Multi-capital and Integral Thinking

Conceivably, one way to support multiple material topics and taxonomies (e.g., GRIs and SDGs) is to take an integral approach to true materiality (Thurm 2016). In this study this means the inclusion of all topics, including hard to measure, qualitative topics and narratives. Contrary to the likes of the IIRC (2013) viewpoint on this matter, this study demonstrates that even qualitative measures such as "well-being", for instance, can effectively be quantified and rolled into a standardised (normalised) quantitative metric. For example, "quality of life" could be measured on a scale from 0% to 100%, where lower numbers represent various stages from innocuous pain to injury through to progressive forms

of acute illness and 100% for death. Furthermore, one could record other aspects and assign targets, such as the associated costs and impact of days off work.

Theoretically, as a last resort, any measurement can be converted to a nominal ordinal value (cf. disclosure reports) (Dixon-Woods et al. 2005; Bazeley 2006). Moreover, using sector specific materiality supports fairer comparisons, and has implications for greater sustainability. This encourages enterprises to compete based on reliable data in the public domain (Eccles & Krzus 2018), and spur the building of more sustainable entity (business) models.

Typically, a group of targets converge to contribute to a material topic, with a set of topics forming a goal. In some nomenclatures, the groupings change; however, they ultimately feed into a set of multi(ple)-capitals (Esbjörn-Hargens 2012; McElroy & Thomas 2015) that combine into the three pillars of economic, social and environmental sustainability (Elkington 2004). Thus, as a matter of practice, the integration and convergence of static financial and sustainability reporting data into integrated reports, forms the basis for consistency in comparisons. By applying integral thinking, integrated reporting, for example, can be seen as a proxy for good governance, helping to attract investors and employees (Blasco & King 2017). Real time, data-driven and dynamically generated integrated reports can assist enterprises to score their progress beyond the voluntary disclosure checkbox (López et al. 2007; KPMG 2020). Therefore, this quadrant of Significance measures the actual (numerator) impact against established, true material targets, and assess the significance of an entities' effort towards a sustainable society.

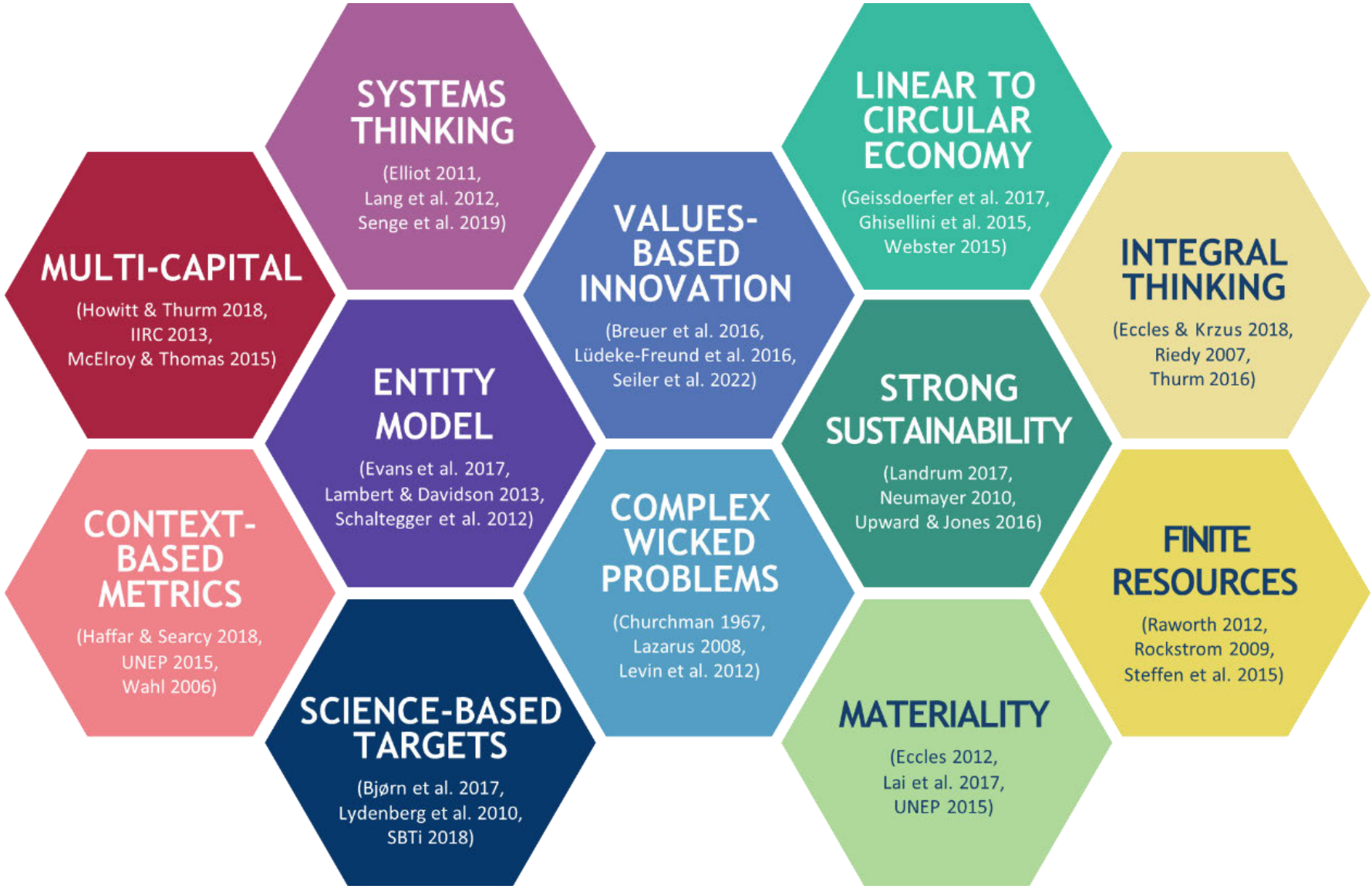


Figure 7.3. *The 12 Foundational Focus Factors identified in this study.*

7.2.2. SCALE: Finite resources, Science-based Targets and Context-based Metrics

Sustainability and integrated reports often fail to include planetary boundaries and science-based targets (Bjørn et al. 2017). To assess actual progress, these finite resources need to be translated into national fair-shares within the Earth's safe operating space (Steffen et al. 2011; Raworth 2012). Rather than being simple disclosures, science-based data is necessary for entities such as enterprises to manage and engage within nature's limits, and thus compete on true performance. These finite boundaries are inter-related, and thus require a holistic approach (Dao et al. 2011) that can be developed using information systems. Modelling using a software-based solution allows entities to see the effects of decoupling performance from growth (Jackson 2009), thereby creating the opportunity to transition to the steady-state economy (O'Neill et al. 2018), and beyond. Forming the basis of the denominator, sophisticated software can calculate projected allocations and set backcast targets by employing a variety of formulations or methods as dictated by the science-based targets at each scale.

For example, leveraging the Internet of Things (IoT), millions of data points can be made available at successive scales of integration in real-time from Earth based systems using predicted model-data on climate change, perturbations, and extreme events (Mudunuru et al. 2024). The big data on these metrics can be analysed using scale-linked mathematical models, with the science of global thresholds and allocations translated into actionable targets, within context, using consistent and comparable units of measure. This exercise may persuade entities to shift their thinking away from self-referential and incremental reporting towards radical improvements in their approach to sustainability, thus fostering enterprise and world-wide innovation. Encouraging measuring what matters most through context-based metrics requires assessing impacts (numerator) within the setting of vital capital availability (denominator) as defined by the Scale quadrant.

7.2.3. SHIFT: Values-based Innovation, Linear to Circular Economy and Systems Thinking

The focus grouping of Shift outlines the thrivable transformation which we must aspire towards to achieve a prosperous economy. The elaboration of values among enterprises, and indeed among sectors and beyond (Breuer & Lüdeke-Freund 2016), encourages innovation and experimentation. Innovation management acts as a lever for new business networks to solve problems that individual enterprises cannot address, thus fostering collaboration (Berman & Korsten 2013), and spurring on globalisation (Ferreira et al. 2015; Varadarajan 2017). Values-based networks aimed at ecological justice, the natural environment (Marcus et al. 2010), human society and the economy (Breuer & Lüdeke-Freund 2017), encourage measuring performance beyond efficiency gains, and integrating sustainability within the fabric of the enterprise. This can facilitate the transition to the circular economy (Dentchev et al. 2018). Formulating innovative solutions to circular economy challenges requires a top-down, scale-linked and participative design science approach (Malhotra et al. 2013).

Taking an integral thinking perspective (Riedy 2007) by adopting a critical, first-principled examination of the science-based facts (Kopnina 2017) entities may innovate their business models by shifting their focus through radical innovation. Technology platforms powered by extensive information systems may allow enterprises to experiment with a range of business models and solutions (Remane et al. 2017). Supported by information systems, these platforms can extract patterns and discover trends, indicating which business models are more conducive to transitioning to more sustainable outcomes. Furthermore, the use of software simulations can give enterprises the ability to manipulate weights and allocations, and thus allows measurement of their impact on business model innovation (Ball 2006) as defined by the Shift quadrant.

7.2.4. SCOPE: Entity Model, Strong Sustainability and Complex Wicked Problems

Finally, this study endorses a stratified, multi-scale approach, whereby at each level the unit of analysis is based on the model of the entity under consideration. For example, when considering an enterprise, the unit of analysis is the business model. For an industry, this would be the sector model and for cities or countries, the relevant governance model. Each recursive level is scale-linked with the next successive level above it, and thus lends itself to being easily implemented by way of a software program, such as an executive or decision support systems. Furthermore, each unit exhibits a classification system. In the case of enterprises, we have the business models made from a set of grouped patterns (Lüdeke-Freund, Carroux, et al. 2018). Several such patterns have been discussed in the literature, with potentially millions of combinations available for experimentation, according to Lüdeke-Freund (2019). As was explained, even business model narratives may be categorised by converting to a nominal classification value (taxonomy) based on patterns. Innovation of the business model encourages transitions to more sustainable business models (Spieth & Schneider 2016; Baldassarre et al. 2017), with enterprises changing their business model because of sustainability opportunities (Liyanage & Uusitalo 2016). With business model innovation seen as an ill-defined problem (Foss & Saebi 2018b), experimenting with patterns to generate sustainable business models (Schaltegger, Lüdeke-Freund, et al. 2016) minimizes risk and generates superior value through known successful patterns (Lüdeke-Freund, Carroux, et al. 2018).

For a truly thriving society, a strong sustainability approach is necessary and sufficient (Upward & Jones 2016) to effect cumulative change, whilst keeping in line with regenerative capacities across all material topics and capitals identified by global thresholds and allocation (Reporting 3.0 2018). Landrum (2017) advocated integrating strong sustainability into the entity's worldview to avoid obfuscating (also known

as "*greenwashing"*) sustainability indicators. Devising models for sustainable innovation, at enterprise or industry level, beyond lessening impact (Varadarajan 2009) requires a strong sustainability approach. Modelling complex systems (e.g., weather patterns, ocean acidification or crop production) is difficult and best achieved with forward-looking sustainable strategy modelling, a computational engine and relevant assumptions (e.g., formula engine and aggregation methods) (Lloret 2016). While forecasting sits alongside descriptive business intelligence based on past trend analysis, backcasting sits alongside predictive analytics, producing forward-looking models that may incorporate the augmentation, simulation, optimisation, and analysis of impacts arising from complex wicked problems (Donnellan 2019). This is important to set the correct range towards the sustainability goals, which are accordingly grouped in this study under the focus quadrant of Scope.

Overall, the THRIVE Framework incorporating the Systemic Holistic Model and the 12 Foundational Focus factors, provide a robust all-encompassing blueprint for entities to use when transforming their entity models to adopt and implement more sustainable strategies. Additionally, more than just a predictive tool, the THRIVE Platform is a prescriptive tool for guiding humanity towards thrivability. Built on the THRIVE framework, informed by the sciences and tested empirically, this approach leverages information systems, machine learning and big data analytics to provide guidance in ensuring the longevity of all species, including our own, as we evolve within the confines of the safe operating space that we call "mother Earth". The universal adoption of this free openly accessible tool within the sustainability metrics field, and among research groups, academia, accelerators, business leaders and startups alike, ought to provide the impetus for encouraging society to move to a more sustainable, indeed thrivable, future. Recognising that there are no sustainable entities on an unsustainable Earth, the imperative is now for entities to make the necessary and sufficient innovative radical transformation (Waddock et al. 2022).

7.3. Limitations

This is a first attempt, as far as is known, at developing a framework and then a case-study evaluation of a software tool using machine learning that empirically links ex-post sustainability performance of entities across scales to their categorical entity model. As such it does not deal with operationalisation aspects, such as leadership towards sustainability (Brown 2011; Broman et al. 2017; Kurucz et al. 2017), theory of change (Virakul 2015), collaboration, globalisation and innovation (Wirtz et al. 2016; Kiron et al. 2017). Furthermore, as a largely conceptual study, very few examples are provided in this thesis, other than the case study example from the Seafood Stewardship Index (THRIVE Project 2023).

A comprehensive conceptual study of this kind and expanse characteristically suffers from a few limitations besides time and investment. Given the breadth and nuanced views expressed by leading experts, here are some key shortcomings identified in this study:

- Bias: Since the research and evaluation was largely carried out by a single researcher over an extensive period, individual subjectiveness is inevitable. To a large extent, this was mitigated by involving multiple researchers (Delphi study) and methods, and by discussions with several experts in several meetings over the years. Additionally, the universal use of software and machine learning for much of the data manipulation and interpretation serves to partially mitigate some of this bias (Dixon et al. 2018; Mehrabi et al. 2019).
- Terminology: It was evidenced early in this study that there was a disparity in some of the terms as the research field crosses several disciplines. Generally, the impact of this disparity was reduced by defining terms at the beginning of discussions and reviews.
- Datasets: The study used both illustrative and real data. Principally, this was because it was discovered that there was a

lack of specifically context-based source datasets. Secondly, given the theoretical and conceptual nature of the study, illustrative data served well to showcase critical aspects of the framework (Ebert & Welsch 2004).

- Sampling: Responses to the Delphi study amounted to 8 and the original AI training dataset revolved around 30 entities. Whilst these numbers are respectable, they are not high for statistical significance. Successive levels of iteration helped honing the results with ultimately 92% accuracy when run across the 18 million plus data points in the data sets (Randall et al. 2007; Creswell et al. 2011).
- Ambiguity: The study discovered a plethora of standards during its investigation (over 200), with many experts expressing a real need for consolidation to remove inconsistencies (this is currently taking place in the industry). The study was therefore not able to examine all existing standards. However, the THRIVE Platform fortunately offers a solution that facilitates congruency by allowing users the choice of formula and weight engine. An investigation of these and early attempts at cataloguing the same can be found in Fedeli and Glinik (2021).

Overall, it is worth noting that the artefact produced consisted of the framework and a corresponding instantiation in the form of the platform software case study as a minimal viable product. As understood, this is the first attempt at computationally linking business models with sustainability performance, and as such the expectation is that further studies can aim to refine and improve on this framework and software implementation.

7.4. Significance

The conceptual THRIVE framework is the accumulation of over 14,000 hours over seven years of intense, worldwide research, expert review, and several software trials, followed by a series of refinements. Its unique, top-down, holistic systems approach to the simulation of

sustainability performance is an original contribution to the field of sustainability metrics. Furthermore, the scale-linked enforcement of strong sustainability and context-based metrics ensures theoretical rigour in the face of common empirical data deficiencies.

The interactive THRIVE Platform tool offers the ability to identify which entity model are more sustainable than another. It offers transparency in the choice of taxonomy and methodology, as well as interactivity and flexibility in the choice of formulations and weights. Acting as an ingestor of all standards, frameworks, and methodologies, it applies the emerging science to ensure congruent comparisons are being made. This is important, with much heated debate currently around consolidation of standards and approaches as discussed earlier and in the literature review. Importantly, the THRIVE Platform links quantitative sustainability performance with categorical entity models (Lambert 2015), such as organisational business models, through the application of advanced innovative machine learning techniques. It offers users of the platform the ability to manipulate input parameters, working with past historical datasets, as well as engaging with forward looking backcast targets (Holmberg & Robèrt 2000).

From a practical perspective, instantiations of this tool can be used by entrepreneurs or startups to identify approaches that historically have yielded better performance (Winter & Aier 2016). It may also be used as an educational tool to teach business students about the relative merits of entities on the path to sustainability. In both instances, THRIVE Project has received attention, and has been asked to develop a version of the THRIVE Platform that may be used for educational purposes. Lastly, with some minor modifications, it may also be used as a self-assessment tool, and consultants have inquired as to whether a version could be made available to them for use when advising newfound companies such as startups. Another practical example being worked on as of now, is the Brisbane Olympics 2032. I am part of a team involving the Brisbane City Council (BCC) and Brisbane Sustainability Agency, developing specific

programs applying the THRIVE Framework and THRIVE Platform to further develop an App version that captures carbon footprints, tracks mobility, energy and water consumption, and provides guidance on more sustainable practices.

Lastly, from a methodological perspective this study applies DSR to the field of management science to derive prescriptive technological rules (e.g.: See ***Section 6.3***) which may be used to develop more sustainable entities in the future (Joan E. van Aken 2004). For a list of methodological innovations emanating from this study - based on ***Table 6.2*** - these include better ways of controlling for bias using predictive analytics leveraging AI, the blending of multiple frameworks resulting in multi-disciplinary frameworks, the integration of regenerative economics principles foundationally baked in, and the introduction of experts to enhance study outcome, as well as improved evaluation techniques based on the structured approach to entity models identification.

7.5. Future Research

This study represents a first step towards a framework and software tool informing the space of thrivability – a step beyond sustainability. Current projects include the THRIVE Platform v3 as well as partnerships with the Brisbane City Council, and Brisbane Sustainability Agency to deliver an App version of the THRIVE Platform (for scope 4 handprints) in connection with the Brisbane Olympics 2032. Furthermore, there are several areas whereby the framework and platform may be improved, including but not limited to:

- Expanded datasets: This study has implemented THRIVE Platform v2, which uses around 18m+ data points over a period of a year, including both real and illustrative data. Future versions of the THRIVE Platform will be able to handle much larger datasets.
- Reliability: Effort will need to be made to improve the reliability of results as these are only as accurate as the source dataset. This includes refinement to formulae and weight engines.

- Mobile technologies: The availability of the system as an app lends itself to be used this way, and thus supports the implementation of "*personal*" nano level 1 in the scale-linked hierarchy. This is akin to the concept of eHealth, aggregating the health of creatures, companies, cities, countries and so forth, and lend itself to integration with the IoT.
- Real-time data acquisition: Future offerings of THRIVE Platform may well incorporate dynamic real time data acquisition, especially with reference to environmental and social data, which may be used to supplement any historical data offerings.
- Smart social contracts: Research is already underway in the realm of holochain technologies as they may be applied here, providing a way of enforcing thresholds and allocations using distributed ledger technologies. This is particularly relevant at the higher levels of the 7Cs (Fedeli 2020).
- Mass adoption: As a free online tool that measures sustainability performance, the THRIVE Platform encourages mass adoption by consumers, business leaders, researchers, and policymakers. This in turn will make the tool more useful as usage of the system expands its knowledgebase.
- Regenerative Economy in lieu of Circular Economy: With the latter being a subset of the former. An updated version of the SHM will be modified to include the broader concept of regenerative economy (Fedeli, M. D., Boyd, G. 2023).
- Extended use of AI: Whilst the case study of the Seafood Stewardship Index uses a small AI model to derive the relevant SBM, further advances in this technology as of recent, will mean that large datasets can be processed with more power in an instant (Fedeli & Lüdeke-Freund 2020).

As alluded by Geissdoerfer et al. (2018), there will come a time in the future whereby all BMs will be SBMs, thus negating the need to

prequalify the same. It is also worth noting that development on THRIVE Platform v3, incorporating several enhanced features that are beyond the scope of this study, has begun. The team behind the THRIVE Framework welcomes feedback and encourages expert participation. Further information is available at the website https://Framework.ThrivabilityMatters.Org.

7.6. Concluding statement

This study develops the THRIVE Framework (TF), the Systemic Holistic Model (SHM), and the proof-of-concept THRIVE Platform instantiation, aiming at turning the analysis of sustainability reporting data into a publicly available resource, empowering civil society and organisations to learn, interpret, and make better decisions in their day-to-day life. It compares favourably with many other studies, going beyond the usual enterprise or sectorial levels, developing tools that span the whole globe. Unlike traditional approaches, rather than evaluate qualitative design of what is deemed "a priori" a sustainable entity (e.g., business) model, this study provides a method to evaluate the quantitative performance of an entity (e.g., business) model "a posteriori" in an automated way based on audited public records.

It achieves this by answering there two questions, and then establishes a link between the two using technological rules informed by the blueprint:

- RQ1: How to recognize (identify and categorize) a sustainable entity (e.g., business) model pattern?
- RQ2: How can the sustainability performance of an entity (e.g., business) model be assessed?

This provides utility, a useful way to link sustainability performance, in the case of businesses, with BMI and SBMs. As far as it is known, this is the first study to take this approach across scales, such as portfolios, regions, or countries. Thus, companies, researchers, practitioners, and policymakers are encouraged to use the scalable technologies on offer in this study, together with predictive analytics and AI engines to further the

development of empirically proven sustainable entity models. Through systemic orchestration, the THRIVE Framework supports strategic guidance for strong systemic sustainability at speed, scale, and scope towards thrivability, thereby placing humanity back onto the trajectory towards thrivable transformations and a prosperous future for the benefit of us all.

This thesis develops a framework, tools, and techniques to quantitatively measure the sustainability impact of entities relative to their entity model. The adopted approach is contextualized, operating at each holonic scale, meaning, one can use it to derive impacts of entities such as organisations, bioregions, portfolios, or even globally. The approach is holistic, taxonomy-agnostic and relies on third-party public audited data. You can find a brief introduction here.

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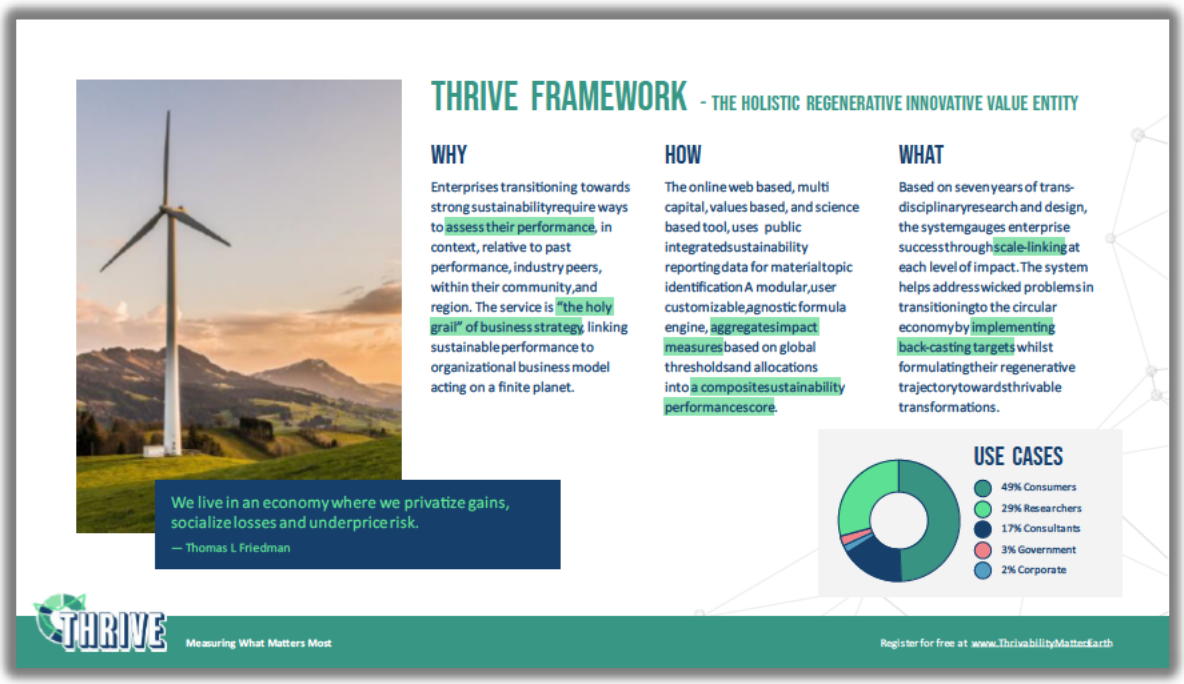
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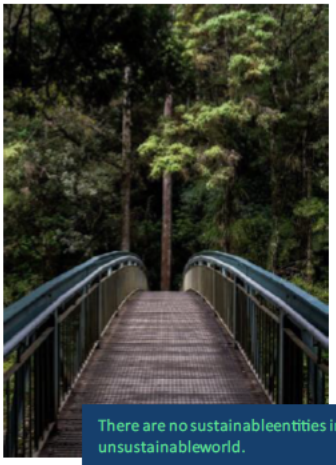
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APPENDIX A: THE THRIVE FRAMEWORK

The TF, SHM, 12FFF, and 7Cs artefacts and supporting literature are available in several places and shared on a creative commons basis freely with the public. THRIVE conducts monthly showcases of the THRIVE Framework, answering questions in a Q & A style session. You can find the continually updated and revised document including presentations online here, or by visiting https://ThrivabilityMatters.Earth.





There are no sustainableentities in an unsustainableworld.

— Morris D Fedeli

THRIVE PLATFORM

THRIVE Platform utilizes impact charts for instant visualization of performance, thresholds and allocations. Charts can showcase historical performance whilst providing guidance with backcast targets. These are informed by what the best available science demonstrates is necessary and sufficient to achieve long term prosperity.



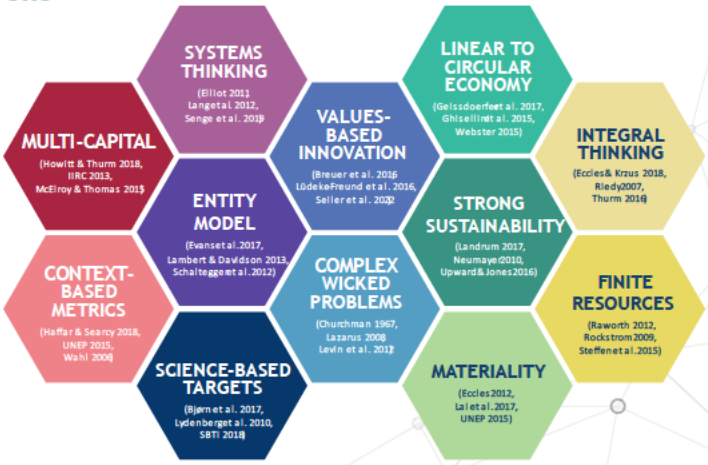
THRIVE Measuring What Matters Most

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FOUNDATIONAL FOCUS FACTORS

The 12 Foundational Focus Factors are the culmination of comprehensive research over a period of several years into the necessary and sufficient conditions required to transition humanity towards sustainability and indeed Thrivability.

Utilizing a systems thinking approach, THRIVE Platform through a process of systemic orchestration guides entities towards thrivability.
As a predictive tool it supports backcasting by taking a radical approach to entity model innovation across scale-linked levels.



Source: Assessing Corporate Sustainability Performance of Business Models. How business model innovation drives a successful sustainable business strategy? Fedeli (2018).

Presented at the 3rd New Business Model Conference in Sofia, Bulgaria in (2018).

THRIVE Measuring What Matters Most

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ASSAILING THE SEVEN C'S – CREATURE, COMPANY, COMMUNITY, CITY, COUNTRY, CONTINENT, AND COSMOS

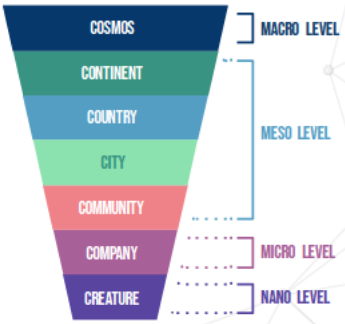
THRIVE Framework is an open public platform providing instant top-level visual comparison between the sustain-ability performance of entities at stratified levels of granularity such as city, bio-regions or country-wide. Comparisons may be within a sector or community or longitudinally across years with each level scale linked to the next.
Invoking the precautionary principle, taking a strong sustainability stance, and based on the framework for strategic sustainable development (FSSD), the platform invites non-substitution of natural capital resources with man-made ones.

Whether discovering an entity's commitment to gender equality, renewable energy, becoming carbon neutral, or fighting the climate crisis, visualizations are unique as they provide instant comparisons at a glance as to where an entity is succeeding or failing in its mission towards sustainability.

This first-principled approach, incorporates backcasting targets, placing entities on the trajectory towards thrivability with the sustainability performance index providing a context-based assessment of its' impact. THRIVE Platform's intuitive visualizations represent the utility of resources together with global thresholds and allocations with entity impacts shown by material topic based on well-established metrics like the SDG indicators. By re-integrating rather than reinventing, the THRIVE Platform indicates resource allocation, inner and outer thresholds, impact and a sustainability performance indicator for each relevant material topic as well as an overall sustainability performance score.

Furthermore, the dashboard incorporates dials and levers allowing one to manipulate weights and produce and capture customized charts to suit their needs for insertion in reports, presentations and other publications. A variety of charting and mapping options provide an easy to use, instant visual aid, displaying normalized sustainability performance measures in conjunction with selectable and scalable colour coded material topics and strategy.

THRIVE Platform measures what matters most, by empowering society and provoking entities to flourish by providing guidance towards thrivability.



THRIVE platform integrates the 7Cs, by measuring performance, adopting a scale linked, values based, context based, and science based approach informed by the natural sciences.

THRIVE FRAMEWORK

Seven years in the making - and some 14,500+ hours of research and development – the THRIVE Framework is a trans-disciplinary, holistic model which aims to investigate the likely outcome of actions well before they occur.

The purpose of the THRIVE Framework is to help measure the potential of initiatives taken today to help transform society towards a better future: a place that is 'Thrivable', or beyond mere sustainability.

TACKLING THE UNKNOWN

We live in a world that is defined by volatility, uncertainty, complexity and ambiguity (VUCA). Adopting a transdisciplinary approach allows us to create models that account for these interdependencies.

We can undertake experiments at a safe distance, we propose 'what-if' scenarios using advanced computer techniques, and we use the power of big data to make predictive analysis.

We aim to provide information systems that support sense-making in environmental and social sustainability transformations. Entities that seek access to decision support systems when designing principles for these transformations may benefit from our framework.

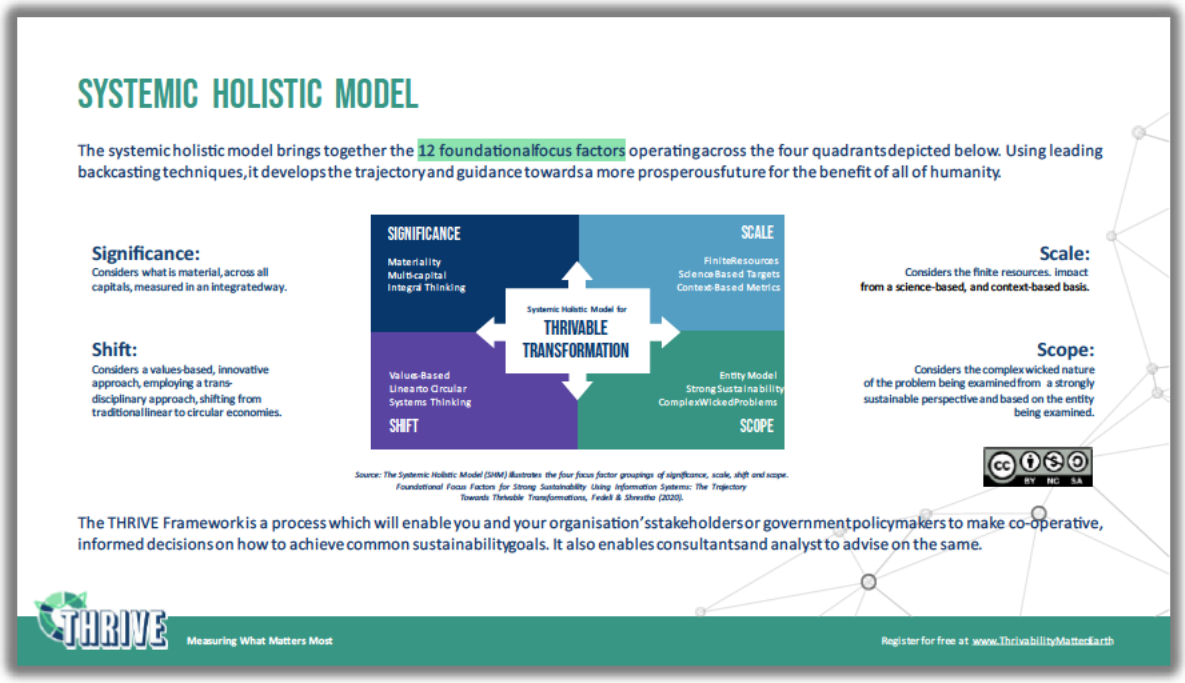
By leveraging machine learning and pattern analysis, the modelling of complex systems can be effected at speed, scale and scope. This provides an opportunity to develop technological rules to assist in combatting the many existential threats the world faces.

PROVIDING POSITIVE GUIDANCE

Applying a theory of change, and implementing backcasting techniques, we can execute the trajectory towards 'thrivable' transformations - as illustrated below.

The THRIVE Framework uses data from scientific research (theoretical), as well as local, regional, and cultural environments (practical) to build scenarios based on four high-level perspectives as shown in each quadrant of the systemic holistic model chart.

By adopting the systemic holistic model and by implementing systemic orchestration, society can continuously strive to thrive and engineer the future it aspires to be.



Furthermore, the 7Cs are articulated at length in the following paper: *Fedeli, M.D., & Glinik, M. (2021). Assessing the sustainability performance of entities: A review and classification of tools, methods, and approaches. Paper presented at the 6th International New Business Model Conference, Halmstad University, Halmstad, Sweden.*

Technological Rules

The rules or "R" codes illustrated in this study are based on the exaptation of the technological rules emanating from the sciences. These have been coded from the Literature Review (***Section 2.1-2.5***) and connected to each of the 12FFF in the conceptual framework (CF) (***Section 2.6***). They have been collated below for reference:

INSIGHT (R81): Given VUCA times, the need for worldwide cooperation and collaboration amongst organisations, governments, and academia is needed, with risk management also playing a part.

INSIGHT (R82): There is a need for innovative management, instilling a culture of innovation toward building resilience to avoid the worst in feedback loops in tackling VUCA times.

INSIGHT (R83): The need to take a precautionary approach to sustainability building on the FSSD. Radical innovations at the heart of addressing the wicked complex problems faced by humanity.

INSIGHT (R84): The need to take a first-principles approach to sustainability to ensure resilience in the face of VUCA. Replication is seen as the best approach when adapting technological rules, and generally accurate at the macro level.

INSIGHT (R85): Ex-post techniques to measure sustainability performance are lacking. Most approaches to date concentrate on ex-ante assessment based on recognised practices that are simply deemed improvements towards sustainability.

INSIGHT (R86): An outside-in a-posteriori black-box approach can provide empirical quantitative results which is focussed on measuring value.

INSIGHT (R87): The examination of the impact of keystone actors is a useful and exemplary way to tackle the sustainability of the environment and natural world.

INSIGHT (R88): Integrating a scientifically informed strong sustainability approach is necessary in a finite world of unknowns operating within the sustainable value network.

INSIGHT (R89): A BM represents an organisation's core logic for creating value and is mostly emerging from scholarly research in the field of strategy and innovation.

INSIGHT (R90): Organisations, governments, and academia initial BM serves as a proto-strategy, testing an hypothesis until it is implemented successfully.

INSIGHT (R91): BM is conceptual and ought to be hard to imitate to provide a competitive advantage. BM is more generic than strategy and is thought of as art, requiring evaluation against incumbent models.

INSIGHT (R92): First-hand recognition that a firm does not operate in isolation, and that there are feedback loops. Developing BMs is seen as an art and an abstract representation or reflection of its realised strategy.

INSIGHT (R93): Compared to strategy, BM does not factor in competition. Akin to the scientific method, a BM is about a narrative, developing a hypothesis and testing it in action.

INSIGHT (R94): The BMC adopts BMI practices to identify (multiple) patterns used for designing a BM that creates, delivers, and captures economic value. As a strategic conceptual device, it leads to novel and useful changes in how enterprises operate towards value imperatives.

INSIGHT (R95): The BM is a new unit of analysis and seen as part of a comprehensive framework for systemic change, capturing a systems-level approach to how a firm conducts business.

INSIGHT (R96): We live in a world of finite resources. Our economic activities and global actions sparked by consumerism are depleting natural resources including our carbon sinks.

INSIGHT (R97): Disruptive innovation, particularly of one's BM is the most rewarding. Entities do not work in isolation but are at the mercy of the ecosystem supporting them including other industry competitors and regulatory bodies. Collaborations is key to environmental sustainability.

INSIGHT (R98): Systems thinking approach is necessary to implicate interconnectedness and address super-wicked problems.

INSIGHT (R99): Values-based innovation help organisations deal with complex and wicked problems and in dealing with systemic sustainability innovations in values-based networks and business models, even improving culture. Modelling is useful in addressing super wicked problems.

INSIGHT (R100): Expressing the normative is essential if we are to achieve the desired outcome. Note that a BM stretches beyond the boundary of an enterprise.

INSIGHT (R101): See BMs as patters in action. Take a long-term view, holistic approach to sustainable development, with consumption and waste generation within carrying capacities.

INSIGHT (R102): Organisations are not self-contained and thus must consider how it is affected by, and its effect are, on other organisations across boundaries and the ecosystem around it.

INSIGHT (R103): Business models are identified as a pattern acting as a factor in the interdependencies between organisations.

INSIGHT (R104): The sustainable value network model and their value forms provide the link between an individual firm and the larger production and consumption system. Sustainable value creation is at the juncture of systems thinking and sustainability-oriented innovation.

INSIGHT (R105): Systems thinking, leading to envisage a society by design that is restorative and regenerative.

INSIGHT (R106): Scale-linking leading to multiple levels of regenerative capacities.

INSIGHT (R107): The need to bring humanities footprint within regenerative and absorptive capacities. The EF approach to "global overshoot" is simplistic by assessing what is happening today, rather than what is sustainable, ignoring scales, and contains numerous quantitative and congruency errors.

INSIGHT (R108): Composite indices are well suited in measuring well-being and in capturing impacts in complex multi-dimensional trans-disciplinary systems that aggregate data across different domains.

INSIGHT (R109): The promotion of ecological integrity and social equity, as well as global cooperation and collective action through new institutions and governance systems prioritising ecological and social well-being over economic growth and profit.

INSIGHT (R110): Environmental footprints and planetary boundaries are complementary and provide for the capturing of impacts at scales by incorporating harmonisation of the metrics. This forms the basis for mitigating sustainability (or a lack thereof) at the global level.

INSIGHT (R111): Important to implement circular economy models emulating biomimicry, invoking collaboration to develop synergies towards the greater good.

INSIGHT (R112): Need to better understand the role of BMs as it pertains to corporate success and how to evaluate BMs. BMs is a key driver for successful innovation, adaptation, and success.

INSIGHT (R113): Some studies suggest as valuable is the use of text mining automation tools on annual reports. Others analyse BM configurations as well as super-ordinate levels of portfolio.

INSIGHT (R114): Emphasis on scale-linking at the super-ordinate level across multiple tiers. Developing predictive models that work universally at scale at solving complex solutions.

INSIGHT (R115): Build strong trans-disciplinary approach to multitier conceptual framework to address complexity at scale. Be cognizant of feedback loops over temporal and spatial scales. Provide triangulation by combining qualitative conceptual analysis with on-the-ground data.

INSIGHT (R116): Suggest integrated approach to BM analysis based on systems theory as measuring and evaluating BMs is difficult. More work needed in this area.

INSIGHT (R117): Organisations exhibit multiple BMPs working across enterprises and scales and in support of super-ordinate patterns.

INSIGHT (R118): SBM are about transformation and alignment with strong sustainability (thus avoiding substitution of resources). The normative approach to business model innovation "success" is toward sustainability.

INSIGHT (R119): BMI of existing BMs towards sustainability has been shown to deliver better performance, profitability, higher market capitalisation, improved competitiveness, and improved sustainability.

INSIGHT (R120): Through BMI, the aim by way of strategy is to produce an actual BM which is empirically measured to be (more) sustainable.

INSIGHT (R121): Ranked benchmark of BMs based on framework to augment impacts. IT-based decision support system for BMs.

INSIGHT (R122): Evaluating BM risks with respect to the sustainable value network. Use BMI to improve the same. Assess BM using a canvas and scorecard.

INSIGHT (R123): Measurement of BMI is an evolving field of research. Development of effective and reliable measurement methods is crucial to our understanding on the impacts on a firm.

INSIGHT (R124): Sustainable business model as a source of innovation. BMs as a (re)combination of BMPs. BMI can draw upon proven successful pattern combinations.

INSIGHT (R125): BM is a systemic representation of how a company creates, delivers, and captures value. Adopt system dynamics to incorporate sustainability into the

innovation process. BM seen as a source of competitive advantage beyond mere strategy.

INSIGHT (R126): Innovation for sustainability translates BMs into BMI for sustainability (BMIfS). Akin to strategy, these have shown to deliver competitive advantage. Empirically measured impacts are the only true measure of strong sustainability on a finite planet. BMI seen as a risk minimisation technique.

INSIGHT (R127): Capitalism driven by industrialisation, emerging markets, competition, and cost reductions through externalisation.

INSIGHT (R128): Capitalism has been responsible for much of the 'great divide'. The pursuit of endless growth, coupled with GDP as a measure of 'success', has delivered a skewed perception of well-being. Newer measures of well-being and sustainability are needed that also capture non-economic factors.

INSIGHT (R129): A combination of degrowth and/or green growth is necessary to stay within the natural regenerative and absorptive capacities.

INSIGHT (R130): A global imperative has emerged, instilling a need for global systemic transformation.

INSIGHT (R131): GDP is not a suitable indicator of sustainable development. Integrating a scientifically informed strong sustainability approach is necessary. Building on ecological economics, society will need to transition to a steady-state economy.

INSIGHT (R132): Colonialism persists till this day, creating social division, while the commons are being exploited and destroyed. An interdisciplinary approach, working with local communities and collective action globally, is seen as the best way to address these complex sustainability challenges.

INSIGHT (R133): Sense-making plays an important role in understanding the market and in delivering products and services to consumers with sustainability in mind.

INSIGHT (R134): Disruptive innovation whilst difficult to manage has shown to be the most impactful and rewarding.

INSIGHT (R135): For disruptive innovation to be effective we need a holistic and trans-disciplinary approach that factors in the supply and delivery chain, allowing for the benchmarking of any enterprise, industry, or sector. IT is an important enabler of a firm's sustainability strategy.

INSIGHT (R136): Bring disruptive innovation to global systemic transformation requires tracking metrics and effectiveness and iterative continuous improvements of the BM.

Technology plays a vital role as organisations prioritize transitioning towards sustainability as part of their business model innovations.

INSIGHT (R137): Sustainable business implies empirically profit-normative, socially, and environmentally impactful. The nexus of strategy and innovation could yield the understanding necessary as to which business models are positively sustainable.

INSIGHT (R138): Integral thinking connects the complex challenges of sustainability with sustainable business models, helping entities develop effective sustainability strategies. Integral thinking is a holistic and multi-dimensional approach to complexity whereby sustainability is an extension of innovation.

INSIGHT (R139): Leaders see their organisation and actions not part of the problem. Solutions require a global collective collaborative effort by all at every level. Leaders can use (AI-enabled) information systems to foster change by including sustainability within their core organisational principles.

INSIGHT (R140): Corporate reports by and large are disclosures addressing basic compliance requirements. These reports often lack metrics, science-based targets, and in-context based measurement, making them unusable for comparisons. Notably, impacts are often self-referential (inward looking) or greenwashed to appear favourable.

INSIGHT (R141): Standardisation of sustainability or integrated reports would provide a basis for fair comparison. Attempts to date have not provided the integrated and harmonised approach necessary.

INSIGHT (R142): The One Planet Thinking initiative is an attempt to bring systems level thinking to the corporate level, thus recognising the holonic and scale-linking nature of the world in relation to biodiversity.

INSIGHT (R143): Consolidation within the industry is necessary to provide uniformity and comparative measures between the plethora of approaches provided by standard setters. However, many take very different viewpoints and thus disagree on the basic premise of what is or is not material.

INSIGHT (R144): Triple or authentic materiality measures sustainability performance relative to our regenerative and absorptive capacities. Many countries are requiring organisations to comply with various levels of standardisation, with the industry littered with often confusing requirements.

INSIGHT (R145): Reporting impacts is voluntary and suffers from a lack of alignment and harmonisation between the various rating/ranking/standards providers.

INSIGHT (R146): Reporting lacks contextualisation within thresholds, based on environmental limitations identified by scientific evidence. These impacts need to be measured relative to production benchmarks through aggregate composite indices.

INSIGHT (R147): There is a myriad of self-assessment tools, open research platforms, assessment, and benchmarking tools available. It is important to address the context gap openly and transparently, where contextualisation and consistency of metrics is paramount (context matters). Embrace CBS.

INSIGHT (R148): WBA is attempting to benchmark organisations worldwide sector by sector. There have been doubts as source data sets are not made available publicly and transparently (despite stating the contrary). Need for a comparative uniform universal harmonised sustainability performance index.

INSIGHT (R149): True sustainability impact may only be assessed after the fact (of taking some action), and the value comes from developing methods that enable us to predict which configurations will persist. Taking a holonic view, it is crucial to adopt policies that are precautionary in nature.

INSIGHT (R150): Improve interoperability by transferring the pluralistic, interdisciplinary, scientific knowledge, into tools for informed environmental decision-making leveraging significant local and global impacts. Consider the use of proxies and technology to predict the behaviour of complex systems.

INSIGHT (R151): Leveraging AI, bake in the grounded, science-informed, technological rules, abstract the taxonomy and (agnostic) methodology, and transparently provide granular access to the vast Earth Observation datasets.

INSIGHT (R152): There is a transition to being sustainable. There is no doubt that this will be the default modus operandi for all organisations (entities) into the future. AI will be a key catalyst in this transition.

INSIGHT (R153): Systems thinking (social sciences) coupled with system dynamics (biophysical sciences) forms the worldview in support of our transition to becoming sustainable. Tackling complex trans-disciplinary integrated issues through innovation.

INSIGHT (R154): Governments and their influence on legislation play a pivotal role in enacting the transformations needed in industrial ecology to arrive at a sustainable future.

INSIGHT (R155): Business leaders see BM innovation towards sustainability as a source of competitive advantage and building this into their strategy.

INSIGHT (R156): Creativity and innovation have been shown to be key mechanisms in addressing sustainable development. A values-based view links values to open innovation.

INSIGHT (R157): Business model innovation is the most impactful form of innovation. Although BM 'by design' ought to be more sustainable, without an empirical assessment, it is unknown as to whether this is so, and to what extent.

INSIGHT (R158): Business leaders are seeking to know a priori which innovations are subjectively more desirable. Which business model patterns are likely to lead to more sustainable outcomes.

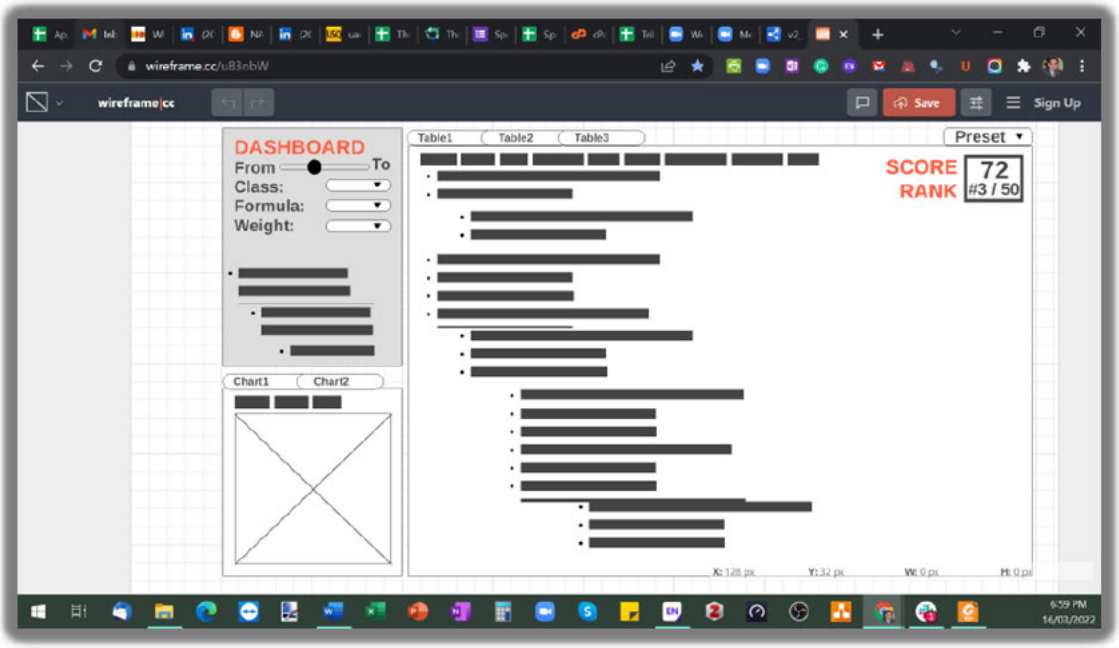
INSIGHT (R159): Given our finite resources and a myriad of VUCA problems in this world, there is little time to waste. We urgently seek proven solutions to our many challenges ahead.

INSIGHT (R160): Take a systems view addressing the super-ordinate levels. Adopt a 'black-box' ex-post empirical assessment.

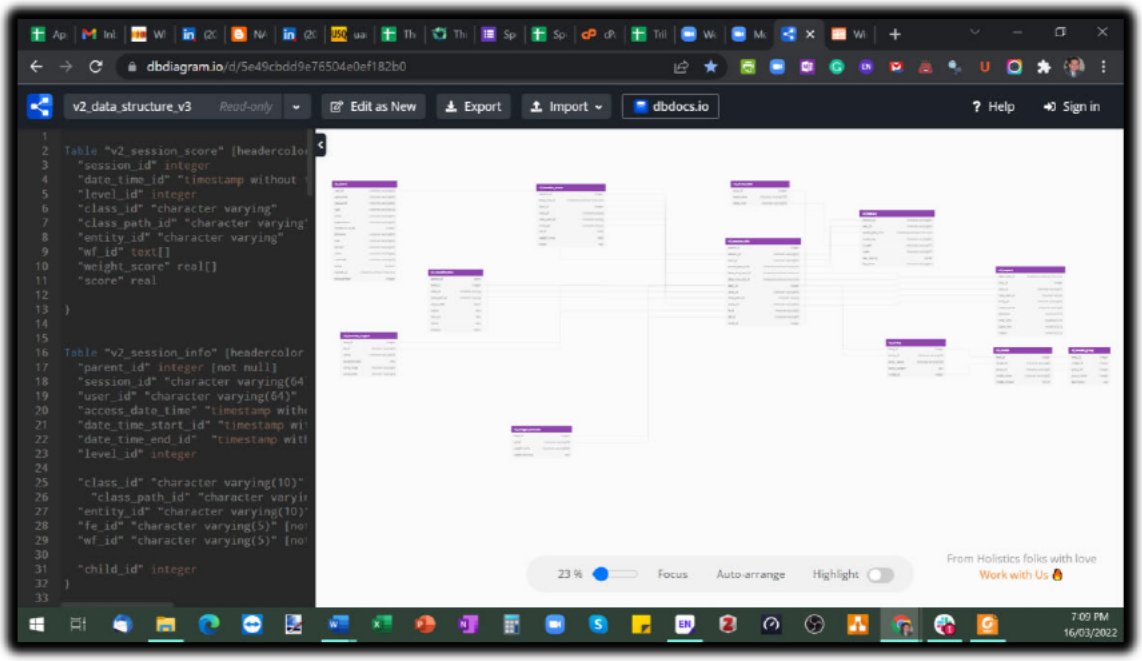
APPENDIX B: THE THRIVE PLATFORM

The THRIVE Platform is the instantiation of the THRIVE Framework and serves to demonstrate the usefulness of the platform through the integration of the 12FFF. Key elements of the documentation include:

- Dashboard wireframe (early version) showing presets, formula and weight engine as well as score and rank.



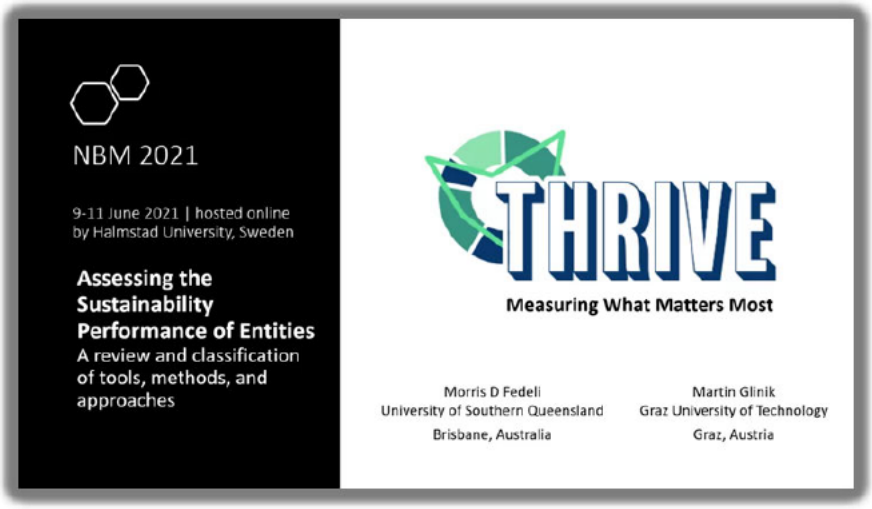
- Data structures: available online via dbdiagram.io. Please note that v2.x is a scalable multi-level and multi-user database-driven solution. V1.x was largely a proof of concept (POC) and as such was single user and not scalable across the 7Cs.



- THRIVE Platform Presentations: There are over a dozen presentations on the THRIVE Platform available from the website https://platform.strive2thrive.earth. Examples include:
    - How can one learn to thrive: Lessons from the THRIVE framework, 2022.



- Assessing the sustainability performance of entities, 2021.



- Overview of the THRIVE framework: Measuring what matters most, 2022.



- The THRIVE platform – Measuring what matters most, 2020.



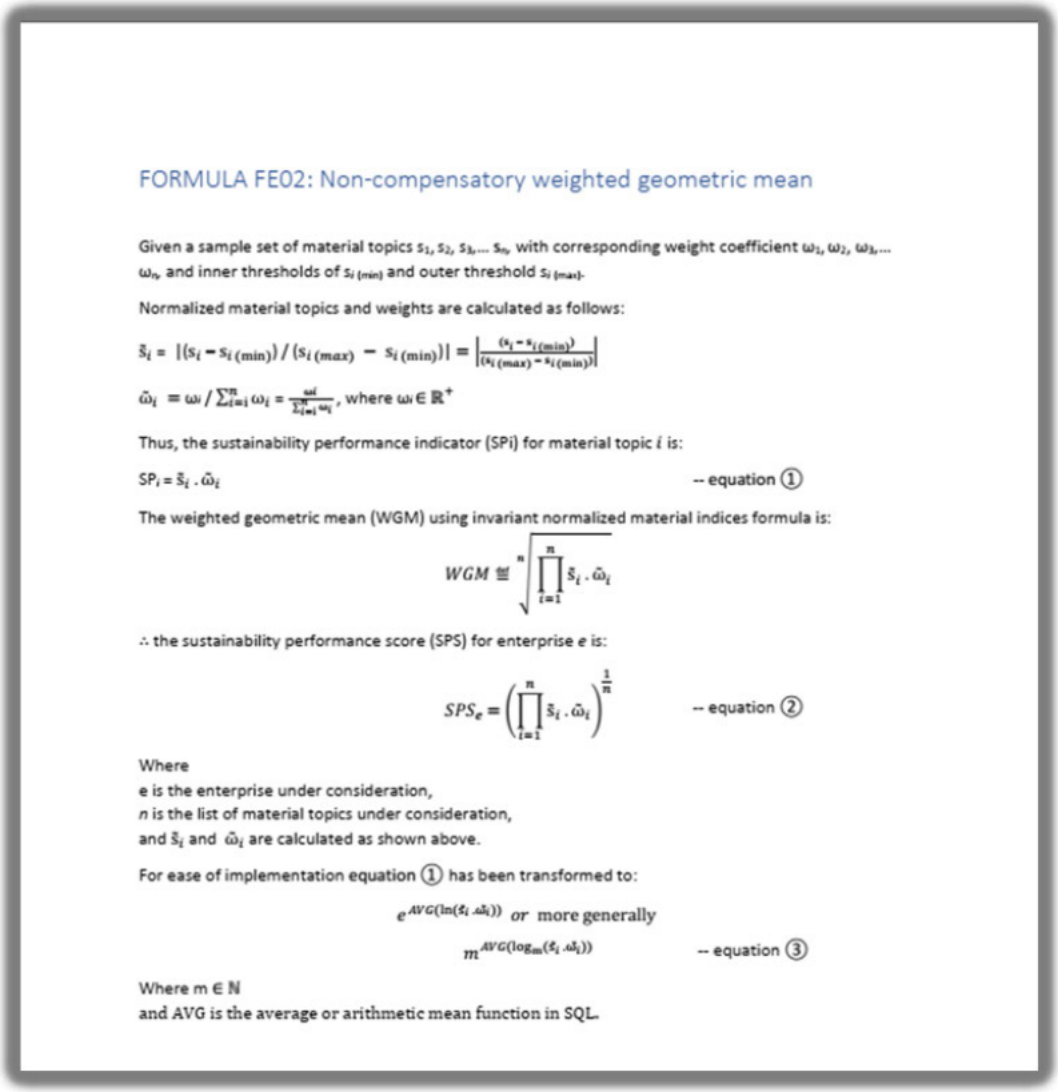
- The classification of sustainable business model patters using machine learning, 2020.



- Introducing THRIVE: Measuring what matters most, 2020.



- Sample weight formulation: As identified in this study and developed by the author.



FORMULA FE02: Non-compensatory weighted geometric mean

Given a sample set of material topics $s_1, s_2, s_3, \ldots s_n$, with corresponding weight coefficient $\omega_1, \omega_2, \omega_3, \ldots \omega_n$, and inner thresholds of $s_{i\,(min)}$ and outer threshold $s_{i\,(max)}$.

Normalized material topics and weights are calculated as follows:

$$\tilde{s}_i = |(s_i - s_{i\,(min)}) / (s_{i\,(max)} - s_{i\,(min)})| = \left|\frac{(s_i - s_{i\,(min)})}{(s_{i\,(max)} - s_{i\,(min)})}\right|$$

$$\tilde{\omega}_i = \omega_i / \sum_{i=1}^{n} \omega_i = \frac{\omega_i}{\sum_{i=1}^{n} \omega_i}, \text{ where } \omega_i \in \mathbb{R}^+$$

Thus, the sustainability performance indicator (SPi) for material topic i is:

$SP_i = \tilde{s}_i \cdot \tilde{\omega}_i$ -- equation ①

The weighted geometric mean (WGM) using invariant normalized material indices formula is:

$$WGM \triangleq \sqrt[n]{\prod_{i=1}^{n} \tilde{s}_i \cdot \tilde{\omega}_i}$$

∴ the sustainability performance score (SPS) for enterprise e is:

$$SPS_e = \left(\prod_{i=1}^{n} \tilde{s}_i \cdot \tilde{\omega}_i\right)^{\frac{1}{n}}$$ -- equation ②

Where
e is the enterprise under consideration,
n is the list of material topics under consideration,
and $\tilde{s}_i$ and $\tilde{\omega}_i$ are calculated as shown above.

For ease of implementation equation ① has been transformed to:

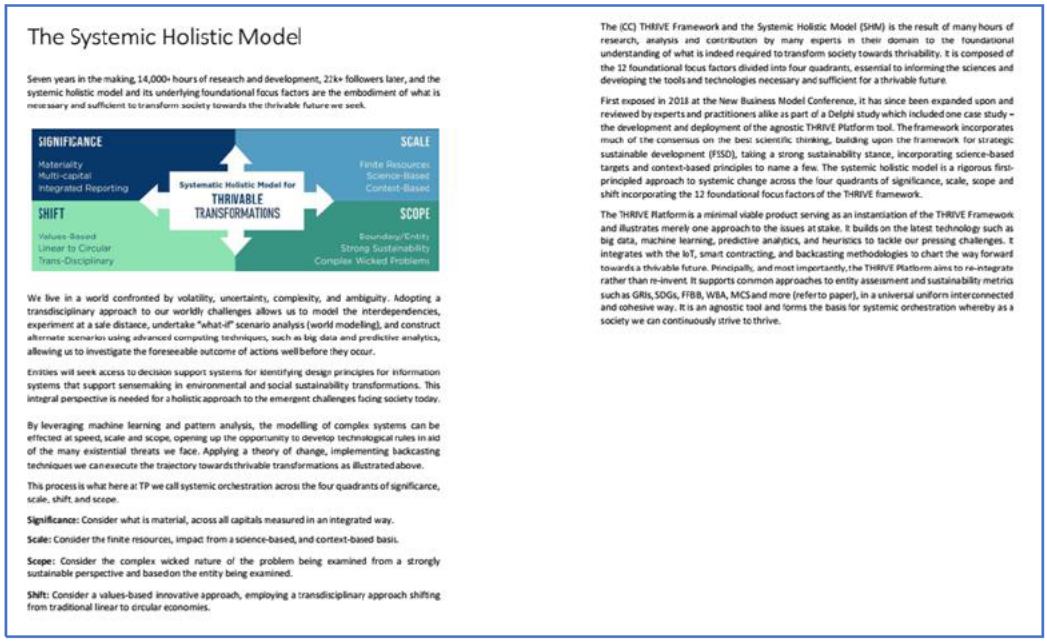
$$e^{AVG(\ln(\tilde{s}_i \cdot \tilde{\omega}_i))} \text{ or more generally}$$

$$m^{AVG(\log_m(\tilde{s}_i \cdot \tilde{\omega}_i))}$$ -- equation ③

Where $m \in \mathbb{N}$
and AVG is the average or arithmetic mean function in SQL.

- THRIVE Walkthrough training video illustrating how the platform works. There is also a THRIVE Platform Guided Tour document available for v1.x and v2.x.

- (Early) conceptualisation and description of the SHM:



The Systemic Holistic Model

Seven years in the making, 14,000+ hours of research and development, 21k+ followers later, and the systemic holistic model and its underlying foundational focus factors are the embodiment of what is necessary and sufficient to transform society towards the thrivable future we seek.

We live in a world confronted by volatility, uncertainty, complexity, and ambiguity. Adopting a transdisciplinary approach to our worldly challenges allows us to model the interdependencies, experiment at a safe distance, undertake "what-if" scenario analysis (world modelling), and construct alternate scenarios using advanced computing techniques, such as big data and predictive analytics, allowing us to investigate the foreseeable outcome of actions well before they occur.

Entities will seek access to decision support systems for identifying design principles for information systems that support sensemaking in environmental and social sustainability transformations. This integral perspective is needed for a holistic approach to the emergent challenges facing society today.

By leveraging machine learning and pattern analysis, the modelling of complex systems can be effected at speed, scale and scope, opening up the opportunity to develop technological rules in aid of the many existential threats we face. Applying a theory of change, implementing backcasting techniques we can execute the trajectory towards thrivable transformations as illustrated above.

This process is what here at TP we call systemic orchestration across the four quadrants of significance, scale, shift, and scope.

Significance: Consider what is material, across all capitals measured in an integrated way.

Scale: Consider the finite resources, impact from a science-based, and context-based basis.

Scope: Consider the complex wicked nature of the problem being examined from a strongly sustainable perspective and based on the entity being examined.

Shift: Consider a values-based innovative approach, employing a transdisciplinary approach shifting from traditional linear to circular economies.

The (CC) THRIVE Framework and the Systemic Holistic Model (SHM) is the result of many hours of research, analysis and contribution by many experts in their domain to the foundational understanding of what is indeed required to transform society towards thrivability. It is composed of the 12 foundational focus factors divided into four quadrants, essential to informing the sciences and developing the tools and technologies necessary and sufficient for a thrivable future.

First exposed in 2018 at the New Business Model Conference, it has since been expanded upon and reviewed by experts and practitioners alike as part of a Delphi study which included one case study – the development and deployment of the agnostic THRIVE Platform tool. The framework incorporates much of the consensus on the best scientific thinking, building upon the framework for strategic sustainable development (FSSD), taking a strong sustainability stance, incorporating science-based targets and context-based principles to name a few. The systemic holistic model is a rigorous first-principled approach to systemic change across the four quadrants of significance, scale, scope and shift incorporating the 12 foundational focus factors of the THRIVE framework.

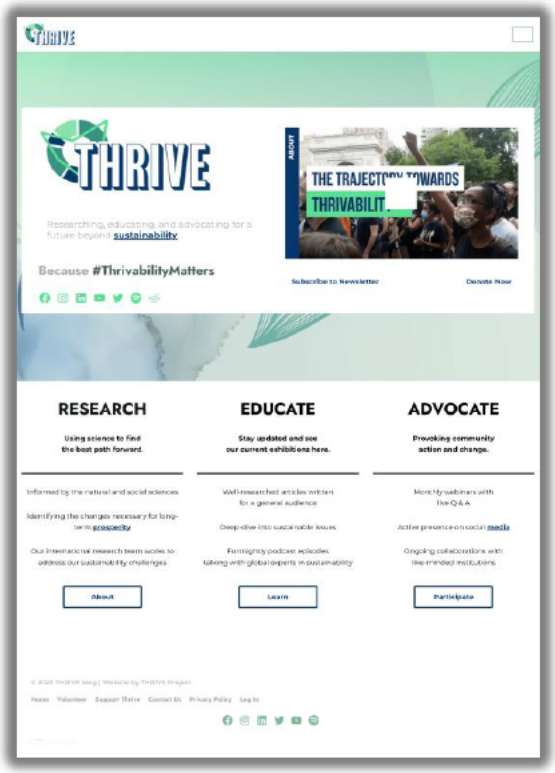
The THRIVE Platform is a minimal viable product serving as an instantiation of the THRIVE Framework and illustrates merely one approach to the issues at stake. It builds on the latest technology such as big data, machine learning, predictive analytics, and heuristics to tackle our pressing challenges. It integrates with the IoT, smart contracting, and backcasting methodologies to chart the way forward towards a thrivable future. Principally, and most importantly, the THRIVE Platform aims to re-integrate rather than re-invent. It supports common approaches to entity assessment and sustainability metrics such as GRIs, SDGs, FFBB, WBA, MCS and more (refer to paper), in a universal uniform interconnected and cohesive way. It is an agnostic tool and forms the basis for systemic orchestration whereby as a society we can continuously strive to thrive.

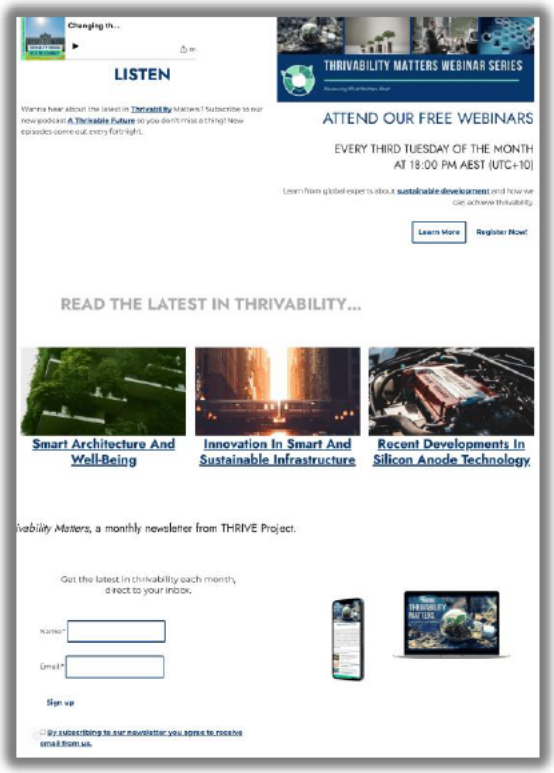
- Seafood Stewardship Index (SSI): Evaluating the strategies and sustainability performance of keystone actors in the seafood industry. Full whitepaper available here.



APPENDIX C: THE THRIVE PROJECT

- THRIVE Project Home page and Blog page with over 500 publications: journal articles, reports, blogs, whitepapers, podcast, webinars produced on an ongoing basis, all informed by the THRIVE Framework.





Morris Fedeli, Author at THRIVE blog

blog.thrive2thrive.earth/author/morris

Morris Fedeli

Morris D Fedeli is a semi-retired practitioner and doctoral researcher at the University of Southern Queensland, Australia, with three decades of industry experience in helping organizations achieve success through the application of new emerging innovative business models and technologies. As a pracademic, he offers a unique Australasian perspective, with experience across three continents and degrees in science, business and project management. His research interest and passion lie in sustainable business innovation strategies for a prosperous society and thrivable future.



UNRISD Thresholds of Transformation Report

- by Morris Fedeli, Alexander Rehnberg, Michael Hill
- February 1, 2023
- 8 min read

The Thresholds of Transformation report was released by the United Nations Research Institute for Social… Read More »UNRISD Thresholds of Transformation Report

THRIVE

1/5

THRIVEFest!

- by Jonathan McPhail, Morris Fedeli
- December 24, 2022
- 4 min read

On December 18, 2022, Thrivers came together from all over the world to celebrate a… Read More »THRIVEFest!



The magic of science: How we transform plastic waste into delicious vanilla

- by Halima Hussain, Morris Fedeli
- October 6, 2022
- 5 min read

From iced coffee straws to takeout bags, plastic has become a daily necessity. Many fields… Read More »The magic of science: How we transform plastic waste into delicious vanilla



2/5

Can we use Artificial Intelligence for Sustainability?

- by Amanda Raven, Morris Fedeli
- August 16, 2022
- 13 min read

"We're at the beginning of a golden age of AI. Recent advancements have already led… Read More »Can we use Artificial Intelligence for Sustainability?



Nuclear Fusion for Energy: How Viable is it Really?

- by Fahad Zareef, Morris Fedeli
- July 4, 2022
- 14 min read

There are two notable nuclear reactions that can be used to generate power: Nuclear fusion… Read More »Nuclear Fusion for Energy: How Viable is it Really?



Eco-friendly Labels: What's Really in the Package?

- by Morris Fedeli, Raman Omkarsinh, Aaron Humphrys, David Whiteley
- December 29, 2021
- 13 min read

3/5

There are genuine labels out there for consumers, but even these vary in authenticity. Some are specific to certain types of products, others are more general. In this article, we'll delve into some of the major industries using eco friendly labels and some of the most trustworthy certifications to look out for.



Nuclear Energy as a Clean Energy Source

- by Natasha Marais, Morris Fedeli
- November 10, 2021
- 6 min read

Nuclear energy as a clean energy source remains a heavily debated topic. When we think… Read More »Nuclear Energy as a Clean Energy Source



Zoonotic diseases and food production: Preventing the next pandemic

- by Morris Fedeli, Halima Hussain
- November 8, 2021
- 8 min read

4/5

The term zoonotic disease refers to any infectious disease that came from non-human animals. These… Read More »Zoonotic diseases and food production: Preventing the next pandemic



The Effects of Bee Extinction on Food Production

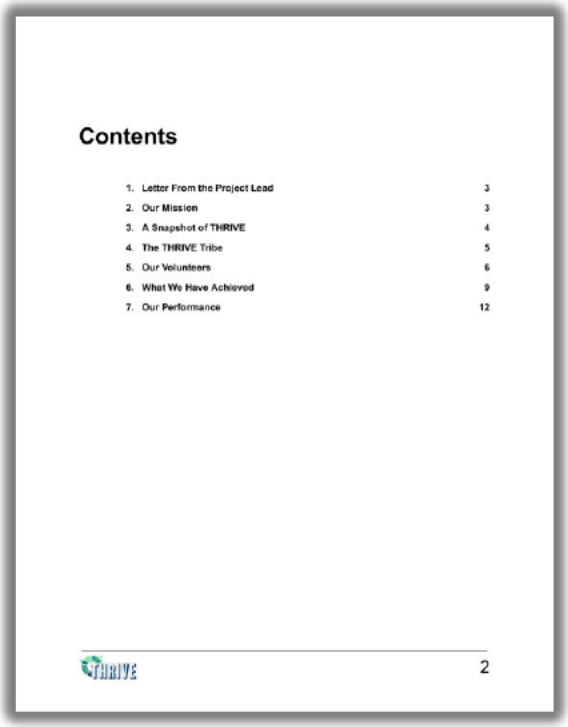
- by Adriana Mohr, Morris Fedoli
- October 27, 2021
- 7 min read

Did you know that bee extinction has a direct influence on the world's food production?… Read More »The Effects of Bee Extinction on Food Production

- 9

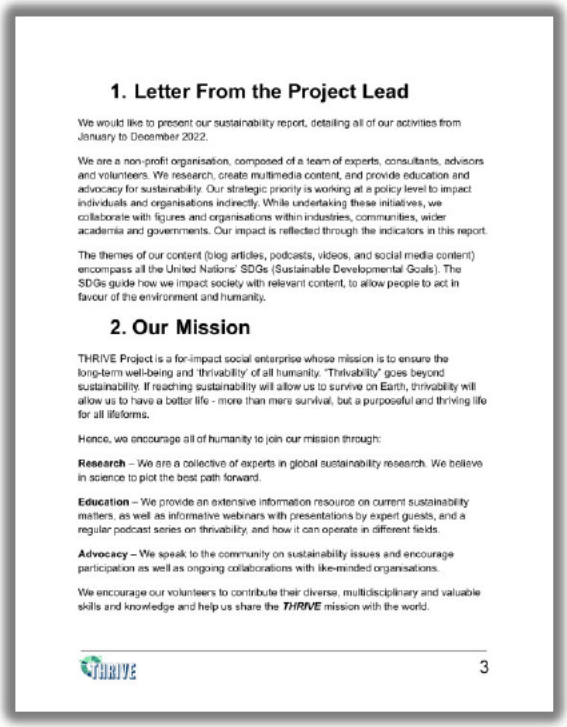
- THRIVE Project Performance Report incorporating its GRI Report: Developed by the team using the principles from the THRIVE Framework.





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4. The THRIVE Tribe 5
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1. Letter From the Project Lead

We would like to present our sustainability report, detailing all of our activities from January to December 2022.

We are a non-profit organisation, composed of a team of experts, consultants, advisors and volunteers. We research, create multimedia content, and provide education and advocacy for sustainability. Our strategic priority is working at a policy level to impact individuals and organisations indirectly. While undertaking these initiatives, we collaborate with figures and organisations within industries, communities, wider academia and governments. Our impact is reflected through the indicators in this report.

The themes of our content (blog articles, podcasts, videos, and social media content) encompass all the United Nations' SDGs (Sustainable Developmental Goals). The SDGs guide how we impact society with relevant content, to allow people to act in favour of the environment and humanity.

2. Our Mission

THRIVE Project is a for-impact social enterprise whose mission is to ensure the long-term well-being and 'thrivability' of all humanity. "Thrivability" goes beyond sustainability. If reaching sustainability will allow us to survive on Earth, thrivability will allow us to have a better life - more than mere survival, but a purposeful and thriving life for all lifeforms.

Hence, we encourage all of humanity to join our mission through:

Research – We are a collective of experts in global sustainability research. We believe in science to plot the best path forward.

Education – We provide an extensive information resource on current sustainability matters, as well as informative webinars with presentations by expert guests, and a regular podcast series on thrivability, and how it can operate in different fields.

Advocacy – We speak to the community on sustainability issues and encourage participation as well as ongoing collaborations with like-minded organisations.

We encourage our volunteers to contribute their diverse, multidisciplinary and valuable skills and knowledge and help us share the ***THRIVE*** mission with the world.

3. A Snapshot of THRIVE

The seeds of what would become the THRIVE Project were planted in 2004, as a growing group of individuals in North America, Europe, Asia and Australia connected with one another over their shared desire to make a difference.

THRIVE was formally set up in 2016 as The Holistic Regenerative Innovative Value Entity, a web-based, multi-capital, values-based tool. Built upon the best available science, it addresses our 21st-century challenges by measuring well-being. Our THRIVE Platform tool uses machine learning and predictive analytics to guide society towards the future we aspire to, by accessing extensive historical repositories and leveraging learnings from experts around the world.

Although THRIVE was set up as a research-based platform to measure sustainability in a way that informs the future, the founders of the platform realised that there is a need to share the research-based information with society at large. This sharing of information will help provoke societal action to achieve sustainability and a 'thrivable' future where all life forms live in harmony.

With that end in mind, the education and advocacy components were added to THRIVE's organisational aims. Consequently, the scope of the organisation moved from being a platform to a project, enabling countries, cities, companies, and individuals to transform themselves into thrivable entities. Much like a stethoscope, THRIVE keeps track of the well-being of each of these entities, measuring their impact on the vital capitals (natural, social, human and others) of the planet. THRIVE endeavours to make sure that these measurements are used to inform people's actions and political decisions.

Eight years in the making, we are a respected international movement in the field of thrivability, with no other organisation approaching sustainability, as universally, holistically, and transparently as we do. To this end, harnessing the latest in machine learning, holo-chain, and cloud computing, we have developed technologies, tools and educational programmes, arming individuals with the understanding to make the changes they seek in the pursuit of prosperity for all.

4. The THRIVE Tribe

We have a group of three advisory teams, who direct our team of volunteers. To learn more about our team, visit our website at https://strive2thrive.earth/team/.

THRIVE Awards

THRIVE values the work and effort that our team members contribute. One of the ways we celebrate this is through the distribution of awards. In recognising their achievements, this page displays the different awards given out to members and webinar speakers.

THRIVE Member of the Month

Every month THRIVE selects a THRIVE Member of the Month, based on votes from peers.

This award is given to those who:

- Have gone over and above the call of duty.
- Are helpful and supportive of our mission and fellow THRIVERS.
- Routinely contribute to THRIVE's efforts, and deliver/hand over tasks on time.
- Collaborate with others in the team.
- Follow documented processes.

In 2022, we selected 10 Members of the Month.
For each awardee, THRIVE arranged for the planting of 10 indigenous seedlings in Lockhart, Australia. In total, 200 seeds were planted.



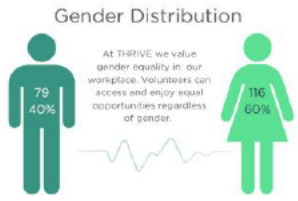
5. Our Volunteers

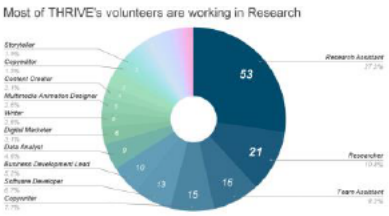
Ever since our founding, THRIVE has grown to 195 volunteers, collaborating across 31 different types of roles, 5 continents, and 43 countries. Our community is multicultural and multilingual which proudly enriches our knowledge exchange during training sessions and daily meetings.

The majority of our team members are based in Australia, with 126 in total. THRIVE has historically had a major presence in the country, as THRIVE's main office is located there.



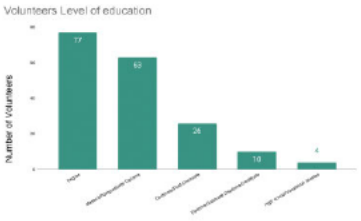
Equal gender participation is something that we foster at THRIVE. The majority of our team are women (60%), with expertise in a variety of fields, from research, data analytics, multimedia and many in between. The remaining 40% are male.





Research, education and advocacy are at the forefront of THRIVE's efforts to build a thrivable future. However, as THRIVE has spawned from research efforts first and foremost, a plurality of THRIVERS (38.1%) work in research positions.

Despite this, many THRIVERS, including researchers, work in other areas and teams as part of our cross-pollination initiative - where all volunteers are constantly interacting and sharing knowledge from different but complementary areas.



We prize highly educated professionals. So far, almost half of THRIVERS have attained postgraduate or higher-level degrees (49.6%), with a plurality having completed graduate degrees (42.8%).

Almost

50%

of our volunteers have high level of expertise

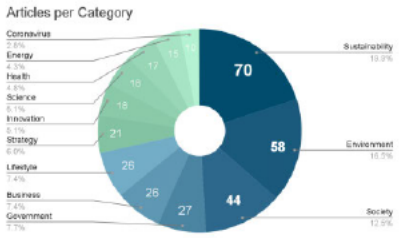
6. What We Have Achieved

Our content is guided by the United Nations' Sustainable Development Goals (SDGs). Adopted by the United Nations in 2015 as a universal call to action to end poverty, protect the planet, and ensure that all people enjoy peace and prosperity by 2030, these are used as the basis for our monthly themes, where 1-2 SDGs are focused on in our content. We create content in a variety of mediums, including:

- Videos
- Blog Articles
- Webinars
- Podcasts
- Social Media Posts
- Newsletters

In 2022, 87 blog articles were published across 12 categories, summing to a word count of 180,000 in total. Furthermore, 47 authors have published articles.

The three biggest focuses for our blog articles were sustainability, environment, and society - aligning with our goal to advocate for a 'thrivable' future where all lifeforms live in harmony.



We also have (as of the end of 2022) 127 YouTube videos on THRIVE's YouTube Channel. The content had 19,856 views distributed across 172 countries out of 195 worldwide.

Youtube			
How many videos?	Total Views	How much time does that represent?	How many countries played our content?
127	19,856	14 hr 50 mins	172

In our webinars, we invite experts to speak about our quarterly SDG topics and themes. From the start of our webinars to the end of 2022, more than 40 business, technology, small business, academic and advocacy professionals have spoken at our webinars. We discuss further details on the webinars we have delivered below.

Webinar	
How many webinars have we delivered?	How much time does that represent?
33	14 hr 15 mins

We also launched our podcast series, "A Thrivable Future", with 19 episodes created at the time of this writing.

Podcast	
How many podcast episodes have we delivered?	How much time does that represent?
19	12 hr 17 mins

We also created many social media posts and newsletters to engage our audience. LinkedIn is THRIVE's most popular social media platform - we have 3,323 followers on the platform, and share content there almost every day.

Our "Thrivability Matters Newsletter", has also been a useful source of information, including articles and upcoming events..

Alternative methods of disseminating information	
Social Media Posts	Newsletters
242	15

7. Our Performance

Our impact is through our content. All SDGs are approached in our content. Below, we presented the impact of our content in 2022.

General Disclosures 2022

GRI 2: General Disclosures 2022

2-1 Organizational Details
Not-for-profit organization, headquartered in Brisbane, Queensland, Australia.
Volunteers in various parts of the world (see item 2.8).
Operation virtual.
For more information, access: https://blog.thrive2thrive.earth/about-thrive-project

2-2 Entities included in the organization's sustainability reporting
This report includes 2 not-for-profit organizations: Thrive Project and THRIVE for Life Foundation (which funds small operational matters like the prizes etc based on donations)

2-3 Reporting period
January to December 2022

2-4 Restatements of information
This is THRIVE's first report

2-5 External assurance
No external assurance.

2-6 Activities
Our activities are described at our website: https://blog.thrive2thrive.earth/

2-7 Employees
No employees, only volunteers (about the volunteers, see next item)

2-8 Workers who are not employees

At the end of 2022 the organization had:

Volunteers	Female Volunteers	Male Volunteers	Countries	Roles

71	35	30	17	26

Contractual relationship: Volunteer Agreement according with the laws of Queensland, Australia

2-9 Governance structure and composition
There is a team of advisors who supports and guides the organization and makes executive decisions.

2-10 Nomination and selection of the highest governance body
The group of advisors are the highest governance body.

2-11 Chair of the highest governance body
Chairs is on rotation.

2-12 Role of the highest governance body in overseeing the management of impacts
It is a role of our structure and team, not the governance body.

2-13 Delegation of responsibility for managing impacts
Structure and team.

2-14 Role of the highest governance body in sustainability reporting
It is a role of our structure and team, not the governance body.

2-15 Conflicts of interest
The organization leaders declare no conflict of interest.

2-16 Communication of critical concerns
Due to our nature, Thrive doesn't cause negative impacts. Our aim is to alleviate the negative impacts caused by organizations all over the world, through education and information.

2-17 Collective knowledge of the highest governance body
The knowledge and experience of advisors and project lead are described at: https://blog.thrive2thrive.earth/team/

2-18 Evaluation of the performance of the highest governance body
Thrive doesn't have a process to evaluate the knowledge of the highest governance body.

2-19 Remuneration policies
We are all volunteers. However, we do have funded projects based on grants.

2-20 Process to determine remuneration
The funded projects are on a project basis and commensurate to the grant being applied for.

2-21 Annual total compensation ratio
Not applicable. There are no financial compensation.

2-22 Statement on sustainable development strategy
We achieve sustainable development through researching, educating and advocating.
(https://blog.thrive2thrive.earth/)

2-23 Policy commitments
Our commitment in being a responsible business is in our mission: ensure the long-term well-being and 'thrivability' of all humanity.

2-24 Embedding policy commitments
The volunteers are advised and trained to embed the mission.

2-25 Processes to remediate negative impacts
We don't have negative impacts. We cause impacts by information and education, alleviating negative impacts in other organisations and individuals.

2-26 Mechanisms for seeking advice and raising concerns
Thrive doesn't have mechanisms for individuals to seek advice and raise concerns about responsible business conduct in the organization's operations and business relationships.

2-27 Compliance with laws and regulations
No instances of non-compliance with laws and regulations during the reporting period.

2-28 Membership associations
We work alongside several other groups such as the FEI, r3.0, GTAC and other UN-affiliated research group.

2-29 Approach to stakeholder engagement
We have periodical meetings to engage volunteers. Call in the website: https://blog.thrive2thrive.earth/volunteer/

2-30 Collective bargaining agreements
Not applicable. There are no collective bargaining agreements.

GRI 3: Material Topics

3-1 Process to determine material topics
Discussion with the project leader to define which indicators are material to the organization.

3-2 List of material topics

We define as our material topic: Indirect Economic Impact.

3-3 Management of material topics

We accompany the indicators monthly.

GRI 201: Economic Performance

201-1 Direct economic value generated and distributed
Not applicable. Thrive does not generate a direct economic value, it generates incommensurable value.

201-2 Financial implications and other risks and opportunities due to climate change
One of the reasons our organization was created was due to climate change. Our blog, podcasts, videos approach climate change to educate and inform people and other organizations to alleviate its financial impact. For more information access: https://blog.thrive2thrive.earth/blog and visit our channel at YouTube:
https://www.youtube.com/channel/UCIOO9nu4JJ1EQpvR2bGRiUg

201-3 Defined benefit plan obligations and other retirement plans
Not applicable.

201-4 Financial assistance received from government
We don't receive any assistance from the government.

GRI 202: Market Presence

202-1 Ratios of standard entry-level wage by gender compared to local minimum wage
Not applicable.There are no wages.

202-2 Proportion of senior management hired from the local community
75% of our advisors are located in Australian territory. However, as we are a global organization, the definition of the local community is not applicable to us.

GRI 203: Indirect Economic Impacts

203-1 Infrastructure investments and services supported
Not applicable.There are no investment in infrastructure. Our economic indirect impact is described in the following indicator.

203-2 Significant indirect economic impacts
Please, refer to " 6. What We Have Achieved " to further details about our significant indirect economic impact.

GRI 204: Procurement Practices

204-1 Proportion of spending on local suppliers
Not applicable. There are no spending with suppliers.

GRI 205: Anti-corruption

205-1 Operations assessed for risks related to corruption
There are no assessments. Our operations does not involve commercial relationships.

205-2 Communication and training about anti-corruption policies and procedures
There are no training. Our operations does not involve commercial relationships.

205-3 Confirmed incidents of corruption and actions taken
There were no incidents in the period of the report.

GRI 206: Anti-competitive Behavior

206-1 Legal actions for anti-competitive behavior, anti-trust, and monopoly practices
Not applicable. We don't sell any product, and so, we are not competitive.

GRI 207: Tax

As a not-for-profit, taxes are not applicable.

GRI 301: Materials

All indicators are not applicable. THRIVE doesn't have an office where volunteers go to work, so there are no consumption of materials or resources direct related to their activity, only the domestic consumption.

GRI 302: Energy

All indicators are not applicable. THRIVE doesn't have an office where volunteers go to work, so there are no consumption of materials or resources direct related to their activity, only the domestic consumption.

GRI 303: Water and Effluents

All indicators are not applicable. THRIVE doesn't have an office where volunteers go to work, so there are no consumption of materials or resources direct related to their activity, only the domestic consumption.

GRI 304: Biodiversity

304-1 Operational sites owned, leased, managed in, or adjacent to, protected areas and areas of high biodiversity value outside protected areas
Not applicable. Our operation does not affect directly biodiversity.

304-2 Significant impacts of activities, products and services on biodiversity
THRIVE has several articles related directly and indirectly to biodiversity. At the end of 2022, 315 articles were published in 15 categories. The two main categories written were sustainability, and environment, representing 19,9% (70 articles) and 16,5% (58) respectively.

304-3 Habitats protected or restored
Thrive does not protect or restore habitats. Our impact is described in the previous indicator.

304-4 IUCN Red List species and national conservation list species with habitats in areas affected by operations
Not applicable. Our operation does not affect directly biodiversity.

GRI 305: Emissions

All indicators are not applicable. THRIVE doesn't have an office where volunteers go to work, so there are no consumption of materials or resources direct related to their activity, only the domestic consumption.

GRI 306: Waste

Not applicable. THRIVE doesn't have an office where volunteers go to work, so there are no waste generation direct related to their activity, only the domestic generation.

GRI 308: Supplier Environmental Assessment

308-1 New suppliers that were screened using environmental criteria
There are no screening for our volunteer suppliers.

308-2 Negative environmental impacts in the supply chain and actions taken
Not applicable. We alleviate negative impacts.

GRI 401: Employment

401-1 New employee hires and employee turnover

We are a diverse organization where in 2022, volunteers from 18 countries start working with us. From a total o 65 newcomers, 34 were women and 31 were men. The majority came from Australia, 38 respectively, followed by Nigeria (6) and Pakistan (4).

Newcomers by gender group		
Under 30 years old	30-50 years old	Over 50 years old
23	39	3

Regarded to turnover rate, 90 volunteers left the organization in 2022 from 19 countries. Breaking down that number by gender, 29 are male and 61 are female. Again, Australia holds the highest number, 64 volunteers, representing 71% of the turnover. Thrive works with contracts, normally with 6 months or 1year duration, what explain our high turn over rates.

Turnover by gender group		
Under 30 years old	30-50 years old	Over 50 years old
42	41	7

401-2 Benefits provided to full-time employees that are not provided to temporary or part-time employees
The organization have only volunteers. They are from different countries, work from home and have a flexible schedule.

401-3 Parental leave
Not applicable. We don't have employees, and we don't pay salary for parental leave.

GRI 402: Labor/Management Relations

402-1 Minimum notice periods regarding operational changes
Not applicable. There are no labor/management relations, as there are only volunteers.

GRI 403: Occupational Health and Safety

All indicators are not applicable. THRIVE doesn't have employees, only volunteers who work from home.

GRI 404: Training and Education

404-1 Average hours of training per year per employee
There were 189 internal meetings in 2022 with an average of 7 Thrivers per meeting. All meetings involve training, some are fully focused on training others partially. The average meetings' training time is 40m, representing 112h. The volunteers share their expertise in training sessions which are recorded and shared with all members to access. Our training library grows steadily.

404-2 Programs for upgrading employee skills and transition assistance programs
For our volunteers, there are Thrive awards and Thrive Member of the year (page 9).

404-3 Percentage of employees receiving regular performance and career development reviews
Not applicable. Thrive only has volunteers.

GRI 405: Diversity and Equal Opportunity

405-1 Diversity of governance bodies and employees
THRIVE does not have governance bodies due to the collaborative workspace.

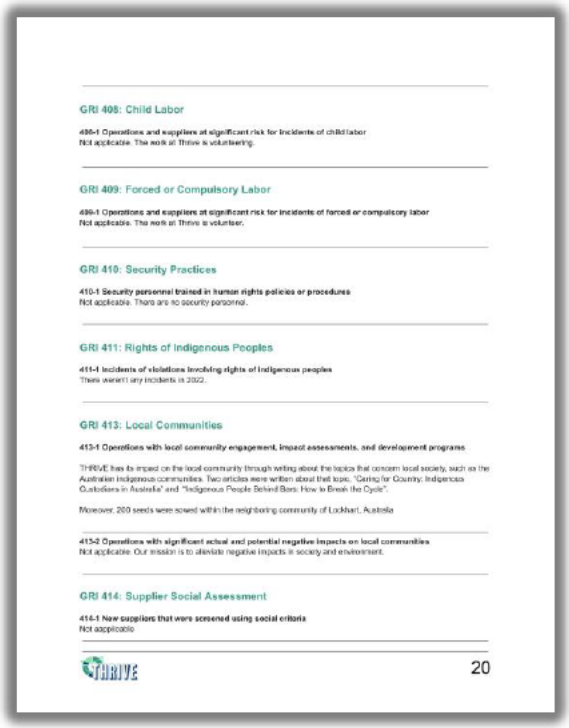
405-2 Ratio of basic salary and remuneration of women to men
Not applicable. There is no remuneration.

GRI 406: Non-discrimination

406-1 Incidents of discrimination and corrective actions taken
There weren't any incidents in 2022.

GRI 407: Freedom of Association and Collective Bargaining

407-1 Operations and suppliers in which the right to freedom of association and collective bargaining may be at risk
Not applicable. There are only volunteers.



GRI 408: Child Labor

408-1 Operations and suppliers at significant risk for incidents of child labor
Not applicable. The work at Thrive is volunteering.

GRI 409: Forced or Compulsory Labor

409-1 Operations and suppliers at significant risk for incidents of forced or compulsory labor
Not applicable. The work at Thrive is volunteer.

GRI 410: Security Practices

410-1 Security personnel trained in human rights policies or procedures
Not applicable. There are no security personnel.

GRI 411: Rights of Indigenous Peoples

411-1 Incidents of violations involving rights of indigenous peoples
There weren't any incidents in 2022.

GRI 413: Local Communities

413-1 Operations with local community engagement, impact assessments, and development programs

THRIVE has its impact on the local community through writing about the topics that concern local society, such as the Australian Indigenous communities. Two articles were written about that topic. "Caring for Country: Indigenous Custodians in Australia" and "Indigenous People Behind Bars: How to Break the Cycle".

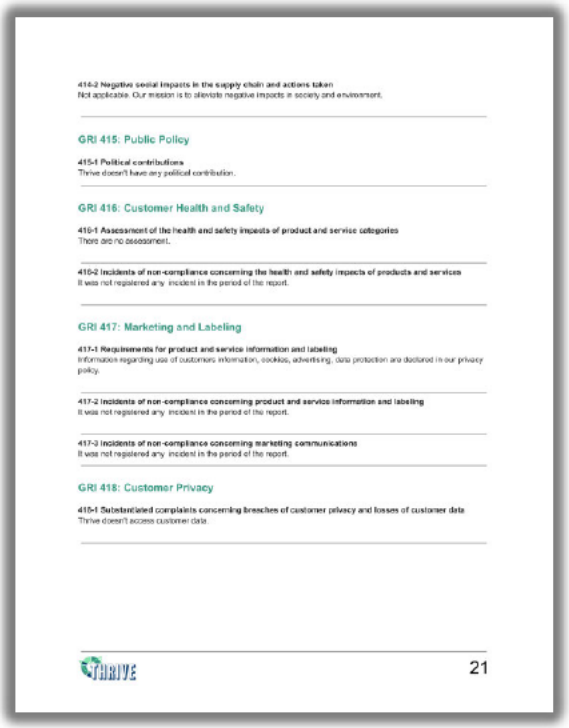
Moreover, 200 seeds were sowed within the neighboring community of Lockhart, Australia

413-2 Operations with significant actual and potential negative impacts on local communities
Not applicable. Our mission is to alleviate negative impacts in society and environment.

GRI 414: Supplier Social Assessment

414-1 New suppliers that were screened using social criteria
Not applicable

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414-2 Negative social impacts in the supply chain and actions taken
Not applicable. Our mission is to alleviate negative impacts in society and environment.

GRI 415: Public Policy

415-1 Political contributions
Thrive doesn't have any political contribution.

GRI 416: Customer Health and Safety

416-1 Assessment of the health and safety impacts of product and service categories
There are no assessment.

416-2 Incidents of non-compliance concerning the health and safety impacts of products and services
It was not registered any incident in the period of the report.

GRI 417: Marketing and Labeling

417-1 Requirements for product and service information and labeling
Information regarding use of customers information, cookies, advertising, data protection are declared in our privacy policy.

417-2 Incidents of non-compliance concerning product and service information and labeling
It was not registered any incident in the period of the report.

417-3 Incidents of non-compliance concerning marketing communications
It was not registered any incident in the period of the report.

GRI 418: Customer Privacy

418-1 Substantiated complaints concerning breaches of customer privacy and losses of customer data
Thrive doesn't access customer data.

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- THRIVE Audience Overview Dashboard

