
Analysing trust as a means of improving the effectiveness of the virtual supply chain

Ian Paterson, Heather Maguire*
and Latif Al-Hakim

Faculty of Business
University of Southern Queensland
TOOWOOMBA QLD 4350, Australia
E-mail: ianpaterson@hotmail.com
E-mail: maguireh@usq.edu.au
E-mail: hakim@usq.edu.au
*Corresponding author

Abstract: This article focuses on trust within interorganisational virtual organisations, which are regarded as legally separate but operationally interdependent companies focused on responding to a market opportunity and facilitated by ICT as a medium for communication and coordination. The context of the research described in this paper is the Australian meat and horticulture supply chains. Within the context of these two supply chains the perceived importance and perceived levels of 12 trust factors are investigated. The research identifies three trust factors demonstrating critical gaps between the expected performance level and the perceptions of actual performance common to the meat and horticulture supply chains. These factors were information sharing, reliability and work standard. Two other critical factors were identified in the meat supply chain, *i.e.*, timeliness and customisation, while three other critical factors were identified as specifically relating to the horticulture supply chain, *i.e.*, shared values, POS information and honesty and integrity.

Keywords: supply chain; virtual organisation; trust factors; gap analysis.

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Biographical notes: Ian Paterson has held senior positions in Australian agribusiness. Paterson graduated with a Doctorate in Business Administration in April 2007 from the University of Southern Queensland. His doctoral thesis was titled 'Trust and technology adoption in Australian agribusiness supply chains: a gap analysis approach'.

Heather Maguire lectures in management at the University of Southern Queensland. Her PhD investigating psychological contracting in the banking industry was awarded in 2001. She also holds a BEd, MBus and a MBA. Maguire has consulted for industry in a range of areas including the impact of change in the Australian finance sector and administrative process improvement within a range of industries. Maguire's research interests include trust, relational capital any psychological contracting, information management and corporate governance, and the concept of virtual organisations.

Latif Al-Hakim lectures in management in the Faculty of Business at the University of Southern Queensland, Australia. His experience spans industry, research and development and academic institutions. Dr. Hakim was awarded his undergraduate degree in 1968. His Masters (1978) and PhD (1983) were awarded by the University of Wales (UK). Dr. Hakim has published extensively in information management and systems modelling. He is the author and editor of seven books, more than ten chapters in books and more than 60 papers in various journals and conference proceedings. He has also consulted to a number of major industrial organisations in Australia.

1 Introduction

Dourma (1997) proposes that “internationalisation of markets, increasing complexity of new technologies and increasing speed of innovation are some of the key drivers that make competition hard at the single company level and call for a much deeper attention to the design and management of interactions among companies”. The need for such interaction has given rise to the ‘virtual’ organisation. The trend towards virtual organisations is particularly apparent within Australian agribusiness in response to industry deregulation and increasing demand for traceability from ‘paddock to plate’ (MLA, 2003a). Building effective and efficient virtual organisations such as the supply chains researched in this study is highly dependent upon trust. This paper examines the perceived level and perceived importance of trust within the Australian meat and horticulture supply chains with a view to developing a framework for improving the effectiveness of these two supply chains and of virtual organisations in the wider context.

2 Defining virtual organisations

A plethora of definitions of virtual organisations exist along with a wide range of alternative terminology such as “virtual corporation” (Byrne *et al.*, 1993), ‘virtual enterprise’ (Hardwick *et al.*, 1996), and ‘virtual company’ (Porter, 1993). Kasper-Fuehrer and Ashkanasy (2001) refer to the two approaches taken within the literature to defining virtual organisations as ‘intraorganisational’ and ‘interorganisational’. The research described in this paper is based on the interorganisational view of a virtual organisation, *i.e.*, where “business units of different organisations collaborate to form a cooperative form, namely a virtual organisation” (Greenberger and Wang, 2002; Kasper-Fuehrer and Ashkanasy, 2003; Klenn, 1994).

Many supply chains are becoming virtual organisations. This is evident in Australian agribusiness where Australian government policy has removed and deregulated many of the statutory bodies, which had marketed farm produce, leaving the private agribusiness sector, in most cases, to market Australia’s agricultural products (Keogh, 2004). The notable trend flowing from this deregulation and industry restructuring has been the growth in farmers operating as contracted parts of an integrated supply chain (Keogh, 2004). Traditional relationships between retailer, manufacturer, distributor and farmer have begun to change, with moves towards partnerships and alliances that have a greater emphasis on supply chain management (Thompson, 2001).

Supply chain management alters the strategy of companies and how they interact with each other. “The supply chain concept fundamentally changes the nature of organisations; control is no longer based on ownership and control, but rather on integration across the interfaces between function and companies” (van Hoek, 1998, p.187). Van Hoek’s description of the impact of supply chain management mirrors closely the description of a virtual organisation provided above.

In recent years the various Australian agribusiness sectors in the grain, meat, seafood, horticulture, wine, wool, sugar and cotton industries have consolidated to become larger enterprises and landholders. This rationalisation of the farm size is a direct reflection of “retailers seeking to deal with fewer, larger, technically efficient and innovative suppliers” (Fearne and Hughes, 2000, p.763). It has become very important within these increasingly *virtual* organisations that the size of the farming operation is “big enough to forge a sturdy alliance” with supply chain partners (Drabenstott, 2000, p.67).

The growing need for organisations to form virtual networks in order to compete has brought increasing attention to the concept of ‘relational capital’ defined by Gulati and Singh (1998) as “the value of a firm’s network of relationships with its customers, suppliers, alliance partners and internal sub-units”. Relational capital is underpinned by trust and the importance of trust to the establishment of strong relational capital amongst members of a virtual organisation forms the rationale for this paper.

3 The importance of trust to virtual organisations

Trust relates to the willingness of two or more partners to take the risk of relying on the exchange of another partner in whom they have confidence (Batt, 2003; Kwon and Suh, 2005; Mayer *et al.*, 1995; Moorman *et al.*, 1993; Sahay, 2003; Selnes, 1998; Wilson, 1995; Wu *et al.*, 2004; Zineldin and Jonsson, 2000). Trust in supply chain partnerships requires each partner to have a belief in the other partner not to take advantage of them (Batt, 2001a–b; Heffernan, 2004; Kwon and Suh, 2005; Lane and Bachmann, 2000; Zineldin and Jonsson, 2000).

To maintain a long-term partnership between supply chain partners Dapiran and Hogarth-Scott (2003) proposes that “a degree of trust is essential”. The commitment to building trust by supply chain partners is claimed to be a significant determinant in achieving successful supply chain partnerships (Heffernan, 2004; Kwon and Suh, 2005; Poirier, 1999; Sahay, 2003; Selnes, 1998; Wilson, 1995; Zineldin and Jonsson, 2000). Additionally, lack of trust in a supply chain is claimed by Poirier (1999) as “the single biggest obstacle to advancing supply chain improvement”.

Four types of trust have been suggested in the literature. Competence trust, contractual trust and goodwill trust were proposed by Sako (1992), whilst Styles and Hersch (2005) also referred to personal trust. These four categories of trust are important in assisting to solve a number of challenges, which are faced in attempting to form effective, mutually beneficial relationships within the interorganisational virtual organisation.

The first challenge is that the mix of cultures of the member organisations can pose a barrier to effective interaction. The firms comprising a virtual organisation are likely to display a range of intraorganisational cultures reflecting considerable differences in aspects such as risk tolerance, conflict tolerance, control, means–ends orientation, *etc.*

(Robbins *et al.*, 1997), which may hinder communication and cooperation. The establishment of personal and goodwill trust between member organisations reduces the potential negative impact of these intercultural difficulties throughout the supply chain.

Secondly, as described by Kasper-Fuehrer and Ashkanasy (2003) and Muthlein (1995) “Unlike most other forms of cooperation such as joint ventures or cartels, members of virtual organisations retain their legal and economic independence.” Such independence may increase doubts/fears that members of the virtual organisation will not act to the mutual benefit of other members. In the absence of a legal framework, contractual trust may act as “a substitute for traditional control mechanisms” (Ariss *et al.*, 2002; Jagers *et al.*, 1998; Kasper-Fuehrer and Ashkanasy, 2001; Styles and Hersch, 2005).

Related to contractual trust is the concept of competence/process trust, which refers to the partners’ confidence in the ability of partner organisations to fulfil their role to the required standard. Such confidence is built through demonstrated ability and, at least initially, reputation (Styles and Hersch, 2005).

The third challenge that may face the virtual organisation is the commonly accepted proposition that a virtual organisation commonly comprises “almost any association of people who are linked, not by face-to-face relationships but by sharing information through electronic networks” (Hunt, 2000, p.18; Weber, 2002, p.557). ICT, including mobile phones, e-mail, the internet, fax machines and other electronic devices, acts as a communication and coordination mechanism among partners (Malone and Rockart, 1993) but may, because of the lack of face-to-face contact, exacerbate the problems associated with establishing mutually beneficial relationships between independent entities displaying a range of organisational cultures. This increasing lack of personal contact between representatives of the member organisations of a virtual organisation needs to be combined with a high level of personal and goodwill trust between entities if communication is to be effective.

Despite the importance being placed on trust, limited research has been undertaken to assess the perceived *level* and perceived *importance* of trust within Australian agribusiness supply chains (Al-Hakim, 2005; Al-Hakim and Chua, 2005).

4 Investigating trust in Australian agribusiness

The selection of the meat and horticulture supply chains for this study was based upon their importance to the Australian economy and upon initiatives undertaken to improve trust and traceability between the virtual organisations comprising the entities making up these supply chains. The Australian meat industry is the second largest red meat exporter in the world. Over 71% of the beef production and processing in Australia is undertaken in Queensland and New South Wales (MLA, 2006a).

The Australian horticulture industry is a significant regional employer and is the fastest growing agribusiness sector representing the second largest primary industry after beef in Queensland (GROWCOM, 2006; QDPI, 2002a–b).

Numerous attempts have been made to build trust within Australian agribusiness. Many virtual organisations that are part of Australian agribusiness supply chains are members of various industry groups such as Meat and Livestock Australia, Horticulture Australia, and National Farmers Federation (HAL, 2007; MLA, 2007a; NFF, 2007). These industry groups collaborate with their members on industry issues and policies to

implement initiatives including those intended to build trust in the supply chain. Australian agribusiness organisations and industry groups also endeavour to build trust in their supply chain partnerships through negotiation/collaboration with local, state and federal governments on a range of issues that affect agribusiness such as international market access and free trade agreements, water and land resources management, environmental management, and import risks associated with plant and animal quarantine and biosecurity.

During 2006 the National Farmers Federation was instrumental in collaborating with the Australian government to enact a mandatory code of conduct between the horticultural growers and wholesalers under the Trade Practices Act 1974 (DAFF, 2007; NFF, 2006). The Australian government initiated the mandatory code of conduct to improve the transparency and clarity of transactions between horticultural growers and wholesalers of fresh fruit and vegetables. If successful, this initiative should improve trust within the horticulture supply chain.

The Australian beef industry sectors and industry groups, in collaboration with the Australian government, initiated the mandatory traceability system known as the National Livestock Identification System (NLIS) under government legislation (Queensland Government, 2005). NLIS traces cattle by using Radio Frequency Identification Devices (RFID) ear tags as part of a whole of life tracing system for cattle. This joint agreement between government and the meat industry supply chain to mandate the NLIS system has the potential to greatly improve *process trust* between the sectors in the beef industry supply chain through the ability to identify individual cattle throughout the supply chain (MLA, 2006b).

Virtual organisations forming part of meat and horticulture industry supply chain have collaborated in relation to ICT to help build trust through information sharing. The Australian meat industry initiated the Meat Standards Australia tenderness grading system for Australian beef to build trust between members of the supply chain and to guarantee consistency of end product quality (MLA, 2003a; 2007b).

The use of barcoding in the meat and horticulture industry is evolving to manage traceability by electronically identifying products in the supply chain from the producer to the retailer. The Australian meat industry has undertaken studies of supply chain partners using barcoding in the form of the European Article Number (EAN) system to trace product from the processor downstream to the next link in the supply chain to the retailer (Food Science Australia, 2006; MLA, 2001; 2003b; 2006c). The largest beef producer in Australia, Australia Meat Holdings is using a system titled QTRAC, which is an integrated system using barcoding technology that has the capability to track the cattle from the farm to the final retailer (AMH, 2007).

The Australian horticulture industry supply chain is moving towards more electronic identification of pallets, cartons, trays, and individual pieces of fruit and vegetables. Woolworths supermarkets required all their supply chain partners in the fruit and vegetable sector in 2005 to place GS1 barcodes on all pallets (GS1, 2007b; Woolworths, 2007). A working group is currently assisting the fresh fruit industry in developing, implementing and resolving any issues related to the uptake of the GS1 System and the supporting B2B, e-commerce and e-business (GS1, 2007a).

The use of electronic barcoding in both the meat and horticulture industry builds *process trust* through traceability together with improved quality and speed of information flow between the members of the virtual supply chain.

5.1 Confidentiality

Confidentiality has been proposed as an important factor in building trust between supply chain partners along with the sharing of secrets (Batt, 2001a–b; Moorman *et al.*, 1993; Sahay, 2003; Wong and Sohal, 2002).

5.2 Honesty and integrity

Honesty and integrity has been identified as one of the main factors in building and maintaining trust in supply chain partnerships (Batt, 2001a; 2003; Coulter and Coulter, 2002; Heffernan, 2004; Kwon and Suh, 2005; O'Malley and Tynan, 1997; Ruppel, 2004; Sahay, 2003; Selnes, 1998; Wu *et al.*, 2004; Yee and Yeung, 2002; Zineldin and Jonsson, 2000).

5.3 Work standards

Trust in a supply chain can be related to the members' competence or work standard, skill, knowledge and ability to fulfil a promise, agreement or obligation (Coulter and Coulter, 2002; Kwon and Suh, 2005; Mayer *et al.*, 1995; Selnes, 1998; Wu *et al.*, 2004; Yee and Yeung, 2002). Mutual trust between supply chain partners is built on the trust in, and acknowledgement of, the competence of the other partner to provide goods or services customised to their requirements (Batt, 2003; Coulter and Coulter, 2002; Heffernan, 2004; Kwon and Suh, 2005; Zineldin and Jonsson, 2000).

5.4 Politeness and friendliness

The trust factors empathy and politeness, together with being warm and friendly, can maintain and build trust when supply chain partners are involved in regular interaction (Coulter and Coulter, 2002).

5.5 Shared values

Supply chain partnerships are built on the trust that their partners pursue shared values or compatible goals (Batt, 2003; Coulter and Coulter, 2002; Dapiran and Hogarth-Scott, 2003; Sahay, 2003; Wilson, 1995; Wong and Sohal, 2002; Zineldin and Jonsson, 2000).

5.6 Experience and qualifications

Trust can also be established between supply chain partners based on the experience, professional qualifications or expertise of partner organisations relating to the manufacture of goods or provision of a services required (Coulter and Coulter, 2002).

5.7 Reliability

Trust in partnerships can be related to contractual trust where the partners' trust in each other is increased by continually delivering on promises of the contract. "Trust is developed by the partners doing what they said they would do" (Heffernan 2004, p.121).

Trust between partners is based on the knowledge the partners are reliable and will keep their promises to each other (Batt, 2001a–b; 2003; Heffernan, 2004; Kwon and Suh, 2005; Morgan and Hunt, 1994; Myhr and Spekman, 2005; Sahay, 2003; Schurr and Ozanne, 1985; Wong and Sohal, 2002; Wu *et al.*, 2004; Yee and Yeung, 2002; Zineldin and Jonsson, 2000). This trust factor is particularly important within the two agribusiness supply chains included in this study. As discussed previously these supply chains typify the virtual organisation with most agreements within the context of the meat and horticulture supply chain organisations included in this study being informal. In this case there is no protection for parties through a formal contract where retribution could possibly be sought for non-delivery on promises.

5.8 *Timeliness*

The promptness of a partner in reacting to another partner's request builds trust between the partners in the supply chain (Batt, 2001b; Coulter and Coulter, 2002; Selnes, 1998; Yee and Yeung, 2002).

5.9 *Customisation*

Trust between partners can be created by the supply chain partners adapting and customising business operations and providing alternatives to meet the specific needs of the other supply chain partner (Batt, 2001a; Coulter and Coulter, 2002; Heide, 1994; Zineldin and Jonsson, 2000). Collaboration between partners can enable the supply chain members to adapt and customise their supply chain practices, goods and services to fit their partner's business to provide improved performance for the supply chain (Coulter and Coulter, 2002; Zineldin and Jonsson, 2000). Trust in the supply chain can build relationship satisfaction, which can encourage partners to collaborate and adapt business processes, designs and planning of the goods and services, which are used in their supply chain (Zineldin and Jonsson, 2000).

5.10 *Information sharing*

Maintaining and building trust between supply chain partners relies on continued commitment to communication together with sharing information and planning (Batt, 2001a–b; 2003; Coulter and Coulter, 2002; Dapiran and Hogarth-Scott, 2003; Kwon and Suh, 2005; Myhr and Spekman, 2005; Ruppel, 2004; Sahay, 2003; Selnes, 1998; Wu *et al.*, 2004; Yee and Yeung, 2002; Zineldin and Jonsson, 2000).

6 Research methodology

The current research investigating the trust factors outlined in Table 1 was undertaken in three stages. Stage 1 involved an in-depth literature review to identify the factors of trust as outlined in the previous section. Two pilot case studies were conducted as part of the initial stage to trial the structured questions relating to the 12 factors of trust identified in Stage 1. Stage 2 employed a total of 36 cases studies, 18 from the meat industry and 18 from the horticulture industry. These case studies involved face-to-face interviews with senior managers from organisations located in the northern New South Wales and

Queensland regions of Australia. The 18 case studies in each industry were divided into six sectors with each sector represented by three case study organisations. This research design has made it possible for the meat and horticulture supply chain and each of the six sectors within these supply chains to be compared in relation to the perceived importance and perceived level for each of the factors of trust.

Stage 3 involved the data analysis. Data was entered into SPSS and overall, industry, sectoral and individual factor means for the perceived performance level (*level*) and expected performance level (*importance*) of trust in the two agribusiness supply chains were obtained. Gaps between level and importance of trust were then investigated. Critical gaps between the mean *level* and *importance* of each trust factor were also calculated using three methods of gap analysis (paired sample *t*-tests, mean weighted gap analysis and the mean unweighted Importance Performance Analysis (IPA)).

Three methods of gap analysis were utilised because the limited sample size for each industry and the limited number of organisations selected for each sector meant that results of the paired sample *t*-tests could be regarded as indicative only. Confirmatory analysis using both weighted and unweighted gap analysis was used to minimise subjectivity in relation to the selection of critical gaps.

7 Results

7.1 Demographic data

Over 50% of the case study organisations had annual turnover of over \$50 million. Almost 64% of respondents reported having informal partnerships with suppliers with another 25% stating that they had both informal and formal partnerships with suppliers. Similarly over 72% of respondents reported having informal partnerships with customers and a further 25% reported being involved in both informal and formal partnerships with customers. This lack of formal agreements within the case study organisations supports the categorisation of the two supply chains included in the study as virtual organisations and mandates the need for a high level of trust between the organisations comprising the two supply chains.

The categorisation of the two supply chains investigated in this study as virtual organisations is also supported by the apparent low level of personal contact between representatives of the various entities involved. All organisations involved in the case study interviews used computer technology. Almost 80% had a website for their organisation and over 91% stated that they regularly used the internet for research and information gathering. Only 2% of respondents reported that their organisations did not use e-mail. Seventy percent of the respondent organisations used teleconferencing and 22% regularly used videoconferencing. Fax usage had remained constant with 74% reporting that they still employed facsimile. Seventy-two percent of respondents indicated that the use of letters between industry partners was decreasing. Similarly almost 50% of respondents stated that face-to-face contact with other organisations was decreasing. Technologies introduced by government or industry to increase accountability within the two agribusiness supply chains involved showed varied user rates. Seventy-six percent employed barcoding while only 55% were currently using EAN.

7.2 *Perceived performance level (level) and expected performance level (importance)*

Means for perceived performance level (*level*) and expected performance level (*importance*) for each of the factors of trust were measured on a seven-point Likert scale ranging from 1 = Extremely Low to 7 = Extremely High. Means for the level and importance of each factor for (a) the meat industry (b) the horticulture industry and (c) overall are shown in Table 2.

Table 2 Means for the perceived performance level (level) and expected performance level (importance) of trust in the meat and horticulture industry supply chains

<i>Factors</i>	<i>Level</i>			<i>Importance</i>		
	<i>Meat</i>	<i>Horticulture</i>	<i>Overall</i>	<i>Meat</i>	<i>Horticulture</i>	<i>Overall</i>
Confidentiality	5.06	5.44	5.25	5.78	6.22	6.00
Honesty and integrity	5.67	5.50	5.58	6.61	6.44	6.53
Work standard	5.72	5.00	5.36	6.72	6.17	6.00
Friendliness	5.06	5.06	5.06	6.00	5.67	5.83
Shared values	5.56	5.06	5.31	6.44	6.00	6.22
Politeness	5.67	5.61	5.64	6.28	6.11	6.19
Experience and qualifications	6.00	5.61	5.81	6.61	6.22	6.42
Reliability	5.33	5.22	5.28	6.61	6.33	6.47
Timeliness	5.33	5.72	5.53	6.44	6.28	6.36
Customisation	5.17	5.39	5.28	6.33	5.94	6.14
Information sharing	4.83	4.78	4.81	6.22	6.33	6.28
POS information	4.06	4.50	4.28	5.06	5.78	5.42
Overall mean of the factors	5.29	5.24	5.26	6.26	6.12	6.19

The expected performance level (importance) was higher than the perceived performance level at (a) the combined industry level (6.19 versus 5.26), (b) the meat industry (6.26 versus 5.29), (c) the horticulture industry (6.12 versus 5.24) and for each individual factor. Whilst this may not be surprising, what does require further in-depth analysis is the difference in ratings for individual factors across industry and sector and the size of the gap between level and importance of each trust factor. ‘Work standards’ was regarded as the most important factor (mean = 6.72) within the meat supply chain whilst ‘honesty and integrity’ was regarded most highly (mean = 6.44) in the horticulture supply chain. Respondents from the meat industry perceived ‘experience and qualification’ (mean = 6.00) as the trust factor operating at the highest level whilst the horticulture industry regarded ‘timeliness’ (mean = 5.72) as the best performing trust factor.

Of greater interest than the overall industry results is an analysis of factor means amongst the six sectors of each supply chain because it is within the context of the relationships between organisations operating across the various sectors that trust is so important. This analysis is shown in Table 3.

Table 3 Sectoral means for the perceived performance level (level) and expected performance level (importance) for trust in the meat and horticulture supply chains

<i>Meat industry sectors</i>			<i>Horticulture industry sectors</i>		
<i>Sectors</i>	<i>Level</i>	<i>Importance</i>	<i>Sectors</i>	<i>Level</i>	<i>Importance</i>
MP [Meat producer]	5.14	6.14	HNS [Horticulture nursery and seeds]	5.08	6.11
MF [Meat feedlotter]	5.61	6.11	HG [Horticulture grower]	5.11	5.97
MA [Meat abattoir]	4.56	5.97	HP [Horticulture processor]	4.58	6.31
MW [Meat wholesaler]	4.72	6.28	HW [Horticulture Fruit market agent]	5.08	5.86
MB [Meat butcher]	5.83	6.44	HF [Horticulture fruit retailer]	5.17	6.17
MR [Meat restaurant]	5.86	6.61	HR [Horticulture restaurant]	5.78	6.33
Overall mean of the factors	5.29	6.26	Overall mean of the factors	5.24	6.13

Table 3 provides some interesting data. Firstly, as demonstrated in the overall industry data in Table 2 all sectors perceive that the current level of each trust factor of trust fell short of the expected level (importance). Secondly, the differences that can be observed between the level and importance of trust across the sectors of each supply chain, suggest a number of potential barriers to effective interrelationships. For instance the horticulture *processor* sector rates the importance of trust overall at 6.31 whereas the horticulture grower and the horticulture fruit market agent, *i.e.*, the likely upstream and downstream partners to the processor have considerably lower ratings for overall importance of trust (5.97 and 5.86). This situation is reflected in the ratings awarded to the perceived level of trust as well. A similar situation can be observed in relation to the meat abattoir sector and the meat feedlotter and meat wholesaler sectors. Additionally, the size of the gap between perceptions of importance and current levels of trust would indicate sectoral dissatisfaction with relationships with other members of the supply chain, *e.g.*, the horticulture processor rates the importance of trust at 6.31 but perceives the current level of trust to be only 4.58. The next section expands on the issue of the gap between perceptions of level and importance of trust.

7.3 Gap analysis

The next step in the data analysis involved the identification of those factors of trust, which demonstrated *critical gaps* between the expected performance level and the perceived performance level. Identification of these factors could provide organisations with an indication of which trust factors should take priority in relation to action to be taken in attempting to improve their relational capital.

7.3.1 Paired sample *t*-tests

The first step in the gap analysis involved testing for significant gaps between level and importance of trust. Paired sample *t*-tests revealed a significant difference between level and importance of trust for each individual trust factor within both the meat and the horticulture supply chain. However, because of the small sample size (18 respondents within each supply chain) the results of the paired sample *t*-test should be regarded as indicative only and would need to be confirmed through weighted and unweighted gap analysis. Results of the paired sample *t*-tests are provided in Table 4.

Table 4 indicates that there could be significant gaps between the level and importance of trust within each of the individual trust factors within the meat and horticulture supply chain.

Table 4 Paired *t*-test for significance difference in mean perceived performance level (level) and mean expected performance level (importance) of trust by factor in the meat and horticulture supply chains

<i>Paired samples (level and importance of each factor)</i>							
	<i>Paired sample test</i>			<i>Horticulture industry</i>	<i>Paired sample test</i>		
	<i>t</i>	<i>df</i>	<i>Sig. (2-tailed)</i>		<i>t</i>	<i>df</i>	<i>Sig. (2-tailed)</i>
<i>Meat industry</i>							
Confidentiality	-3.010	17	.008	Confidentiality	-3.289	17	.004
Honesty and integrity	-3.796	17	.001	Honesty and integrity	-3.308	17	.004
Work standard	-6.185	17	.000	Work standard	-4.123	17	.001
Friendliness	-4.274	17	.001	Friendliness	-2.829	17	.012
Shared values	-3.915	17	.001	Shared values	-3.610	17	.002
Politeness	-3.051	17	.007	Politeness	-2.474	17	.024
Experience and qualifications	-3.051	17	.007	Experience and qualifications	-2.829	17	.012
Reliability	-4.600	17	.000	Reliability	-4.370	17	.000
Timeliness	-4.370	17	.000	Timeliness	-3.344	17	.004
Customisation	-5.024	17	.000	Customisation	-2.397	17	.028
Information sharing	-4.415	17	.000	Information sharing	-4.507	17	.000
POS information	-2.838	17	.011	POS information	-3.465	17	.003

Indicative testing through paired sample *t*-tests was also conducted to investigate the possibility of significant gaps between level and importance of trust for the individual trust factors within the six sectors of each of the supply chains. These results should be regarded with caution because of the small sample size. Table 5 indicates that the meat abattoir sector may be experiencing difficulty in relationships with other supply chain entities. Indications of significant differences were found between expected level (performance) and perceived level (level) of three trust factors, *i.e.*, honesty and integrity, shared values and information sharing with supply chain partners. The data also suggested that particularly problematic areas might include customisation for the meat processing sector and information sharing for the meat wholesaler.

Table 5 Paired *t*-test for significance difference between the mean perceived performance level (level) and mean expected performance level (importance) of trust by factor in the meat industry – by sector

<i>Factors</i>	<i>Sig. (2-tailed) meat industry sectors</i>					
	<i>MP</i>	<i>MF</i>	<i>MA</i>	<i>MW</i>	<i>MB</i>	<i>MR</i>
Confidentiality	.270	.423	.423	.074	.423	n/a*
Honesty and integrity	.074	n/a	.038	.270	n/a	.184
Work standard	.184	.057	n/a	.184	.184	.225
Friendliness	.184	.423	.423	.057	.423	.184
Shared values	.423	.423	.038	.270	.423	.225
Politeness	.184	.423	n/a	.199	.423	.184
Experience and qualifications	.184	n/a	.184	.423	.225	.423
Reliability	.423	.423	n/a	.094	.225	.074
Timeliness	.225	.184	.225	.118	.225	.423
Customisation	.038	.184	.057	n/a	.184	.423
Information sharing	.057	.423	.038	.020	.423	.423
POS information	.270	.423	.188	.423	n/a	.225

Note: n/a* indicates that there was no difference in ratings applied to level and importance of trust.

Just as the meat abattoir sector would appear to be experiencing the most difficulty in relation to trusting relationships with other members of the supply chain, Table 6 indicates that the horticulture processing sector may find particular difficult in relating to partners with indications of significant difference found in relation to two trust factors, *i.e.*, honesty and integrity and reliability.

Table 6 Paired *t*-test for significance difference between the mean perceived performance level (level) and mean expected performance level (importance) of trust by factor in the horticulture industry – by sector

<i>Factors</i>	<i>Sig. (2-tailed) Horticulture industry sectors</i>					
	<i>HNS</i>	<i>HG</i>	<i>HP</i>	<i>HW</i>	<i>HF</i>	<i>HR</i>
Confidentiality	.423	.423	.225	n/a*	.270	.184
Honesty and integrity	.270	.423	.038	n/a	.300	.423
Work standard	.184	.184	.057	n/a	.074	.423
Friendliness	n/a	.057	.074	n/a	.423	n/a
Shared values	.118	.057	.225	n/a	.423	.423
Politeness	.423	.423	.130	n/a	.423	n/a
Experience and qualifications	.423	.423	.057	n/a	.184	n/a
Reliability	.184	.130	.038	n/a	.270	.423
Timeliness	.225	.184	.057	n/a	.423	n/a
Customisation	.423	n/a	.074	n/a	.225	.184
Information sharing	.192	.184	.095	.423	.038	.423
POS information	.423	.423	.208	.225	.184	.300

Note: n/a* indicates that there was no difference in ratings applied to level and importance of trust.

7.3.2 Weighted gap analysis

Once indicative data relating to the ‘critical gaps’ in trust factors had been attained from the paired sample *t*-tests, confirmatory gap analysis was undertaken. This involved first of all weighted gap analysis. The mean weighted gap for each trust factor was attained by multiplying the mean importance and the mean gap together. The weighted mean gaps for each factor within the meat and horticulture industry are provided in Table 7.

Table 7 Mean weighted gaps between perceived performance level (level) and expected performance level (importance) for trust factors within the meat and horticulture industry supply chain

<i>Meat industry</i>			<i>Horticulture industry</i>			
<i>Importance</i>	<i>Mean gap</i>	<i>Weighted gap</i>	<i>Trust factors</i>	<i>Importance</i>	<i>Mean gap</i>	<i>Weighted gap</i>
5.78	0.72	4.16	Confidentiality	6.22	0.78	4.85
6.61	0.94	6.21	Honesty and integrity	6.44	0.94	6.05 ₍₅₎
6.72	1.00	6.72 ₍₅₎	Work standard	6.17	1.17	7.22 ₍₃₎
6.00	0.94	5.64	Friendliness	5.67	0.61	3.46
6.44	0.89	5.73	Shared values	6.00	0.94	5.64
6.28	0.61	3.83	Politeness	6.11	0.50	3.06
6.61	0.61	4.03	Experience and qualification	6.22	0.61	3.79
6.61	1.28	8.46 ₍₂₎	Reliability	6.33	1.11	7.03 ₍₄₎
6.44	1.11	7.15 ₍₄₎	Timeliness	6.28	0.56	3.52
6.33	1.17	7.41 ₍₃₎	Customisation	5.94	0.56	3.33
6.22	1.39	8.65 ₍₁₎	Information sharing	6.33	1.56	9.87 ₍₁₎
5.06	1.00	5.06	POS information	5.78	1.28	7.40 ₍₂₎

Note: Numbers (1) to (5) indicate the factors with the highest weighted gaps in trust factors.

The five trust factors with the highest weighted gap between expected level (importance) and perceived level (level) within the meat industry supply chain were Information Sharing (8.65), Reliability (8.46), Customisation (7.41), Timeliness (7.15) and Work Standard (6.72). A comparison of the results shown in Table 4 (paired sample *t*-test) and Table 7 (weighted gap analysis) demonstrated that the factors with the five highest weighted gaps corresponded exactly with the five factors for which paired sample *t*-tests indicated a statistical significance level of .000.

The five trust factors with the highest weighted gap between importance and level within the horticulture industry supply chain were Information Sharing (9.87), POS Information (7.40), Work standard (7.22), Reliability (7.03) and Honesty and Integrity (6.05). As with the meat industry a comparison of the results for paired sample *t*-test analysis (Table 4) and weighted gap analysis (Table 7) shows that the five highest weighted gaps corresponded with the five factors for which paired sample *t*-tests revealed a statistical significance level ranging from .000 to .004 with one exception. Shared values which had the fifth strongest result for statistical significance did not make the top five in weighted gap analysis because it had the same mean gap as honesty and integrity

but the importance rating for honesty and integrity (6.44) was higher than that for Shared Values (6.00). Weighted gap analysis and IPA at sectoral level have not been reported in this paper because of word length restrictions and small sample size. It is proposed to perform this analysis when the survey is extended to a larger sample.

7.3.3 Importance performance analysis

The third step in the gap analysis used to identify the trust factors exhibiting critical gaps between expected performance level (importance) and perceived level involved the use of IPA to compare the unweighted *importance* and the unweighted *gap* for each factor. IPA was introduced almost 30 years ago (Martilla and James, 1977) and originally involved a procedure to show “the relative importance of various attributes and the performance of the firm, product, or destination under study in providing these attributes” (Hudson *et al.*, 2004). The IPA technique has been modified and developed over time and the modification of IPA used here employing importance and gap is similar to that used by Easingwood and Arnott (1991) who employed two dimensions, *i.e.*, current effect on performance (similar to importance) and scope for improvement (similar to gap within the current study).

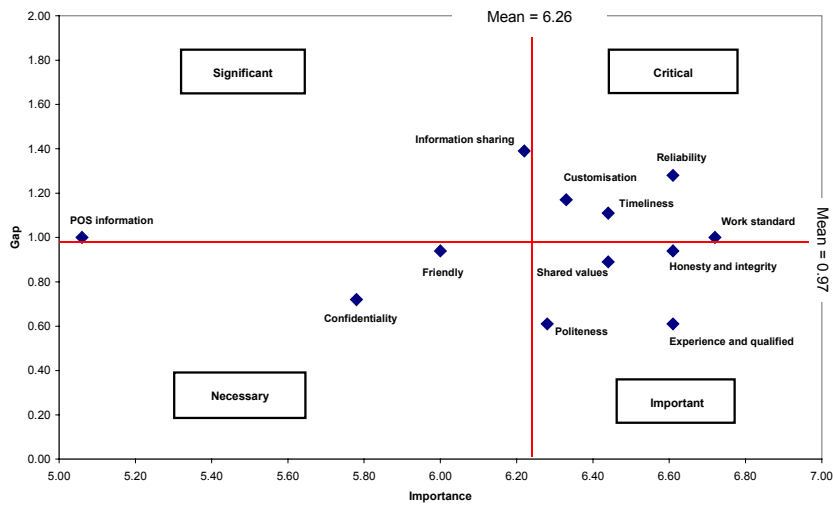
A matrix is used to graphically plot the two determinants of the factors using the unweighed *importance* and the unweighted *gap* between importance and perceived level. The graph is then divided into four quadrants to identify where each factor is located. These four quadrants can be labelled ‘Concentrate here’, ‘Keep up the good work’, ‘Low priority’ and ‘Possible overkill’. None of the factors of trust in the meat industry supply chain in this research fell into the ‘Keep up the good work’, Low priority’ or ‘Possible overkill’.

All factors of trust in the meat industry supply chain had gaps and therefore all fell into the ‘Concentrate here’ quadrant of this matrix. The ‘Concentrate here’ quadrant is concerned with factors that have a low performance or high gap, which needed to be improved. Factors in this sector represent those that need to be improved to provide customer/supplier satisfaction in the meat and horticulture industry supply chain. For this research, the ‘Concentrate here’ quadrant has again been divided into four quadrants to assist in identifying the critical gaps for the factors of trust in the meat and horticulture industry supply chain. These four quadrants have been labelled in order of the *improvement* required. The four improvement quadrants were labelled in order of priority, *i.e.*, ‘Critical’, ‘Significant’, ‘Important’, and ‘Necessary’. The quadrant cross hairs (Hudson *et al.*, 2004) on the graph have been determined by using the mean overall *gap* and overall mean *importance* of the 12 trust factors investigated within the context of the meat and horticulture industry. Figure 1 indicates that the 12 factors of trust in the meat industry all have gaps that require improvement and have been plotted on the matrix according to their mean unweighted *gap* and *importance*.

Factors which fell into the ‘critical’ quadrant represented those which should be addressed first as they are both high in importance and have demonstrated high gaps between perceived level and importance. Four trust factors fell into the ‘Critical’ quadrant of the graph, *i.e.*, they (a) had means above the overall mean (6.26) for trust within the meat industry and (b) had gaps exceeding the mean gap for the trust factors in the meat industry supply chain of .97. These factors were: ‘Reliability, Customisation, Timeliness, and Work standard’.

Factors belonging to the ‘significant’ quadrant should be addressed once critical issues have been addressed. These factors, although below the mean on importance have higher than average gaps between perceived level and importance and are thus likely to have a strong negative impact on supply chain relationships. There were two factors that fell into the ‘Significant’ quadrant. These factors were ‘Information sharing’ and ‘Point of sale information’.

Figure 1 Improvement area for the unweighted factors of trust in the meat industry supply chain



The ‘Important’ quadrant shows factors showing means exceeding mean importance of trust overall but with gaps between importance and level that fell below the overall mean gap. Because the gap is lower for these factors they could be addressed after the critical and significant factor issues have been addressed. These factors were: ‘Shared values’, ‘Honesty and integrity’, ‘Politeness’ and ‘Experience and qualification’.

The ‘Necessary’ quadrant captures factors demonstrating lower than average ratings for importance and gap. They must still however be addressed because their mean importance exceeds 5 (moderately high) and they do exhibit a gap between expected performance (importance) and perceived level. There were two factors of trust in the ‘Necessary’ improvement quadrant, which were: ‘Friendliness’ and ‘Confidentiality’. These factors demonstrated means less than the overall mean and gaps less than the overall mean gap.

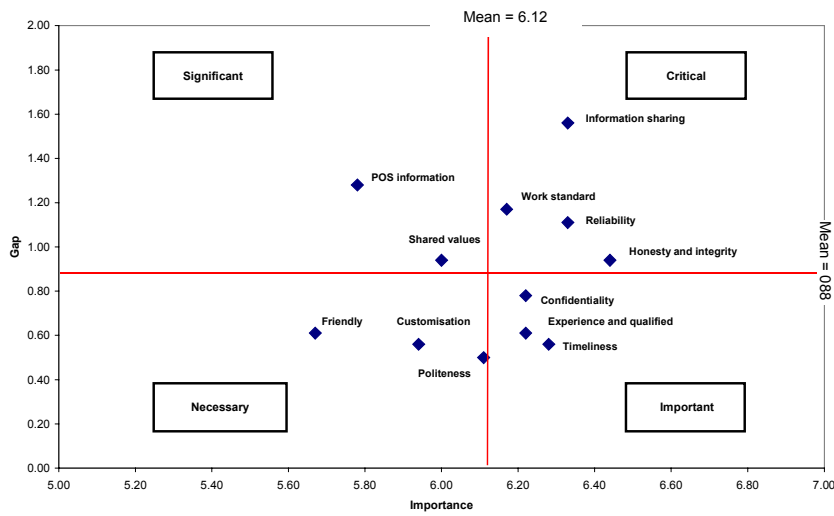
As with the meat industry all trust factors in the horticulture industry demonstrated gaps between importance and perceived level and therefore fell into the ‘Concentrate here’ quadrant, showing the need for improvement. Figure 2 shows the ‘Concentrate here’ quadrant divided into the four quadrants as for the meat industry and labelled: ‘Critical’, ‘Significant’, ‘Important’ and ‘Necessary’. The 12 factors of trust have been plotted on the matrix according to their mean unweighted gap and mean importance.

The improvement quadrant labelled ‘Critical’ shows four factors of trust that fell into this quadrant for the horticulture industry supply chain. These factors were: ‘Information sharing’, ‘Work standard’, ‘Reliability’, and ‘Honesty and integrity’. There were two

factors that fell in the ‘Significant’ improvement quadrant, which were: ‘Point of sale information’ and ‘Shared values’. The ‘Important’ improvement quadrant contained three trust factors, which were: ‘Confidentiality’, ‘Experience and qualification’ and ‘Timeliness’. There were three factors of trust in the ‘Necessary’ improvement quadrant, which were: ‘Friendliness’, ‘Customisation’ and ‘Politeness’.

Having discussed the two gap analysis theories for the factors of trust in the meat and horticulture supply chain, the next subsection discusses the factors of trust with critical gaps in the meat and horticulture industry supply chain.

Figure 2 Improvement area for the unweighted factors of trust in the horticulture industry supply chain



7.4 Identifying the critical gaps

There have been no universally accepted methods to select factors that have critical gaps other than the subjective selection method of selecting three to five of the factors with the highest weighted or unweighted gap or the strongest statistically significant difference in a research study.

This section has utilised results from the three analysis methods used in this research. The three analysis methods used were the paired sample *t*-test, the mean weighted gap analysis and the mean unweighted IPA matrix analysis. As previously mentioned results from the paired sample *t*-tests employed in this study must be regarded with caution because of the relatively small sample size. However, by using the two gap analysis methods to provide confirmatory analysis in combination paired sample *t*-test results, the assessment of the critical gaps in trust will be less subjective.

The selection criteria to determine the factors with the critical gap in trust were based firstly on the factors that had the strongest indicative results from the paired sample *t*-tests. The second criterion concerned the factors that were ranked within the six highest weighted gaps. The third criterion was based on the factors that fell within either the ‘Critical’ or ‘Significant’ improvement areas resulting from the IPA analysis. Table 8 provides a summary of the results from these three types of analysis.

By using this selection criteria, there were four clear critical gaps for the factors of trust identified in the meat industry supply chain which were: 'Reliability', 'Timeliness', 'Customisation' and 'Work standard'. These factors all fitted the 'Critical' quadrant of the IPA analysis, were ranked in the top five for the weighted gap analysis and had the strongest 2-tailed significance results from the paired sample *t*-tests.

A decision to include 'Information Sharing' as a factor displaying a critical gap was based on this factor displaying the highest mean weighted gap and the same result from the paired sample *t*-test as the other four 'critical' factors. Additionally this factor had failed to fit the 'critical' quadrant of IPA by only .04, *i.e.*, the mean importance for this factor was 6.22 compared to the mean for all factors of 6.26.

Results of the three types of analysis for the horticulture supply chain are provided in Table 9.

Table 8 Critical gaps between perceived performance level (level) and expected performance level (importance) for trust factors within the meat industry supply chain

<i>Considerations in determining critical gaps in the factors of trust in the meat industry</i>			
<i>Factors of trust in the meat industry</i>	<i>Paired sample t-test (Sig 2-tailed)</i>	<i>Ranked weighted gap factors</i>	<i>Improvement area</i>
Information sharing	.000	1	Significant
Reliability	.000	2	Critical
Timeliness	.000	3	Critical
Customisation	.000	4	Critical
Work standard	.000	5	Critical
Honesty and integrity	.001	6	Important
Shared values	.001	7	Important
Friendliness	.001	8	Important
POS information	.011	9	Significant
Experience and qualification	.007	11	Important
Confidentiality	.008	10	Necessary
Politeness	.007	12	Necessary

Table 9 Critical gaps between perceived performance level (level) and expected performance level (importance) for trust factors within the horticulture industry supply chain

<i>Considerations in determining critical gaps in the factors of trust in the horticulture industry</i>			
<i>Factors of trust in the horticulture industry</i>	<i>Paired sample t-test (Sig 2-tailed)</i>	<i>Ranked weighted gap factors</i>	<i>Improvement area</i>
Information sharing	.000	1	Critical
Reliability	.000	4	Critical
Work standard	.001	3	Critical
Shared values	.002	6	Significant
POS information	.003	2	Significant
Honesty and integrity	.004	5	Critical
Confidentiality	.004	7	Important
Experience and qualified	.012	8	Important
Timeliness	.004	9	Important
Friendliness	.012	10	Necessary
Customisation	.028	11	Necessary
Politeness	.024	12	Necessary

Four trust factors were shown clearly as having critical gaps in the horticulture industry supply chain, which were: 'Information sharing', 'Work standard', 'Reliability' and 'Honesty and Integrity'. These four factors had strong results from the paired sample *t*-tests (all below .005), were ranked in the first six factors using weighted gap analysis and met the criteria for the critical quadrant of the IPA.

Two other factors were deemed to display critical gaps in the horticulture industry supply chain based on their meeting two of the three criteria. The 'POS information' trust factor was selected as it had an indicative statistically significant difference of .003 with a mean weighted ranking of two and fell within the 'Significant' improvement area. The next factor of trust selected was 'Shared values', which had an indicative statistical significant difference of .002 with a mean weighted ranking of six and fell in the 'Significant' improvement area.

The research has shown that the meat and horticulture industry had three common critical gaps in trust being information sharing, reliability and work standard.

Virtual organisations rely heavily on information sharing and this critical gap could have significant implications from the source of production through to the end retailer and restaurant in the supply chain. This critical gap in information sharing in both meat and horticulture supply chains could result from differences in the business culture of how much and how often information is shared between supply chain partners. Also the business culture may be fearful of sharing confidential information which can reduce information flow. The use of more ICT in the supply chain correlates with less face-to-face interaction, which may exacerbate cultural differences and lower personal mutual trust restricting information flows.

Another critical gap common to both supply chains was reliability. This gap results from partners in the supply chain not keeping their promises and/or delivering on time. Because of the lack of formal agreements in virtual supply chains, perceived reliability is imperative to ensuring efficient supply, effective communication and to partners keeping their word on agreements. A critical gap in work standards was also common to both supply chains. This gap may be related to differing cultures across the individual organisations and sectors of the supply chains and is likely to impact on both competency and process trust.

Other critical gaps of importance to the meat industry were timeliness and customisation. This critical gap can impact on the supply chain through lost business and market opportunities, slow product development to market and a reduction in market share allowing competing food supply chains to take advantage of this weakness. The critical gap in customisation in the meat industry supply chain could indicate that partners are resistant to greater collaboration and to showing goodwill trust with some partners in relation to specific products or services they request. Conversely this situation may point to a reluctance of supply chain partners to collaborate, retaining their independence at the expense of a more efficient supply chain.

Three critical gaps were noted in the horticulture industry, apart from the gaps common to both supply chains. These gaps related to shared values, POS information and honesty and integrity. The consequence of supply chain partners in the horticulture industry not having shared values and goals could contribute to issues with product and service quality, production capacity, profit expectations and business culture overall. The critical gap in POS information concerns competence and process trust. This critical gap

can lead to inventory shortages and subsequent delays in delivering inventory to the retail customers. The consequence of a critical gap in perceptions of level and importance of honesty and integrity between supply chain partners may lead to significant breakdown in relationships and daily negotiations. The introduction of a mandatory code of conduct legislated in December 2006 between horticultural growers and fruit and vegetable wholesalers may help reduce this critical gap.

8 Conclusion

The current research has investigated the role of trust in virtual organisations by analysing the perceived level and the perceived importance of 12 trust factors within the context of the Australian meat and horticulture supply chains. The paper draws on the literature to justify the categorisation of these two supply chains as virtual organisations.

The specific purpose of the study was to identify those factors of trust, which demonstrated critical gaps between perceived level and importance. It was felt that identification of these factors would provide a platform for improving relationships within the two selected supply chains and within virtual organisations in the wider context.

A combination of paired sample *t*-tests, weighted gap analysis and importance performance analysis was used to analyse data collected from 18 organisations operating across six sectors of each supply chain. Key findings of the data analysis relate to the differences in perceived importance of the trust factors across the two supply chains but more importantly between sectors comprising those supply chains. These differences were subjected to the three analysis methods listed above and 'critical' gaps were identified as those which (a) had strong indicative statistical significance from the paired sample *t*-tests, (b) ranked highly in the weighted gap analysis and (c) belonged within the 'Critical' quadrant resulting from the IPA analysis.

The study identified three critical gaps in trust factors common to the meat and horticulture supply chains. These factors were information sharing, reliability and work standard. Information sharing and reliability rated as the two most critical gaps within both supply chains. Two other critical factors were identified in the meat supply chain – timeliness and customisation. Shared values, POS information and honesty and integrity were identified as additional critical gaps within the horticulture supply chain.

While these results may raise awareness and provide a platform for improving relationships between the virtual organisations examined in this article, further research is needed with a much larger sample so that valid data can be provided in relation to critical gaps in trust between the sectors. Extension of the study employing a larger sample to compare parallel supply chains of virtual organisations in the same industry may also prove useful to the industry and extend the literature base in this increasingly important area. The sample size employed in the current study together with underlying cultural differences within and between virtual organisations in different industry sectors prevent the results from being generalised to virtual organisations in other industries. The methodology undertaken in this study could, however, be employed by individual entities within the virtual organisations included in this study so that, at the organisational level, management can identify strategies for improving their relational capital through building and improving trust between themselves and their supply chain partners.

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