Building a Software Tool for Transparent and Efficient Process Assessments in IT Service Management

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Abstract. Process improvements provide a structured approach for organisations to improve the way they operate. A number of process improvement methodologies such as ISO9000, TQM, Six Sigma, Lean, and Agile have been proposed over the last few decades and subsequently software tools have been developed to apply these methodologies. However determination of process capability to measure improvement is predominantly conducted by expert process assessors and consultants with proprietary frameworks. We propose the use of the international standard for process assessment ISO/IEC 15504 for a transparent measurement of process capability. We also demonstrate development of a software tool based on the standard that can facilitate organisations to assess their processes efficiently. In this paper, we explain the development, implementation and preliminary evaluation of a software-mediated process assessment approach in the area of IT Service Management at a large public-sector IT organisation in Queensland, Australia. This paper's contribution is the integration of the design science research methodology with the task-technology fit theory for the development of the software tool as a research artefact. For practitioners the project demonstrates transparent and efficient assessment of IT service processes to facilitate continual improvement.

Keywords: Process Assessment, IT Service Management, Task-Technology Fit, Design Science Research, ISO/IEC 15504

1 Introduction

Organisations have adopted methodologies such as ISO9000, TQM and Six Sigma for better business performance in terms of process effectiveness and efficiency [1]. Software developed to apply these methodologies such as Business Process Modelling tools have expedited process adoption and improvement [2]. However, measurement of process improvements, i.e., process assessments lack uniformity and transparency in the way they are conducted [3]. The lack of software tools for process assessments may be attributed to the lack of a standard structure in the way process assessments are conducted. Moreover it is reported that process assessments are costly and time-consuming [3, 4].

ISO/IEC 15504, the international standard for process assessment, was initially developed for the assessment of software development processes [5]. However this

adfa, p. 1, 2011.

standard has now emerged as a general process assessment standard. COBIT has recently adopted this standard for the assessment of IT governance processes [6]. In response to the paradigm shift of IT's focus from technology to service provision, the standard has published a process assessment model for IT services [7]. We intend to develop a software tool based on the model enabling organisations to self-assess IT service processes. Review of prior studies has found that software tools are primarily designed to support assessors in process assessment. In contrast, the software tool we developed is targeted for IT organisations to self-assess their IT service processes.

According to research conducted by Gartner, investment in IT services exceeded that in IT devices, IT systems and enterprise software in 2012 and is forecast to continue [8]. It is obvious that businesses will increasingly evaluate IT in terms of what value is offered by IT services rather than how the technologies are managed. The IT Service Management (ITSM) discipline has embraced a process approach along with service-oriented thinking in managing IT for business. The popular ITSM framework, Information Technology Infrastructure Library (ITIL®) and the international standard of ITSM (ISO/IEC 20000) stress the importance of process improvement for better IT services. In practice, ITSM is endorsed by an internationally active practitioners' forum called itSMF but there is limited scholarly work in this discipline [9].

The research problem that motivates this research is (a) the lack of transparency in the way process assessments are conducted and (b) the lack of efficiency for organisations to repeatedly conduct process assessments.

We propose an approach called Software-mediated Process Assessment (SMPA): a standards-based process assessment approach by which organisations can self-assess their processes using a software tool. A research project in collaboration with academics, practitioners and standards committee members with combined expertise in ITSM and process assessment was initiated in 2011 to develop and evaluate the SMPA approach. The research team includes an industry partner, one of the world's leading assessment solution providers that provided its software platform to develop our tool. The research question of our research project is: ***How can the software-mediated process assessment approach be developed and used in an IT organisation?*** The objective of this paper is to report the development, implementation and evaluation of the software tool developed for the SMPA approach. We conduct this research as a Design Science Research (DSR) [10] project. The unique contribution to knowledge from this research is the application of fit profile from task and technology requirements to explicate rigorous design principles in building a software tool that addresses IT organisation problems of lack of transparency and efficiency in assessments.

The introduction section discussed the research problem and research question. The following section provides an overview of existing ITSM process assessment approaches. The research methodology is discussed next. The artefact development and demonstration are then explained in detail, followed by an account of the evaluation of the tool. The conclusion summarises the findings and suggests an agenda for future work.

2 Review of Prior Studies

In this section, we firstly review the existing approaches in ITSM process assessments in order to articulate the research problem of lack of transparency and efficiency in the prevalent approaches. We then provide an overview of the task-technology fit theory and the international standard of process assessment, ISO/IEC 15504 that are used in this design science research project.

2.1 Existing Approaches of ITSM Process Assessment

There are several commercial ITSM process assessment tools (e.g. [11]). These bespoke services can be considered as a black box since the rationale behind the assessment activities is not disclosed. We found three prominent ITSM Process Assessment approaches from the literature review: (a) Tudor's ITSM Process Assessment provides an overall approach to conducting process assessments based on ITIL and ISO/IEC 15504 [12]; (b) Standard CMMI Appraisal Method for Process Improvement (SCAMPI) using CMMI for Services (CMMI-SVC) as the measurement model [13]; and (c) ITIL Process Maturity Framework assesses ITIL processes based on five defined levels of maturity [14].

The existing ITSM process assessment approaches advocate their measurement framework for transparent process assessment. All process assessment approaches discussed in the literature and proprietary process assessment services offered by consultants in the IT industry appear to be based on one of the two related measurement models: Capability Maturity Model/ Integration (CMM/ CMMI) and the international standard of process assessment ISO/IEC 15504. Both measurement models for process capability determination originated from the software engineering discipline and are largely harmonized in their measures [5]. Moreover, the role of ISO/IEC 15504 as a consistent measurement framework for ITSM process assessment was confirmed by a systematic literature review [15].

Apparently none of the existing process assessment approaches encourage or demonstrate use of software tools for an efficient self-assessment of IT service processes for organisations. Several initiatives reported about the use of software tools in ITSM process assessments are either proprietary (hence not transparent and efficient) or developed only for the assessors to use (hence does not promote efficient self-assessments by IT organisations). We did not find any published research or industry initiatives towards developing a transparent approach to conduct self-assessments of processes by IT organisations. We base our research on this identified gap. Furthermore, there are industry reports of high costs and unstructured assessment approaches discouraging ITSM process assessments even though organisations see value in the idea of assessments [16]. Therefore this problem is also relevant in the IT industry.

2.2 Transparency and Efficiency Challenges

Addressing transparency and efficiency are two major challenges of process assessments [3]. These challenges are taken into account as important problems that must be solved with the proposed tool.

Transparency. For our task of process assessment, transparency is the concept of facilitating any course of action with accessible information regarding the assessment. Transparency can be improved by aligning the assessment activities with the ISO/IEC 15504 standard that provides guidance on conducting the assessment process. Moreover, there are process assessment tools that are 100% compliant with the normative and informative parts of the ISO/IEC 15504 standard (such as SPICE-Lite Assessment tool or SEAL software assessment tool). These assessment tools provide an interface to the assessors in assisting them to record evidence for standard indicators, rate process capabilities and produce assessment reports. These assessments are transparent in the sense that they align with the standard.

However there is still lack of objectivity in the assessment approach particularly in terms of data collection, analysis and presentation. The existing ITSM process assessment approaches have challenges in regards to transparency because they use interviews to map participant opinions to the standard indicators which are subject to interpretation by both the participant and the assessor. Moreover, assessment results are based on subjective evaluation of the assessors for process capability determination and process improvement recommendations. The issue of transparency is therefore a significant hurdle in conducting an objective and standardised process assessment. We therefore consider transparency is a critical task challenge that needs to be addressed by the tool.

Efficiency. Efficiency determines the degree of economy with which any assessment consumes resources, especially time and money [17]. We believe efficiency can be achieved in process assessments since a number of process assessment activities can be automated with the use of the tool. This translates to significant cost savings from not using expensive assessors and consultants while enabling repeated self-assessments for IT organisations. This opportunity can address the efficiency challenges for process assessment. We therefore consider efficiency as our second task challenge to consider while developing the tool.

2.3 Task-Technology Fit

In DSR projects, researchers are advised to use established kernel theories to inform and justify the research work [18]. We present the task-technology fit (TTF) theory [19] as the kernel theory in our research to advise how the task challenges of process assessment and technology requirements for a new software tool fit together to articulate artefact design and development. The choice of TTF theory is justified by the core focus of the research question to build a technology solution in response to task challenges.

TTF theory proposes that IT is more likely to have a positive impact on individual performance if the capabilities of the IT match the tasks that the user must perform

[20]. TTF deviates from self-reported user evaluations and looks at the “fit” between the technology features and the task requirements to be supported by the technology. TTF theory was later applied for evaluation of group performance by verifying the fit with group support systems technology [19]. Since then the theory has been applied to a diverse range of information systems and is considered one of the prominent theories to explain the impact of IT on performance. We adopt Zigurs and Buckland's TTF theory for two primary reasons: (a) the software tool is a decision support tool that shares similar technology dimensions as proposed in the theory, viz. communication support, process structuring and information processing; and (b) our approach of designing an ideal fit profile to match task and technology is supported by this theory.

2.4 International Standard for Process Assessment

It is important to have a brief review of the international standard for process assessment, ISO/IEC 15504 which is the basis of the SMPA tool development and evaluation. The standard defines six process capability levels (CL0 to CL5) which in turn consist of a total of nine process attributes (PA1.1 to PA5.2) and further consist of generic practices [21]. Process assessment must be compliant with the ISO/IEC 15504 requirements where the assessors collect objective evidence against process indicators to determine capabilities of a process and to ultimately improve processes in an organisation. A process reference model provides all the indicators to determine process performance (CL1) which is specific to each process. Likewise the process assessment model provides generic indicators to determine higher levels of process capabilities in a standard manner. Fig. 1 illustrates the structure of the ISO/IEC 15504 process assessment model with five steps of process capability levels.

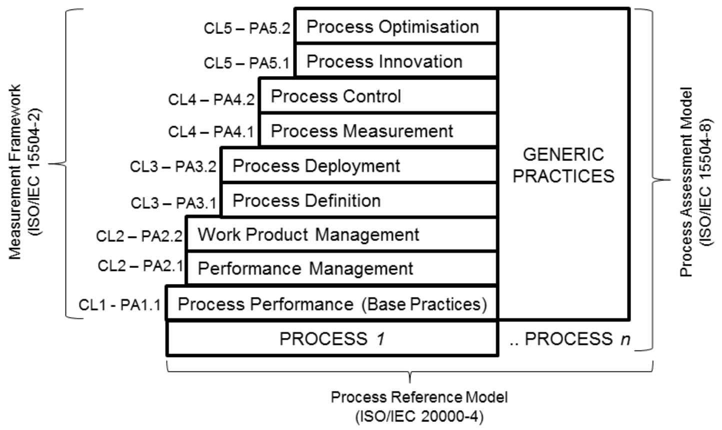

Fig. 1. Process Assessment Model based on ISO/IEC 15504 [21]

3 Research Methodology

We use Design Science Research (DSR) methodology [22] because this research is motivated to develop a novel artefact in order to solve an organisational problem [10]. We follow the six DSR methodology steps: problem identification and motivation, objectives of a solution, design and development, demonstration, evaluation, and communication [22]. We integrate the TTF theory process model with the DSR methodology and use it to explain the development and evaluation of the artefact.

The challenges of lack of transparency and efficiency in ITSM process assessments represent the first DSR phase of **problem identification and motivation**. The second DSR phase, **objectives of a solution** can be defined from the three technology dimensions derived from the TTF theory [19]: communication support; process structuring; and information processing. We use the technology dimensions as technology requirements for the tool development. Ultimately alignment between task challenges and technology requirements is represented with an ideal fit profile that proposes a set of design considerations for the tool development. The process of building the fit profile and ultimately the tool aligns with the **design and development** phase of DSR.

While most of the existing process assessments rely on process-specific indicators that demonstrate objective evidence of process capabilities, the software tool facilitates a top-down approach where assessment at each level is defined with a goal and then assessment is guided by explicit questions and metrics that are set to goal attainment. A top-down approach in process assessment ensures that the measurement follows a transparent workflow of assessment activities. This concept is guided by the Goal-Question-Metric (GQM) approach. The GQM approach defines a measurement model for software metrics on three levels: goal (conceptual level); question (operational level); and metric (quantitative level) [23].

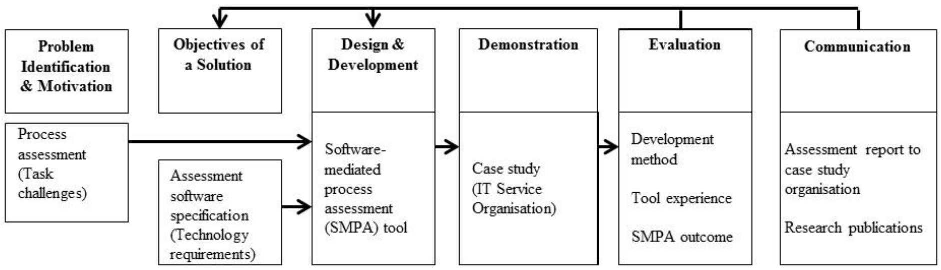

Fig. 2. Research Methodology based on [19] and [22]

A case study organisation was selected as test site for the tool to execute the **demonstration** and **evaluation** phases of DSR. Evaluation is planned during three stages of the research: tool development evaluation; tool experience evaluation; and SMPA approach evaluation. The method of evaluation is qualitative investigation through semi-structured interviews with IT service managers and process performers at the case study organisation. We present this paper as a publication of the **commu-**

nication phase of DSR to obtain feedback regarding the development and evaluation of the artefact.

4 SMPA Tool Design and Development

TTF theory has been associated with evaluative research where a fit of task requirements is sought from existing technologies [24]. We extend the application of TTF theory to understand the development of a new technology for particular task challenges. This approach is particularly suitable for DSR to exert rigour in explaining development of novel artefacts. This also makes sense in the practical world: we have learnt that requirements must be carefully considered before designing and developing a technology solution to overcome task challenges. Therefore, integration of TTF theory in the DSR process is a novel research approach illustrated in Fig. 2 and we propose this integration as a unique contribution of this paper.

In the context of the development of the tool, we now discuss three stages of tool design and development. In the first stage, requirements for assessment workflow and automation to be supported by the tool are discussed (technology requirements) based on task challenges. A fit profile is then established to provide a set of design principles to guide the development of the tool as the second stage. This is followed by the third stage of tool development based on the design principles of the fit profile.

4.1 Process Assessment Technology Requirements

We examine the existing challenges of lack of transparency and efficiency in the task of process assessment that need to be overcome by the software tool. We group our task challenges as a typical “decision task” since process assessments are conducted to make informed decisions on improving processes continually. According to the TTF theory, technology requirements for the challenges of a decision task must focus on “information processing” and “process structuring” dimensions of technology for enhanced performance [19]. We use the term "technology requirements" rather than "technology dimensions" as used originally in the theory. This is because we are not evaluating existing technology dimensions for a fit but trying to develop a technology solution that fits task challenges to technology requirements. The technology proposed for the software tool runs on a cloud-based platform for assessment facilitation and a web-based interface for online surveys.

- **Process Structuring.** The tool must define the assessment process workflow by which the entire procedure is conducted as explicitly documented in the standard [21]. Assessment workflow steps have been proposed to define a structure in the activities: Definition, Preparation, Assessment, Analysis, Results Presentation and Closure phases [12]. The technology requirements of process structuring should lead to the development of the tool that can facilitate the entire assessment process in a transparent manner. Transparency is achieved with the use of a software tool since the software can provide comprehensive coverage of all questions relating to the standard using online surveys. The approach of asking questions directly to the assessment participants and allowing the software tool to objectively calculate process capabilities based on the survey responses promote transparency. Moreover, the assessment report produces recommendations based on the ITIL® framework stored in the knowledge base of the software tool, thereby promoting transparency for process improvements since the recommendations are based on the questions that align with the assessment model of the standard.

- **Information Processing.** The ability to automate activities of process assessment is considered as the information processing requirement for the development of the tool. The steps of assessment data collection and validation, process capability ratings and reporting of the assessment results requires gathering, aggregating, evaluating and finally presenting information. Therefore, having an efficient information processing capability is an important requirement for the tool. Efficiency is achieved by the use of online surveys instead of assessment interviews for data collection; and the generation of process improvement recommendations based on the DSS tool. Process assessments using a software tool can enable cost-effective and repeatable assessments so that the organisations can spend their time and resources on process improvement activities rather than conducting assessments.

4.2 Design Principles

In this project, a fit profile provides design principles for the tool development based on the task challenges and technology requirements. The fit profile as shown in Table 1 answers the research question that we posed in section 1: ***how can the software-mediated process assessment tool be developed and used in an IT organisation?***

Table 1. Fit profile as design principles

Process Assessment (Task challenges)	SMPA tool (Technology Requirements)	Tool Design Principles	Resources Needed
Transparency	Process Structuring	Facilitate Assessment Workflow	International Standard for Process Assessment (ISO/IEC 15504)
Efficiency	Information Processing	Automate Assessment Activities	Decision support systems (DSS) tool

In order to facilitate assessment workflow to address transparency issues, alignment with the international standard for process assessment is critical while developing the tool. Together with a thorough review of the standard [21], its process reference model [25] and the assessment model for IT services [7] were used. Similarly a DSS tool provides decision support by processing relevant information. We use a software tool to automate assessment activities during collection and analysis of process data directly from participants; and presentation of assessment results in the form of process capability and recommendations for decision support in process improvements.

We used the fit profile to present two design principles and the two key resources we needed before commencing the actual tool development. Based on the design principles and using the resources from the fit profile (see **Table 1**), our research artefact was developed to address the task challenges using technology requirements.

4.3 Development of the SMPA Tool

The GQM approach has been previously applied in the software industry. However use of this approach to develop a process assessment tool in ITSM is novel. The international standard defines a reference model where each process is defined in terms of purpose and outcomes [25]. Attainment of the process purpose by meeting the outcomes defines the "goal" component of the software tool.

Likewise, the standard provides a set of base practices to fulfil the process outcomes and a set of generic practices for Level 2 (process management), Level 3 (standardisation), Level 4 (quantitative measurement) and Level 5 (innovation) of process capability. These practices are used as assessment indicators by an assessor in a formal assessment. In our context, the emphasis is on providing information that can drive improvement of IT service processes. The practices specified in the standard were mapped into a set of 177 assessment questions. The tool allocates these questions to the respondents based on three process roles: process performers, process managers and process interfaces. This defines the "question" component of the tool.

Finally every question is rated using the scale: "Not" (N), "Partially" (P), "Largely" (L), "Fully" (F) and "Not Applicable" (NA) as defined in the standard. This rating is a knowledge metric of the process stakeholders. Rather than the assessment team making a subjective choice of the indicator rating, the software tool objectively measures feedback from the process stakeholders directly from the questions and provides a transparent metric to determine process capability.

The application of an objective GQM approach for assessment workflow of the tool is the key facilitator for a transparent process assessment. The features of the SMPA tool automate many of the assessment activities as discussed next.

Assessment Data Collection & Validation. The tool accumulates responses from all the concerned process stakeholders using an online survey interface. Every question also features a free text comments box to capture qualitative contextual data that can be analysed to validate responses and provide specific recommendations. The approach of asking questions directly in a web-based survey environment represents a faster and more efficient data collection method compared to assessment interviews with the same level of rigour in service research [26].

Process Capability Determination & Rating. The software tool determines the final score for each process at each capability level. This is done by calculating the mean value of all the responses for a level by all the respondents. The coefficient of variation (*CoV*) of all the responses is also computed by the tool:

$CoV_x = \frac{\delta_x}{\bar{x}}$ where CoV_x is the coefficient of variation, δ_x is the standard deviation and $\overline{x}$ is the mean value of *x* responses for a particular process capability score.

CoV is useful in determining reliability of the process score based on dispersion of the responses. The mean and the *CoV* are simple statistical measures to understand what the critical mass of assessment respondents think about the processes being assessed. This is a new feature of the tool that is not explicitly stated in the standard.

Assessment Reporting with Process Improvement Recommendations. The SMPA tool is not only a stand-alone survey engine, it has embedded a knowledge base that stores contextual recommendations for process improvements tied to every assessment question. Using the knowledge base developed from best practice guidelines (ITIL®) for process improvements in ITSM, the tool performs gap analysis based on the collected response metrics and produces a report with improvement recommendations. We developed the knowledge base with recommendation items at the question level for four IT service processes in our research project. For every question when the mean rating is either "partially" (P) or "not" (N), i.e. there is an element of risk in the process activity, a recommendation item associated with each question is extracted from the knowledge base and the accumulated knowledge items are compiled to develop the final assessment report with process improvement recommendations.

5 SMPA Tool Demonstration

Agreement was reached with a large government organisation to trial the SMPA tool. The IT service department of the organisation has over 55 IT service staff and delivers IT services to residents across a large area in Australia servicing over 150,000 residents. The IT service department provides 34 identified services supporting IT functions in the organisation and typically manages 300 service requests per week.

Three ITSM processes were selected for assessment: Problem Management, Change Management and Configuration Management based on a process selection approach that provides decision support in selecting critical processes to improve [27]. Prior to implementing the SMPA tool, in April 2013 we conducted a conventional interview-based process assessment led by an experienced ISO/IEC 15504 certified expert assessor following the RAPID methodology [28], hereby referred as the manual assessment, at the organisation to enable the comparison of the SMPA outcomes with those of a manual assessment. The manual assessment scope was agreed to Capability Level 3 for the three processes. The manual assessment determined that while the capability of Problem Management and Configuration Management processes were both rated at Level 2 (Managed), the Change Management process was assessed at Level 0 (Incomplete) as shown in

Table **2**. The process capability ratings in

Table **2** were determined based on the objective evidence collected during interviews by three assessors. The final results were signed off following expert judgment by the lead assessor as fully complying with ISO/IEC 15504 standard.

Table 2. Process Capability results from the manual assessment

Processes Assessed	Process Attributes				
	1.1	**2.1**	**2.2**	**3.1**	**3.2**
Problem Management	F	L	L	L	L
Change Management	P	L	L	L	P
Configuration Management	F	F	L	L	L

The trial of the online SMPA tool was conducted from October to November 2013. To facilitate the assessment, the organisation nominated a senior IT service manager who was trained to use the administrator's console of the tool. The assessment questionnaire was completed by three process managers, five process performers and five other process stakeholders for the three processes. The SMPA tool collected survey responses and generated an assessment report. The assessment report presented different process capability scores as shown in Table 3. The SMPA tool determined that the Problem Management process was at Capability Level 1 (Performed) while the Change and Configuration Management processes were assessed at Level 0 (Incomplete). The report also provided 319 process improvement recommendations and listed 46 user comments from the respondents.

Table 3. Process Capability results from the SMPA tool

Processes Assessed	Process Attributes								
	1.1	**2.1**	**2.2**	**3.1**	**3.2**	**4.1**	**4.2**	**5.1**	**5.2**
Problem Management	L (H)	P (M)	P (L)	P (L)	P (M)	P (M)	N (M)	P (M)	P (M)
Change Management	P (M)	P (M)	P (M)	P (L)	L (H)	P (M)	P (M)	P (M)	P (M)
Configuration Management	P (L)	P (M)	P (L)	P (L)	P (H)	P (M)	P (M)	P (M)	P (M)

Because of the information processing capability of the SMPA tool, there is no human judgment used in determining the process capability ratings. The scores were derived purely based on the analysis of the assessment data captured by the tool. Besides the ratings, Table 3 also presents the reliability score for each rating as shown in parenthesis. The reliability score is based on the number and variation of responses (*CoV*) and is determined based on the following simple rule: High (H) if $CoV < 30\%$; Moderate (M) if $30\% \leq CoV \leq 50\%$; and Low (L) if $CoV > 50\%$. The process capability results from the manual assessment are significantly different to the SMPA tool. These differences are discussed in section 6.2.

6 SMPA Tool Evaluation

DSR projects require an evaluation phase in order to determine effectiveness of the artefact [10]. From the TTF theoretical perspective as well, we have discussed the design principles from the fit profile but evaluation of the fit needs to be reviewed by examining the utility of the tool at the case study organisation.

We organise our evaluation based on the design science evaluation framework [29]. The *ex-ante* evaluation took place in several iterations during the design and development of the artefact. The use of the TTF theory for a fit profile to obtain design principles for the tool, adherence to the international standard of process assessment, use of the GQM approach in facilitating assessment workflow, and software automation in several assessment activities – all of these contribute as evaluation checkpoints for effective tool design and development as detailed in section 4.

6.1 Tool Experience Evaluation

To perform the *ex-post* evaluation we conducted a focus group with the survey participants. Soon after the survey closed the focus group was conducted with seven people who participated in the SMPA assessments. The discussions sought feedback about the experience of the IT service process managers, process performers and other process stakeholders using the tool. Based on the Diffusion of Innovation theory [30], we constructed a focus group protocol to determine key discussion points that constituted the five innovation factors of the new technology use: compatibility, complexity, relative advantage, observability and trialability in order to evaluate experience with the use of the tool.

One of the researchers facilitated the focus group discussion. Participants reported that they found the tool easy to use and largely agreed that a self-assessment experience answering direct questions made the exercise more visible and less costly to implement than a manual assessment. For example:

Assessment Facilitator. *"The tool has the advantage of giving you a really broad dataset. So you can survey 50 people easily because you don't have to have them in a room at one time…"*

Process Performer-2. *"I can be honest as I am not being watched. I can answer truthfully because I'm not going to get in trouble. It gives you a voice. I mean, you can be anonymous with a survey and not worry that your boss is sitting next to you."*

Process Manager-1. *"…the survey can be very accurate, and is probably a better return on investment because you are not taking up everyone's time all at once. I would imagine it would be cheaper to do rather than have someone [expert assessor] across the table for that amount of time…"*

There were also constructive suggestions to improve the relevance and clarity of the assessment questions. For example,

Process Manager-1. *"I think the questions were relevant but the interpretation was the big barrier ... once you understand what was being asked and how it was being presented, it became a lot easier to answer the questions".*

6.2 SMPA Outcome Evaluation

After the SMPA report had been provided to the organisation in December 2013, interviews were conducted with three process managers to enable us to evaluate their perceptions on the validity and quality of the reports. Answers to these interview questions enabled a comparison of the outcomes of the manual assessment and SMPA approach.

There was consensus among the three process managers that the SMPA report produced accurate scores, in particular they commended the reliability score which they believed will help to determine the priority areas of improvement. For example:

Process Manager-2: *"What I like about the report from the tool is that it is backed up by solid evidence, and the reliability score is fantastic – it helps to determine if we are all thinking in the same direction or all over the place – I feel that the reliability score is more powerful than the process capability score in some instances."*

Process Manager-1. *"You can take an example of the configuration management process, we know that we don't do that well – in fact you can say the process is not even in place. Surprisingly the manual report said that configuration management is at Level 2 and I have to disagree. The report from the software rightly scored us a Level 0 for this process."*

All process managers also confirmed that the recommendations from the SMPA tool were valid and more actionable than the manual assessment report.

Process Manager-3. *"Since your recommendations are derived from the comprehensive guidelines of ITIL best practices, I think they are detailed enough for effective implementation … recommendations provided in the manual assessment are very broad and holistic directions."*

Process Manager-2. *"Numbers speak for themselves. We have over 100 process improvement recommendations derived from the tool that can be traced back to the identified gap at every question. I think the manual assessment report had less than 20 recommendations that are not very specific."*

In an attempt to account for the dramatic differences between the scores of the two assessment reports (

Table 2 and Table 3), the following suggestions were discussed:

- The influence of the lead assessor in the manual assessment may introduce bias resulting in judgment based on previous experience, a set of underlying assumptions, and perceptions and interpretations while determining the scores.
- Different staff participated in the two assessments: the manual assessment had 10 participants and the SMPA questionnaire was completed by 11 respondents. Only three process stakeholders participated in both assessments.
- The time lag between the two assessments was six months and a few significant changes during this time such as the implementation of a new ITSM tool and staff changes might contribute to changes in process capability ratings.
- The manual assessment was conducted in a group discussion environment including stakeholders from all roles for a particular process. Peer group discussions may be biased since senior managers and extroverts may dominate the discussion and assert their opinions leaving inactive participation from other process stakeholders. This limitation is removed in the SMPA tool as everyone had an anonymous and equal say about the processes in a more democratic manner through online surveys, therefore improving accuracy in understanding the true picture.

- Assessment questions were more granular in the SMPA tool. While the manual assessment focused on high level discussions and the assessors' judgment of specific assessment indicators based on those discussions, the SMPA approach focused on the standard asking very specific questions for every indicator to determine the process capability. A more granular approach improves the authenticity of the SMPA approach but this means a significant time imposition for survey respondents by examining specific aspects of a process in detail.

In summary, the evaluation in terms of tool experience and outcome confirmed the potential of the SMPA tool to address transparency and efficiency challenges in process assessments in the context of IT service processes. One of the significant achievements of the project is the intention to commercialize the SMPA tool by our industry partner, providing strong evidence of industry relevance of our research outcome and therefore maintaining an effective rigour-relevance balance in DSR [31].

7 Conclusion

The existing guidelines for process assessment lack transparency and assessments by external consultants are costly to conduct. We have developed an online process assessment tool aligned with the international standards to overcome this problem. The challenges to conduct a transparent and cost-effective process assessment and the technology requirements to address such challenges have been considered to develop the tool with the help of a theoretically grounded fit profile. In addition the growth of outsourcing of IT service functions and the use of virtual IT teams around the globe means that the tool with its online survey feature can be an efficient technology for repeated process assessments by IT organisations. The SMPA approach addresses transparency issues in process assessment by following a goal-oriented measurement of IT service processes using a standard process assessment model.

On reflection, it may have been better to select one process for design and evaluation rather than four since no significant benefits arose in terms of design knowledge and contribution with the addition of more processes. The evaluation revealed that it was the transformation of generic practices of the standard that requires more work. The base practices of the standards were well understood by the survey participants. In this regard, we could have focused on the generic practices (capability component) for design and evaluation of the tool rather than the process component.

Our contribution to knowledge is the application of the fit profile from task and technology requirements to develop design principles for the project. The integration of TTF theory with the DSR methodology is a novel approach. The implication of this research in practice is the presentation of a goal-oriented measurement based on the GQM approach for transparent and efficient assessments in IT service management.

We recognise limitations of this research: processes were assessed at only one organisation. Consequently, we do not claim generalisation of this research and call for future research to investigate and evaluate the SMPA approach in more organisations and in broader disciplines beyond IT service management. However, the design principles used in this study can be applied in other contexts beyond ITSM process assessments in the area of assessments of any general process-based management system, such as for COBIT in IT governance or in PMBOK or Prince2 methodologies for project management. Moreover, in practical terms, we do not claim that the SMPA approach can replace a formal and rigorous process assessment. The tool is developed with an intention to automate several activities of a standard process assessment and therefore enable organisations to repeatedly self-assess their processes for improvements rather than to assess via formal audit such as ISO/IEC 20000 certification.

In future, following repeated use of the tool, it will be possible to conduct a long-term outcome evaluation by observing the impact of the SMPA approach on service improvement. We believe the research has contributed towards achieving transparent and efficient process assessments with a well-structured design and development of the artefact. Future evaluation of the research will hopefully uncover more important implications for enhancement of the SMPA tool for process assessments.

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