THE IMPACT OF KNOWLEDGE MANAGEMENT IN MANUFACTURING ON CUSTOMER VALUE

C J TONKIN

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UNDER THE RULES IN OPERATION AT THE TIME OF EXAMINATION THIS RESEARCH REPORT WAS AWARDED THE FOLLOWING CLASS OF MARK: A

MEANING OF CODES:

A 75 - 100%
B 70 - 74%
C 60 - 69%
D 50 - 59%

THE IMPACT OF KNOWLEDGE MANAGEMENT IN MANUFACTURING ON CUSTOMER VALUE

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A research report submitted to the Faculty of Management, University of the Witwatersrand, in partial fulfilment of the requirements of the degree of Master of Business Administration

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Abstract

The objectives in this research were to determine how knowledge management, when applied to core manufacturing business processes, may impact on customer satisfaction ratings, or higher repeat business or increased sales from new products. The defined core manufacturing business processes are product development, supply chain management and process improvements.

This research involved six global manufacturers in the United States and South Africa. It is shown from the research findings that where a manufacturer adopts a knowledge-orientation in its core manufacturing business processes, this can meaningfully support improved customer value indices, in particular customer satisfaction. It was found that knowledge optimisation happens mostly when applied to process improvements. Yet, knowledge creation seems not to be implemented in product development or supply chain management or customer value learning practices. These would be the greatest leverage points for future growth of global manufacturing organisations.

Declaration

I declare that this research is my own, unaided work. It is submitted in partial fulfilment of the requirements of the degree of Master of Business Administration at the Faculty of Management, University of the Witwatersrand. It has not been previously submitted for any degree or examination at any other university.



Caesar Tonkin **4 November 1999**

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Chapter One Introduction

Knowledge management *status quo*

Knowledge management is new for most organisations worldwide and is operational mainly in the financial, services and information technology sectors (Neef, 1999; O'Dell, 1999; Orr, 1999). The "early adopters", for example, include Andersen Consulting, British Petroleum, Buckman Laboratories, Chapparel Steel, Chevron Energy Corporation, Hewlett Packard, McKinsey & Company, Sequent Computers, Skandia Insurance, The Dow Chemical Company, and Xerox Corporation. In these organisations, knowledge management practices have focused on intellectual asset valuation, process improvements, and information management (Sveiby, 1997).

Some manufacturing organisations have achieved significant business benefits such as improved productivity, or cost savings, or faster cycle times, or better technical approaches to processes, or increased sales from new products, or even increased customer satisfaction ratings (Burlton, 1999; Michuda, 1999). In particular, some of these benefits have been achieved by Buckman Laboratories, Xerox Corporation, A T & T, and Chevron Energy Corporation.

The importance of the research

There is a need to consider how knowledge management may impact on manufacturing strategy, systems and performance, and understand what this means for creating ongoing customer value (Basu and Wright, 1997;

Khurana, 1999). There is also a need to assess how knowledge management may influence core manufacturing business processes, such as product development, supply chain, and process improvements.

Further, applying Woodruff's model (1997) **"Translating Customer Value Learning Into Action"**, there is need to understand how customer value learning may be impacted when applying a knowledge-orientation to core manufacturing business processes.

The research findings are important as the results may enable manufacturing organisations to position their knowledge management initiatives accordingly, for example:

- As a way of sharing knowledge and best practices.
- Capturing and re-using past experiences.
- Embedding knowledge in products, services and processes.
- Producing knowledge as a product.
- Using knowledge to drive knowledge creation.

In this regard, the emphasis in future winning organisations will be on how best to manage and create profit streams from information around what customers value, in a dynamic and time-based competitive environment (Neef, 1999), and where mass customisation is becoming increasingly important (Oliver, 1999; Zeleny, 1996).

Research problem

This research has arisen because of the increasing awareness of knowledge management as a fundamental business model (Davenport, 1998; O'Dell and Grayson, 1998; Sullivan, 1997). Managers in manufacturing organisations need to understand how knowledge management can influence their existing business model (Li and Calantone, 1998). From this research, managers in manufacturing organisations will have an increased understanding of how a knowledge-orientation, when applied to core manufacturing processes, can position the organisation to leverage ongoing customer value in dynamic business settings.

Research objectives

Therefore, the research objectives are to:

1. evaluate how a knowledge-orientation in manufacturing influences *core customer value learning.*
2. evaluate how a knowledge-orientation in manufacturing *product development* influences customer value indices.
3. evaluate how a knowledge-orientation in manufacturing *supply chain management* influences customer value indices.
4. evaluate how a knowledge-orientation in manufacturing *process improvements* influences customer value indices.
5. construct a knowledge-orientation model in manufacturing with emphasis on customer value.
6. explore future roles of knowledge management in manufacturing with emphasis on customer value.

Limitations of the research

This research has certain limitations, including those listed below:

- The research findings can be generalised to the 6 participating organisations, though not to global manufacturing organisations *per se*.
- The researcher is aware that in some cases the respondents were not fully competent to answer all questions. Therefore, the questionnaire responses are treated in this research as statements by others reflecting varying degrees of truth (Cooper and Emory, 1995).
- Though the respondents were asked to judge the outcome of the application of knowledge sharing to manufacturing practices, causation is not significantly measured.
- As the research methodology is quantitative, the rich contextual nature of knowledge-sharing practices and organisational processes have not been explored.

Subsequent chapters

Subsequent chapters in the research report are sequenced as follows: The literature review in Chapter 2 focuses on a review of core business processes in manufacturing, core customer value learning practices, and core knowledge-orientation practices. In Chapter 3, the research methodology is presented, in particular, the research objectives, propositions, data gathering techniques, and data analysis methods and statistical techniques. In Chapter 4, the findings from the data analyses are presented using Correspondence Analysis, Pearson's Correlation Analysis, and the Two-Sample t-test. Ordinal

data in a Likert scale questionnaire have been rescaled into interval data in order to perform these statistical techniques. An evaluation of the findings is presented in Chapter 5, including the implications and interpretations in relation to the literature review. Lastly, the conclusions from the research report are presented in Chapter 6.

Chapter Two Literature Review

Introduction

The literature review covers three areas including manufacturing, knowledge management and customer value. From the literature review it is important to identify core manufacturing business processes, as well as core knowledge management and customer value processes. This will aid in understanding how a knowledge-orientation may conceptually influence core manufacturing business processes and customer value learning. Selected core business processes in manufacturing will be evaluated against a framework for knowledge processes, and their concomitant impact on customer value indicators. A framework will be shown later on as an assimilation of the literature findings. The findings serve as further input into designing a knowledge orientation model for manufacturing. This research process is shown in Fig.1 below:

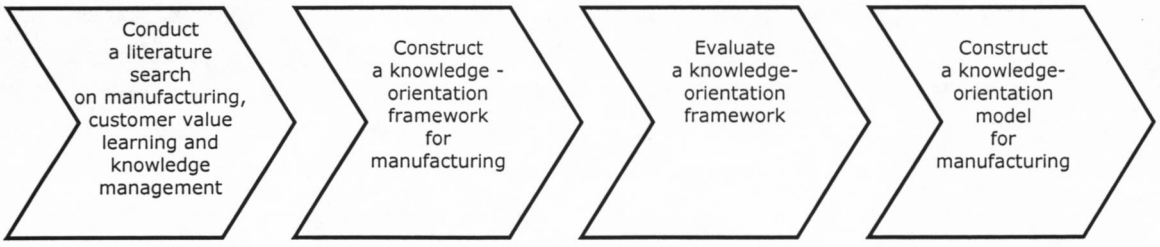


Fig. 1

Constructing a knowledge-orientation framework for manufacturing

Source: Discussions with Professor Neil Duffy (April, 1999)

Core business processes in manufacturing

This part of the literature review aims to identify core business processes in manufacturing and understand how knowledge management, when applied to selected core manufacturing business processes, impacts on customer value indicators. In order to arrive at core manufacturing business processes, it is important to understand the context and meaning. This is done by commenting on areas such as manufacturing strategy and performance objectives, world-class manufacturing, and manufacturing effectiveness and efficiency.

Manufacturing strategy and performance objectives

Maruchek, Pannesi and Anderson (1992, p. 93) define *manufacturing strategy* as a "collective pattern of co-ordinated decisions that act upon the formulation, reformulation and deployment of manufacturing resources and provide a competitive advantage in support of the overall strategic initiative of the firm or SBU". Thereto, sustainable competitive advantage in manufacturing in the future will be based on a shift in mindset from a cost focus to high quality, business perspective, time-based competition, mass customisation, shorter product life cycles, and flexibility (Oliver, 1999). It is no surprise then that several authors argue that manufacturing should take on a more strategic role in business.

Typically manufacturing should encompass business strategy, marketing, manufacturing, research and development, engineering, and sales (Shapiro,

1977; Skinner, 1969). Often these functions have incongruent goals based on their functional rewards (Crittenden, 1992; Maruchek, Pannesi and Anderson, 1992; Platts and Gregory, 1992; Shapiro, 1977), as opposed to business performance measures, such as customer value. In this regard, a key question, according to Platts and Gregory (1992, p. 42), is: "What are the requirements imposed upon manufacturing by the way products win orders in the market?". Perhaps the adoption of a knowledge-orientation by global manufacturers in the future will be the way orders will be won.

Further, Skinner (1992) lists several *manufacturing performance objectives* such as: cost, efficiency, productivity; delivery lead times; quality; service, reliability; flexibility for product change; flexibility for volume change; and the investment required in the production system. A manufacturing strategy is effective when certain key performance objectives are implemented (Pycraft, Singh and Phihlela, 1998; Skinner, 1992). Skinner (1992, p. 25) comments: "What is needed are new manufacturing strategies which innovate entirely new integrated structures and create a true manufacturing enterprise".

World-class manufacturing

Roth, Giffi and Seal (1992, p. 137) state: "World-class manufacturers have a common attribute, namely that they are able to create high-value products and services, and earn a superior return over the long run through the application of competitive manufacturing strategies that win orders in the marketplace".

These authors identified several critical operating principles in manufacturing, as is shown in Fig.2 below:

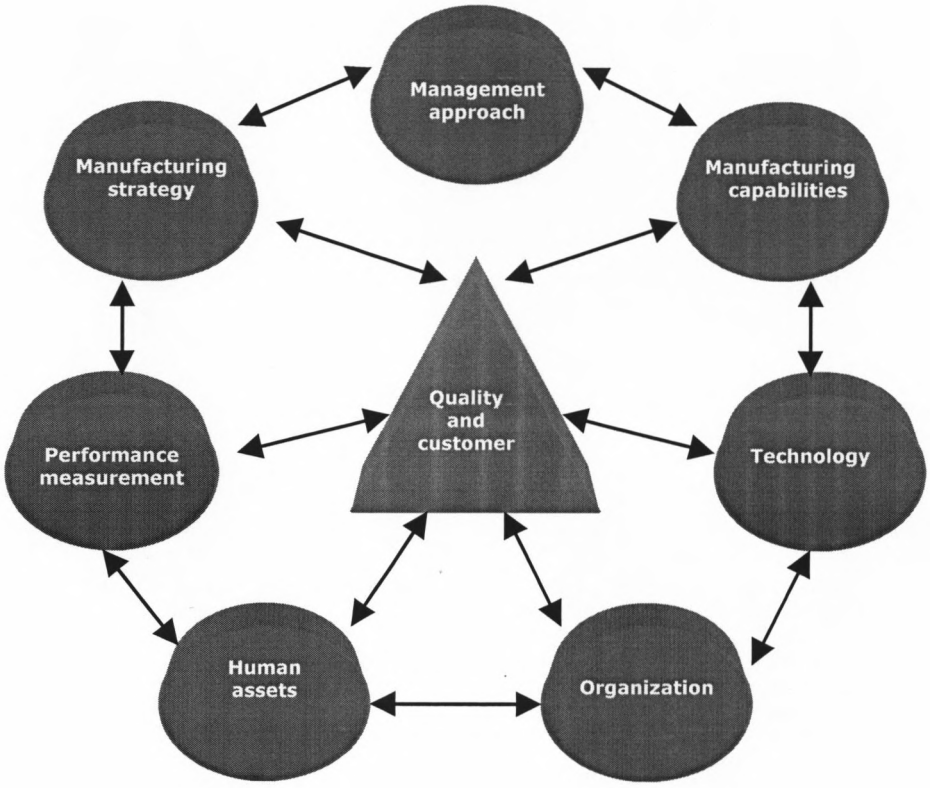


Fig. 2

World-Class Manufacturing Framework

Source: Roth, Giffi and Seal (1992, p.138)

Vermeulen (1998) tested this model amongst several world-class manufacturers in South Africa. He found that those organisations that have successfully implemented world-class manufacturing have also achieved better business performance. Roth, Giffi and Seal (1992) found that achieving customer satisfaction and unique close customer relationships, understanding manufactured products and processes, and quality are important areas in the

implementation of world-class manufacturing. Vermeulen (1998) reached similar conclusions.

Of relevance to knowledge management in manufacturing, Roth, Giffi and Seal (1992, p.153) comment: "World-class companies have not only discovered the existence of this (human) resource, but have found ways to capture it effectively as well." They comment that world-class manufacturers adopt a balanced perspective to managing competition, creating unique value for customers, and creating knowledge.

Further, Basu and Wright (1997) argue that the success of a **"Total Manufacturing Solutions"** approach encompasses "six pillars", as is shown in Fig.3 overleaf:

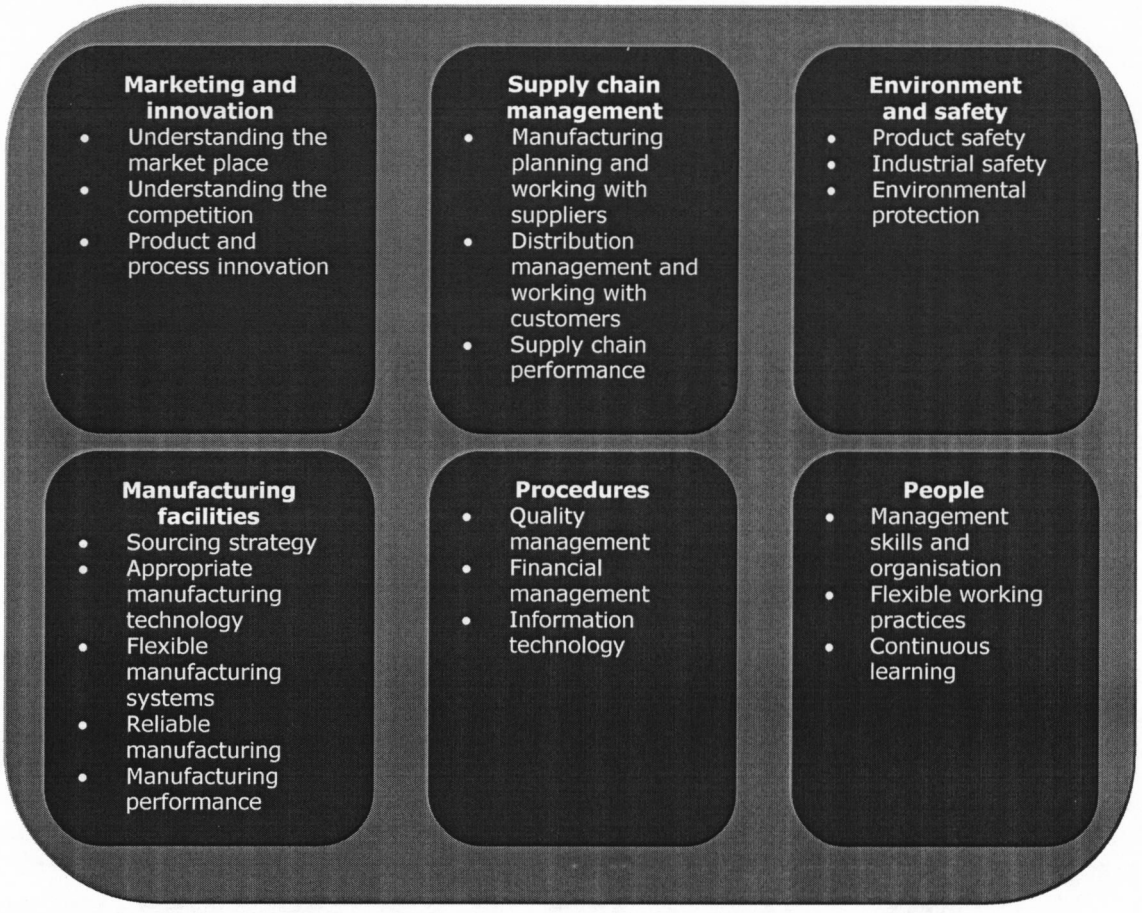


Fig. 3

"Total Manufacturing Solutions"

Source: Adapted from Basu and Wright (1997, p.5)

The authors suggest that these pillars are integrated in a holistic understanding of business processes, and are interdependent. In this regard, it is important to determine whether knowledge management practices may result in improved customer relationships, and achieving business performance objectives, and creating and sustaining customer value.

Manufacturing effectiveness and efficiency

Basu and Wright (1997) suggest that manufacturing performance comprises both manufacturing effectiveness and manufacturing efficiency. *Manufacturing effectiveness* is concerned with planning, inventory management, safety, environment, product quality, training, customer service, quality, and innovation. *Manufacturing efficiency* is concerned with labour productivity, materials productivity, energy efficiency, and plant efficiency.

Skinner (1986) argues that manufacturers should focus on effectiveness such as business strategy, customer service, delivery lead times, quality and asset turns, whilst also focusing on efficiencies such as increasing manufacturing productivity, reducing costs. Skinner (1986, p. 58) argues: "As long as cost and efficiency are the primary measurements of factory success, the manufacturing plant will continue to repel many able, creative people". This is an important aspect when building core organisational capabilities that are aligned to a knowledge management strategy.

Manufacturing "best practices" are characterised by technically competent managers, multiskilled shopfloor employees, multi-functional problem solving (Basu and Wright, 1997; Kasarda and Rondinelli, 1998; Khurana, 1999; Pilkington, 1998), and more meaningful reward systems (Crittenden, 1992). Basu and Wright (1997, p. 96) comment: "However, it is important to note that factories in the future will require fewer people, but people with technical knowledge".

Additional considerations with regards to manufacturing "best practices" include:

- the drive towards advanced or lean manufacturing systems.
- flexible manufacturing systems, such as product design, production
- technology and process orientation (Chambers, 1992; Suarez, Cusumano and Fine, 1995).
- mass customisation (Oliver, 1999; Pilkington, 1998).
- cellular manufacturing.
- pull systems, such as just-in-time, low inventories, short set-ups, and make-to-order.
- focused factories (Skinner, 1974).
- total quality management, such as statistical process control.
- computer-integrated manufacturing (Khurana, 1999).

Further, the drive towards "best practices" encompasses a meaningful understanding of core processes and technologies in manufacturing. Advanced manufacturing systems and technology can be used to increase business agility and customer responsiveness (Kudpi and Pati, 1996; Pycraft, Singh and Phihlela, 1998). Kudpi and Pati (1996) argue that advanced manufacturing systems can have a high impact on intermediaries in product customisation because of the drive for higher quality and shorter lead times. Co-ordination in the channel could then increase as buyers and sellers would share meaningful data (Kudpi and Pati, 1996).

Summation

In sum, manufacturing strategy should be integrated into business strategy. Manufacturing measurements include effectiveness and efficiency, as is shown from Basu and Wright's (1997) framework. Lastly, there are specific manufacturing "best practices" that lead to higher business performance.

The discussion from here is on **selected core business processes in manufacturing, such as, product development, supply chain management and process improvements**. These are important, because when managed to include knowledge sharing, they may have an impact on creating and extracting customer value (Basu and Wright, 1997; Khurana, 1998; Woodruff, 1997).

Product development

Innovation is important to organisations that regularly design and manufacture products. Those companies that continuously increase their sales from new products are market leaders (Kanter, Kao and Wiersema, 1998).

Leonard (1998) states: "The primary engine for the creation and growth of technological capabilities is the development of new products and processes". She explored new product development from a knowledge management perspective as a means to sustaining competitive advantage. Her thesis is that core technological capabilities in manufacturing organisations rest within a system comprising competencies and skills, knowledge embedded in physical

systems and processes, and managerial systems and practices that reinforce knowledge creation and sharing.

Creating new products, new processes or new processes is a way of creating ongoing customer value and retention. Information and knowledge are shared for the greater good of the organisation in innovative cultures. Kanter, Kao and Wiersema (1998, p. 20) comment: "The secret is building that bridge between the idea and its commercial viability". Ultimately though, new knowledge and learning have to be captured and disseminated.

Innovation happens in companies because of the ongoing feedback loop from customers in order to improve product development and refinement and order fulfilment (Kanter, Kao and Wiersema, 1998). Drucker (1998a, 63) writes: "It can be predicted that the main challenge to information technology in the next 30 years will be to organize the systematic supply of meaningful outside information". A key principle then is to identify the sources of innovation. O'Dell and Grayson (1998, p. xii) comment: "Only those organizations that methodically, passionately, and proactively find out what they know, and use it to increase efficiency, sharpen their product-development edge, and get close to their customers, will not only survive, but excel".

Further, based on empirical research on market knowledge competence and product development, Li and Calantone (1998) found that three processes are important: a customer knowledge process, a competitor knowledge process, and the marketing-research and development interface. They concluded that

customers could play an important part in new product development, for example, by assessing technology feasibility in order to reduce investment risk. They comment further that: "A customer learning process may offer firms a solution to the changing markets by collecting and processing information (Li and Calantone, 1998, p.27). Clearly then, knowledge is intrinsic to high performance and innovation in manufacturing (Madhavan and Grover, 1998; Ittner and Larcker, 1997).

Therefore, the business imperative is to grow the organisational explicit and tacit capabilities, whilst ensuring that core rigidities do not stifle the organisation. Core rigidities are "knowledge-inhibiting activities", and take the form of limited problem-solving or an inability to innovate, or limited experimentation or screening of new knowledge (Leonard, 1998). Important sources of technological knowledge include: customers, national laboratories, suppliers, competitors in the same or different industry. As Leonard (1998, p. 211) notes: "Importing knowledge from the market is clearly an essential activity in the design of a range of product lines - including some that meet current demand and others that anticipate future customer needs". Innovation in organisations is about creating new knowledge and information in order to redefine problems and solutions and recreate the environment (Nonaka and Takeuchi, 1995).

Team development between research and development and customer contact employees is important for innovative product development and creating customer value. Blurring of job roles, encouraging initiative and building trust

cross-functional relationships are fundamental principles that enable fruitful knowledge sharing (O'Dell and Grayson, 1998). Thus the shift towards stewardship-type leadership where dialogue around customer value becomes the focus, as opposed to positional power (Block, 1993; O'Dell and Grayson, 1998).

Madhavan and Grover (1998) researched new product development as a knowledge management process. They proposed that trust in team orientation, trust in technical competence, information redundancy, and personal interaction ensure the effective and efficient creation of new knowledge. They see that new product development teams possess embedded knowledge, whereas the new product possesses embodied knowledge. It is the organisation's task to manage the transition from embedded to embodied knowledge. This has an important bearing on teams that create new products or product refinements across many global locations. This may help in answering the question: How do employees build virtual trust relationships? Informal networks, shared mental models (Senge, 1990), new product development routines, and face-to-face contact are important in this light (Madhavan and Grover, 1998).

Innovative organisations have an open culture, embrace ambiguity and conflict, encourage employees to experiment, and adopt a borderless multi-functional organisational structure (Kanter, Kao and Wiersema, 1998). Similarly, Drucker (1998) feels that organisations should design teams to become entrepreneurial and innovative.

The next selected core business process in manufacturing that will be discussed is supply chain management.

Supply chain management

A critical opportunity exists whereby knowledge amongst supply chain partners can be leveraged to create ongoing customer value. Basu and Wright (1997), as well as Clemon and Row (1993), suggest that the opportunity for building shared knowledge and learning within the supply chain is high, as opposed to relying on intuition. Basu and Wright (1997, p. 55) comment: "Supply-chain management asks us to see with new eyes: to see customers and suppliers as part, and indeed partners, in our overall production process. As partners both suppliers and customers, can be, and should be, involved in the planning process".

Strategic partnering or alliances are created to find further ways to add value to customers. "Customer value is created by directing the entire efforts of an organization and its networks of alliance partners and suppliers towards that aim" (Knox and Maklan 1998, p. 38).

Davis (1993) argues that uncertainty in the supply chain exists with suppliers, manufacturing, and customers. Participants are sometimes customers, and at other times, suppliers (Laseter, 1998). They would share resources and expertise within an integrated system (Stuart, Deckert, McCutcheon and Kunst, 1998). These need to be strategically managed using value-adding quantitative and qualititative techniques in the supply chain.

In this research it is important to evaluate whether a knowledge-orientation will help in supply chain analyses. Perhaps this is a major opportunity to build leveraged learning networks in the supply chain.

Laseter (1998, p. 10) argues: "Setting improvement targets, structuring incentives, and investing in supplier development all play a role in finding the right balance". Often this implies sharing knowledge of competency, capabilities, cost structure, risk factors, and partnership potential (Laseter, 1998). Certain key principles are useful such as: structuring the supply web based on strategic objectives and competencies, applying consensus-based forecasts and cross-functional planning processes; and planning resources against forecasts, but allowing orders to move products through the supply web (Laseter, 1998). The real benefit from the supply web comes from integrating suppliers in innovation in terms of scope boundaries, technology planning and customer-driven target costing (Laseter, 1998; Robertson and Ulrich, 1998).

This implies that the supplier adds value through innovation and product development. Billington, Lee and Tang (1998) suggest that manufacturers should find ways to reduce product risk when designing new products and managing life cycles of existing products. Risk factors may include: customer base characteristics, accessibility of information, market competitiveness, technology change and supply chain responsiveness.

Oliver (1999) suggests that as manufacturers drive towards zero inventory holdings, so there is a need to increase "value added logistics". This

is value that is added at the latest possible moment before the customer receives the product. In essence it is about reducing the supply chain disruptions to create what Oliver (1999) calls "seamless supply chain" management. He suggests that there is a need to harmonise information standards and interfaces within the supply chain and value system. As Oliver (1999, p. 11) notes: " . . . new levels of inventory information must be closely coupled with corporate information systems in marketing, manufacturing, purchasing, and even in some cases human resources".

Effective inventory and capacity planning with suppliers, based on understanding customer value drivers, will reduce manufacturing costs and increase gross margin (Oliver, 1999). An underlying principle in manufacturing should be to drive value in the internal operations and value chain, in order to match the unique value propositions for customers in a dynamic time-based competitive market (Clemons and Row, 1993; Sullivan, 1998; Porter, 1986; Treacy and Wiersema, 1995).

The final selected core business process in manufacturing that will be discussed is process improvements.

Process improvements

Continuous organisational learning takes place when information and knowledge are distributed, and shopfloor employees use these to achieve process improvements and create value for customers (Davenport, 1997; Duffy, 1997; O'Dell and Grayson, 1997; Senge, 1990; Sveiby, 1997). Yet, total

quality management, business process re-engineering and the implementation of enterprise-wide systems have not necessarily improved business processes. As Davenport (1997, p. 154) notes: " . . ., information and knowledge-oriented processes have seldom been the focus of rigorous improvement programs".

Therefore, the aim in continuous process improvements is to apply "best practices" or knowledge to eliminate non-value-adding activities. Another aim is to improve the flow of information and "best practices" throughout the manufacturing organisation (Basu and Wright, 1997).

Process complexity requires codifying procedures and capturing knowledge into meaningful databases of problems and solutions, in order to assist in transferring learning and knowledge, as is implied from Khurana (1999). This supports the process of sharing information and knowledge amongst engineers, supervisors and employees. Therefore as processes become more complex shopfloor employees need to be multiskilled. Khurana (1999, p. 96) comments: "The common theme across such settings is the ability of an organization to create, acquire, process, and retain new knowledge, particularly in the face of complexity and rapid change".

Pycraft, Singh and Phihlela (1998) comment that process knowledge is important, when applying say, Taguchi techniques. Quality management leads to strategic advantage, and extends beyond production process control. It is based on meaningful knowledge of customers' requirements through market

research (Berry, Parasuraman, and Zeithaml, 1993; Garvin, 1987), and ongoing relationship marketing.

Managing total quality implies understanding business problems and process improvements, through a formal diagnostic review such as quality function deployment, statistical process control, measuring the cost of quality, training on quality, and improving quality. Through continuous feedback from customers, production staff, engineers, and research and development staff can adjust product quality.

Deloitte Touche Tohmatsu and the University of North Carolina at Chapel Hill conducted a study on critical factors for achieving world-class manufacturing amongst manufacturers in the United States. These researchers found that certain critical factors are evident including: perceived quality, reliable delivery time, conformance quality, prompt handling of complaints, product reliability, expanded customer relationships, and strong supplier relationships (based on The Conference Board, 1998).

In a study amongst global colour picture tube manufacturers, Khurana (1999) found that understanding and managing complex production processes requires broader knowledge than typical shopfloor employees or engineers possess. Khurana (1999) feels that understanding the level of complexity in manufacturing operations will help managers in the design of factories.

Khurana (1999) argues that companies should devise ways to deal with multiple dimensions of knowledge so typically found in manufacturing. Khurana (1999) feels that when the manufacturing process demands engineering-type knowledge, management approaches should support acquiring and using such knowledge. Khurana (1999) supports policies and incentives in manufacturing to develop problem-solving capabilities, acquire detailed engineering knowledge, and refine the analytical skills of shopfloor employees.

Resulting from his study, Khurana (1999) constructed a model for manufacturing problem-solving characteristics in engineering and manufacturing: technical specialisation; empowerment with technical expertise; and ongoing technical learning. Khurana (1999) suggests that a problem-solving approach should allow the input of tacit knowledge and ambiguity. Empowerment should be accompanied by technical expertise and technical information. There should be joint engineer-employee problem solving and communities of practice (Khurana, 1999; O'Dell and Grayson, 1998). Access to tacit and explicit information is important. Khurana (1999, p. 92) notes: "For complex processes, knowledge of cause-and-effect relationships is limited, and frequent experimentation is necessary". This will add to the knowledge about the process particularly when designing a new product, or improving processes.

Summation

In terms of Basu and Wright's (1997) framework, the selected core business processes in manufacturing are marketing and innovation (product development); and supply chain management. A third core process in

manufacturing performance is process improvements because it is related to the outcomes from world-class manufacturing practices, as has been studied by Roth, Giffi and Seal (1992), and supported by Vermeulen (1998). These seem to have the closest relationship to customer value.

To reiterate, the focus in this research is to determine how a knowledge-orientation when applied to manufacturing product development, and supply chain management and process improvements, may impact on customer value indicators.

Next is an overview of the literature on **customer value indicators**, with emphasis, as will be shown, on **customer satisfaction, customer retention and new product sales**.

A customer value framework

This part of the literature review aims to identify core customer value learning practices and indicators. This is done by referring to specific areas such as customer value definition, market orientation in manufacturing, customer learning practices in manufacturing, and customer value indices.

Customer value definition

Woodruff (1997, p. 142) defines customer value as: " . . . a customer's perceived preference for and evaluation of those products, attributes, attribute

performances, and consequences arising from use that facilitate (or block) achieving the customer's goals and purposes in use situations".

Market orientation in manufacturing

Competitive advantage in manufacturing in the future will be based on being market-led and adopting a *customer-of-one* focus (Peppers and Rogers, 1997). This requires a framework for managing customer value and customer value learning (Woodruff, 1997). Clearly, there is need for organisations to continuously reorient their strategies around customer value delivery (Day, 1994; Knox and Maklan, 1998; Peppers and Rogers, 1997). A market orientation in a manufacturing organisation should be a fundamental practice, given that there is a positive relationship between market orientation and organisational performance (Jaworski and Kohli, 1993).

Customer learning practices in manufacturing

The business challenge, according to Woodruff (1997, p. 140), is for managers to "translate customer learning into superior performance with customers". Developing Slater and Narver's (1995) customer framework further, Woodruff (1997), posits a customer value-oriented marketing information system aimed at translating learning into action. The process embraces the need to synthesise customer value learning, strategic thinking on customers, and managerial processes. This is important given that few organisations systematically and continuously predict future customer value (Hamel and Prahalad, 1994).

Woodruff's (1997) **"Translating Customer Value Learning Into Action"** framework is a useful perspective to adopt when formulating manufacturing strategy. It can assist when striving to achieve "best practice" in the aforementioned core manufacturing business processes. Similarly, it is an important input into the design of a knowledge-orientation framework for manufacturing. Woodruff's (1997) model is shown as Fig. 4 below:

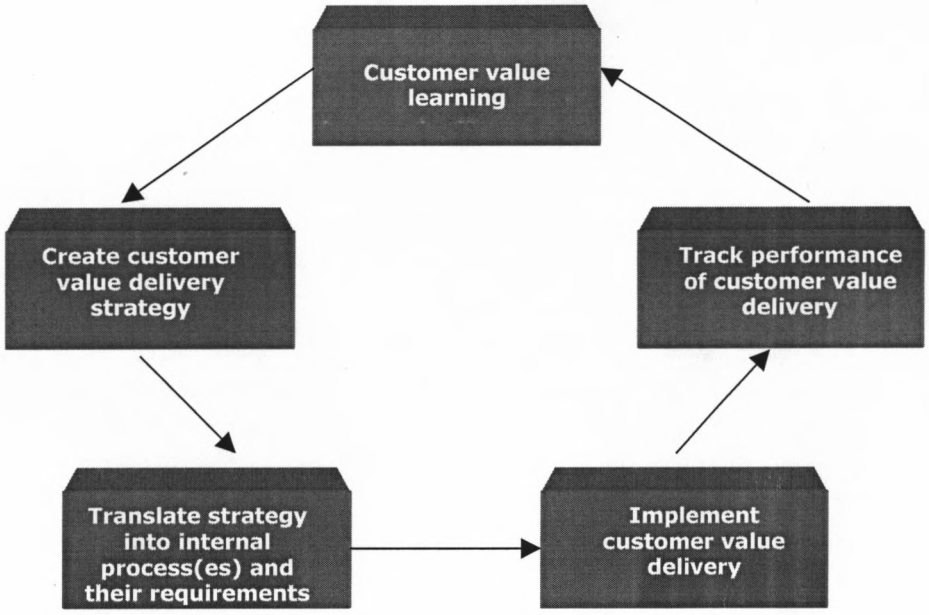


Fig. 4

"Translating Customer Value Learning Into Action"

Source: Woodruff, (1997, p.147)

Manufacturing effectiveness is improved when adopting a relationship marketing approach by undertaking ongoing customer value assessments. This will guide the manufacturing strategy in terms of product development and supply chain dynamics (Basu and Wright, 1997; Woodruff, 1997). A

manufacturer will achieve more efficient process improvements by working with customers, and achieve cost savings in areas such as maintenance, inventory holding, and energy consumption (Anderson and Narvis, 1998). Reaching competitive advantage in certain markets increasingly implies developing customer value models. These are data representations of the worth, in monetary terms, of what the supplier is doing or could do for its customers (Anderson and Narvis, 1998).

In this regard, Peppers, Rogers, and Dorf (1999, p. 154) comment: "Ultimately, to lock a customer into a learning relationship, a company must adapt some aspect of its behavior to meet that customer's individually expressed needs. This might mean mass customizing a manufactured product, or it could involve tailoring some aspect of the services surrounding a product".

Further, based on Treacy and Wiersema's (1995) *value disciplines*, different customers buy different kinds of value, which influences the operational need to focus on unmatched value propositions. Winning organisations in their view, choose their customers and narrow the value focus. This important principle is borne out by research on customer profitability pyramids in a major United States bank by Rust, Zeithaml, and Lemon (1999). These authors state: " . . . market leaders raise expectations and value norms not only in their industries, but across the board" (1995, p. 21). Various authors share this views, such as Drucker (1998); Kim and Maulborgne (1999); and Gilbert and Gadiesh (1998, 1998a).

The value disciplines are the ways that organisations can derive the maximum benefit and competitive advantage from knowledge management (O'Dell and Grayson, 1998; Wiig, 1997). Therefore, organisations need to build an operating model around customer value learning, and to sustain this model through constant transformations and improvements (Woodruff, 1997). Consequently, Treacy and Wiersema (1995) offer new rules to govern market leaders' activities:

1. providing the best offering in the marketplace by excelling in a specific dimension, though maintaining reasonable standards in other dimensions.
2. dominating one's market through improved value each year.
3. building a well-tuned operating model dedicated to delivering unmatched value.

"Successful customer-intimate companies are those that have become expert at their customers' business and at creating solutions", write Treacy and Wiersema (1995, p. 125). Customer knowledge and breakthrough insights about the client's underlying processes become the backbone of a customer-intimate organisation. These companies generate add-on selling because they broaden their areas of client support (Treacy and Wiersema, 1995). The value disciplines are the ways organisations can derive the maximum benefit and competitive advantage from knowledge management (Wiig, 1997).

Manufacturers may adopt specific knowledge management activities in their respective value disciplines - in other words, how they build ongoing

customer value with advanced and world-class manufacturing practices. Therefore, as (Knox and Maklan 1998, p. 34) note: "Companies create value by helping customers decide what solution is best, and then by producing to order, in good time, and at a competitive price".

Anderson and Narvis (1998) posit that building customer value models implies constituting a multi-functional research team. Duncan and Moriarty (1998) suggest that cross-functional teams should integrate marketing activities and brand messages aimed at delivering more effective relationship-building programmes. Berry and Parasuraman (1997, p. 72) call this a "service-improvement leadership team". Similarly, Treacy and Wiersema (1995, p. 171) comment: "tiger teams are small groups of high performers mandated by the executive team to turn realistic options into practical solutions".

Thereto, Knox and Maklan (1998) predict a shift in the marketing planning process from being incremental and product-driven, to becoming cross-functional and value-centred. This shift will generate high business performance. Therefore, information needs to flow efficiently along the product management-field sales-customer service continuum (Cespedes, 1994; Knox and Maklan, 1998).

Customer value indices

Based on Woodruff (1997), customer value indices comprise indicators such as customer satisfaction, customer retention, and sales from new products.

Woodruff (1997) emphasises that *customer satisfaction* is an important indicator of customer value. Based on empirical research, Anderson, Fornell and Lehmann (1994) found a positive relationship between customer satisfaction and quality, and in turn profitability. Parasuraman, Zeithaml, and Berry, (1985) and Zeithaml (1989) also support this view. A major trend emerging in industry in the United States is the need to get rid of unprofitable customers (Basu and Wright, 1997; Knox and Maklan, 1998; Pepper, Rogers, 1997; Rust, Zeithaml and Lemon, 1999; Treacy and Wiersema, 1995).

Further, Griffin, Gleason, Preiss and Shevenaugh (1995) conducted research on best practices for customer satisfaction in multi-product and multi-process manufacturing companies in the United States. These authors concluded that customer satisfaction and customer value should be incorporated into quality control, performance management, training, and compensation practices.

Yet, having satisfied customers does not always result in organisational performance as the relationship may decline over time (Jones and Sasser, 1995). *Customer retention* is known to happen because of increased customer satisfaction, and is often indicated by higher repeat purchases (Reicheld and

Sasser, 1990). Customer retention is the result of the organisation's capability to create customer value.

Slater and Narver (1994) found that *new product* success is positively related to adopting a market orientation. Han, Kim and Srivastava (1998) suggest that innovations should be facilitated by a market-orientation culture. Slater and Narver (1995) posit that a learning organisation uses new knowledge to improve performance, especially during uncertainty. A challenge however, may be that product innovation and quality are no longer the only sources of competitive advantage (Butz and Goodstein, 1996).

Therefore, as customers' expectations expand, so does the need to access changing customer value needs, and to convert these into profit streams (Rust, Zeithaml and Lemon, 1999).

Summation

To reiterate, core customer value indicators such as customer satisfaction, new product sales, and customer retention are selected in this research. It is important to evaluate how a knowledge-orientation, when applied to core manufacturing business processes, product development, supply chain management and process improvements, may impact on customer value learning practices. Some of the customer value learning practices may include an assimilation of: meeting with customers to learn about their current and future needs; building and mining information, knowledge and insight of customers' needs; systematically analysing changing customer needs from

market research; and measuring customer satisfaction each year (Woodruff, 1997).

Lastly, a literature overview of **knowledge management** will be useful to complete the analysis and construct a conceptual framework for manufacturing.

A knowledge management perspective

This part of the literature review aims to identify core knowledge management and knowledge-orientation practices. This is done by referring to areas such as knowledge definition, knowledge management and business strategy, knowledge management and manufacturing practices, value creation, value extraction, knowledge creation and extraction in manufacturing, and a knowledge-orientation framework for manufacturing.

Knowledge definition

Davenport and Prusak (1998, p. 5) define knowledge as: " . . . a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates, and is applied in the minds of knowers. In organizations, it often becomes embedded not only in documents, or repositories, but also in organizational routines, processes, practices, and norms".

O'Dell and Grayson (1998, p. 5) define knowledge as "information in action". Nonaka and Takeuchi (1995) separate knowledge into tacit knowledge and explicit knowledge. They suggest that the interaction between tacit and explicit knowledge is found at the individual rather than the organisational level.

Knowledge management and business strategy

Knowledge management practices in manufacturing aim to raise productivity levels, innovation, and ongoing competitive advantage (Buckman, 1999; Michuda, 1999; O'Dell and Grayson, 1998; Wiig, 1997). Knowledge management therefore entails designing ways to capture and deliver value from information and knowledge in the organisation (Buckman, 1999; O'Dell and Grayson, 1998; Pan and Scarborough, 1998). In manufacturing, the business process owners need to be made responsible for how they create value from information content and knowledge (Davenport, 1997).

A key question in manufacturing practices, that O'Dell and Grayson (1998, p. 31) ask is: "What is the strategic problem or process that could be improved if knowledge about best practices were better shared and transferred in your organization?". Stewart (1997, p. 153) also suggests that three questions should be asked: "What information drives the business? Who has it? To whom is it worth most?". Therefore, the key business imperative is to align business processes, systems and knowledge with customers. These questions form the basis for the research methodology.

Sveiby (1997) classifies the balance sheet of the knowledge organisation according to: tangible book value equity, the external structure, the internal structure, and employee competence. The external structure comprises brands, customer and supplier relations. The internal structure comprises organisational processes, systems, research and development, and attitudes. Employee competence is measured in terms of training, education and experience.

Earl and Scott (1999) researched the role of a Chief Knowledge Officer (CKO) amongst major United States organisations. They found three patterns emerging. Firstly, these organisations' leaders suggest that knowledge is a major source of sustainable competitive advantage, particularly where knowledge is consistently created and shared. Secondly, organisations tend to not know what they know because they are not systematically managing their knowledge. Lastly, major organisations that recognise the need to manage their knowledge, have made explicit attempts such as: designing and deploying techniques and processes to create, protect and use existing knowledge; designing and creating a climate and activities to discover and share knowledge; and describing the purpose and nature of managing knowledge as an initiative.

Earl and Scott (1999, p. 37) suggest that: "Appointing a CKO is one way of galvanizing, directing and coordinating a knowledge management program or initiative". These authors conclude however, that a future scenario is where knowledge management becomes a source of value creation and competitiveness, and the need for a CKO declines.

Knowledge management and manufacturing practices

O'Dell and Grayson (1998, p. 5) view knowledge management as a: " . . . conscious strategy of getting the right knowledge to the right people at the right time and helping people to share and put information into action in ways that strive to improve organizational performance". This is important in the context of manufacturing strategy and performance.

Stewart (1997, p. 26) writes: "As the usefulness of information, information technology, and information work grows, businesses find more ways to substitute them for expensive investments in physical assets - not just inventories, but also factories and warehouses". Amongst manufacturers such in the United States, in particular, it seems that the shift to a knowledge-orientation amongst manufacturing organisations is increasing. The same shift in South Africa though, is yet to happen.

Based on Sullivan's (1998) **"Intellectual Capital Value Matrix"**, a *knowledge-orientation* is feasible in manufacturing when attempting to extract and create value. Sullivan's matrix is shown in Fig. 5 overleaf:

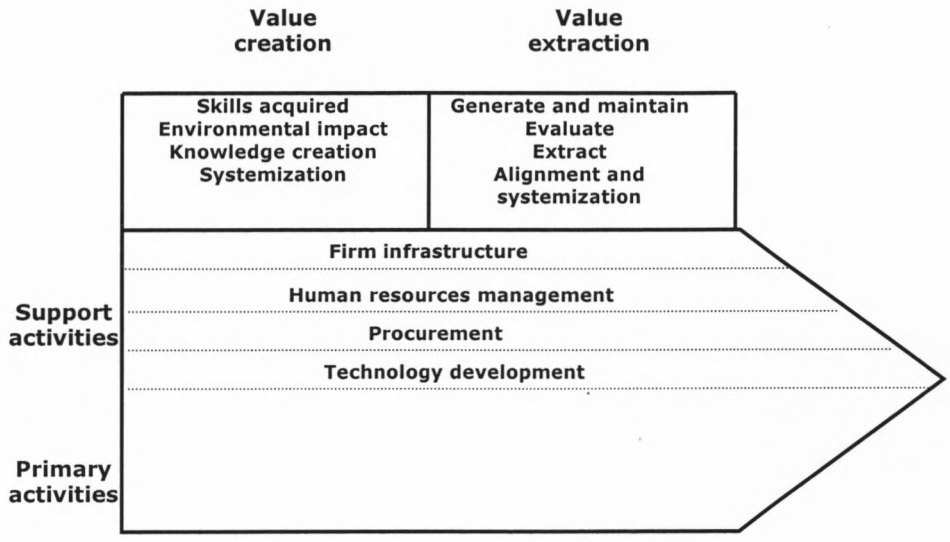


Fig. 5

"Intellectual Capital Value Matrix"

Source: Sullivan (1998, p.42)

Sullivan (1998, p.9) defines knowledge creation as " . . . an activity associated with social processes, structures, and norms. It involves human capital". He argues that the intellectual capital of an organisation comprises human capital, intellectual assets, and intellectual property. He regards the two intellectual functions as value creation and value extraction.

Value creation

The knowledge organisation would create innovations for future commercial use and extract current profits from existing knowledge. Sullivan (1998) sees value creation as activities that create new knowledge through learning or knowledge acquisition. Value creation activities comprise: training, education, building organisational structures, developing customer

relationships, organisational and individual relationships, and managing value and culture.

From a manufacturing perspective, it is suggested that value creation is congruent with business strategy, demand management, *product development*, inventory planning, quality management, and *supply chain management*. Sullivan (1998) suggests that business assets such as manufacturing facilities, supplier networks, complementary technologies, and capabilities are assets by which innovation occurs. These assets should be used to create and retain additional customer value. Based on Sullivan (1998), the core areas common to value creation are building the appropriate structures, processes, and a continuous learning culture.

Value extraction

Sullivan (1998) sees value extraction as activities that access the value required to implement strategic vision and business objectives. Value extraction involves aligning resources to produce an efficient operation, as well as strategic positioning to produce improved marketplace presence.

In manufacturing, this would mean extracting value from intellectual properties, such as patents and trademarks. Value extraction activities include: valuation, decision processes, database management, process conversion mechanisms, asset management, and capabilities. Therefore, in manufacturing terms, these are mainly concerned with efficiencies.

In sum, from a manufacturing perspective, it is useful to view manufacturing effectiveness broadly as knowledge creation, and manufacturing efficiency as knowledge extraction. It is possible to implement a knowledge management strategy in manufacturing by adapting Sullivan's (1998) **"ICM Model of Intellectual Capital"**, as shown in Fig.6 below:

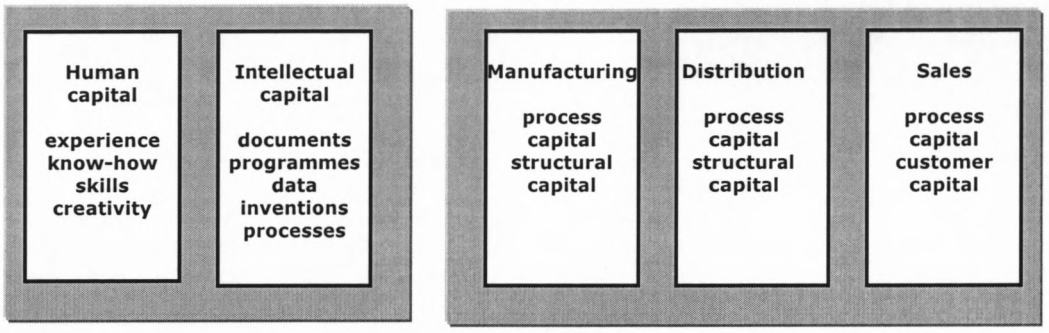


Fig. 6

"ICM Model of Intellectual Capital

Source: Adapted from Sullivan (1998, p.69)

Knowledge creation and extraction in manufacturing

Knowledge management can become an overarching business process that enables manufacturing organisations to be agile and customer-driven. Thereto, organisational structures should be designed around work, information and knowledge flows to achieve the best solutions for customers. Further, measuring the impact of knowledge management in manufacturing should comprise improvements in composite customer value indices, in terms of customer satisfaction, new product sales and customer retention. These should

be balanced against multi-factor productivity indices, such as shortened lead times, based on the strategic value propositions (O'Dell and Grayson, 1998).

Knowledge re-use becomes an important practice to reduce product time to market (Davenport, Javenpaa and Beers, 1996). Therefore, achieving world-class manufacturing will in the future be based on sharing best practices across functions, business units and geographies. It will comprise a collaborative continuous process improvement approach. Thus the shift towards stewardship-type leadership (Block, 1993).

Additional factors to consider when adopting knowledge management in manufacturing may include: values and culture (Hall, 1998; Kanter, Kao and Wiersema, 1997; Ulrich, 1998); performance management; rewarding knowledge sharing; operational practices; employment practices; training; communication; executive management and line management commitment; and information technology infrastructure (Davenport, 1998; Davenport and Prusak, 1998; Drucker, 1998; O'Dell and Grayson, 1998; Leonard, 1998; Stewart, 1997; Wiig, 1997). Davenport (1997) suggests that in an information culture, individual behaviour around information and knowledge create operational quality.

Recall that Khurana (1999) concluded from his study that manufacturing companies should devise ways to deal with multiple dimensions of knowledge so typically found in manufacturing. Khurana (1999) suggests that a problem-solving approach should allow the input of tacit knowledge and ambiguity.

In addition, Nonaka and Takeuchi (1995) concluded from their studies that Japanese companies have been successful because of their capabilities in creating organisational tacit knowledge and disseminating it throughout the organisation and embodying these in products, services and systems. Further, Japanese companies tend to accumulate external knowledge and store this in the company's knowledge base.

"In most cases this interaction (with others external to the organisation) will take place between the product, service, or system that the company offers and customers, suppliers, distributors, and competitors", write Nonaka and Takeuchi (1995, p. 226). Their emphasis is on creating a knowledge network with the external world and exploiting this knowledge domain - "tapping the mental maps of customers" through dynamic, interactive communication.

The question, however, is how to build virtual trust relationships that will encourage employees across the organisational geographies and hierarchy to share and create knowledge. Informal networks, shared mental models (Senge, 1990; Buckman, 1999), new product development routines, and face-to-face contact are important in the transfer of knowledge and best practices across the organisation (Madhavan and Grover, 1998; O'Dell and Grayson, 1998).

Often knowledge transfer is limited because:

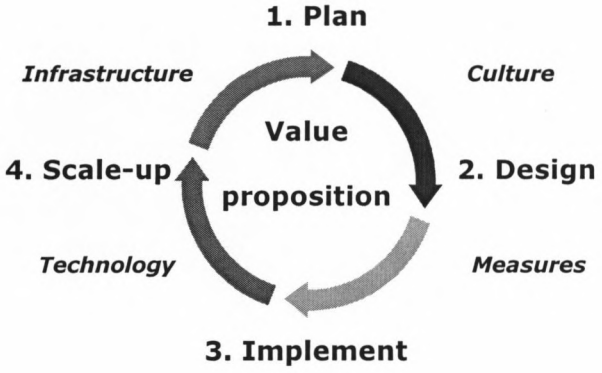
- those who have the knowledge are ignorant of the potential value that others may derive from that knowledge.
- the organisation may not have the resources to make knowledge useful.
- individuals across functions may have no relationship with others to want to share their knowledge.
- individuals may not have a business reason to want to share their knowledge (O'Dell and Grayson, 1998).

This explains why Drucker (1998) suggests that organisations should design teams to become entrepreneurial and innovative.

There is a need for "holistic management of information" (Davenport, 1997). In spite of recent information technology developments such as GroupWare, e-mail, intranets, and software vendors promising that they have designed all-inclusive knowledge management tools, there is a need for pragmatism (Davenport, 1997; O'Dell and Grayson, 1998; Sveiby, 1997). The focus should be on management of information and knowledge sharing as opposed to technology, given that managers prefer face-to-face conversations to using technology (Davenport, 1997; Davenport and Prusak, 1998).

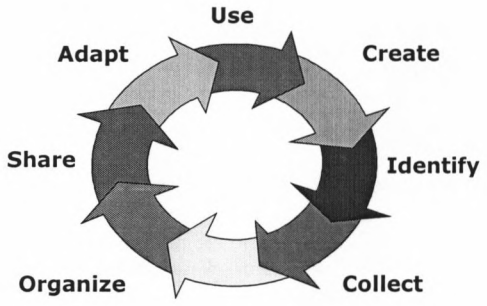
Figures 7 and 8 overleaf indicate core knowledge management practices, as recommended by the American Productivity and Quality Center (O'Dell and Grayson, 1998).

Knowledge-orientation activities in this research are defined as an assimilation of recording, accessing, analysing, and updating "key lessons". Key lessons, broadly, refer to learning from better ways of working. These activities will be evaluated in this research for their impact on customer value when applied to core manufacturing business processes: product development, supply chain and process improvements.



A model for best practice transfer

Fig. 7



Steps in the knowledge transfer process

Fig. 8

Knowledge Transfer Practices

Source: O'Dell and Grayson, (1998, p.7 and p.22)

Based on Basu and Wright's (1997) **"Total Manufacturing Solutions"** framework, and Woodruff's (1997) **"Translating Customer Value Learning Into Action"** framework, Fig.9 below is a framework for applying a knowledge-orientation in manufacturing.

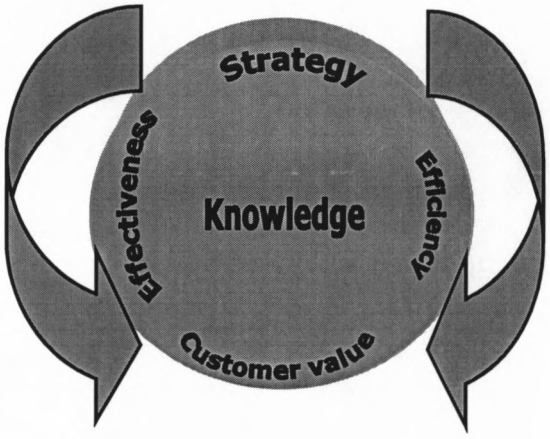


Fig. 9

Customer value and knowledge-orientation in manufacturing

Source: Adapted from Basu and Wright (1997, p.5), and Woodruff (1997, p.147)

A knowledge-orientation framework for manufacturing

By applying a value chain perspective, it is possible to design a conceptual knowledge-orientation framework for manufacturing as shown overleaf in Figure. 10.

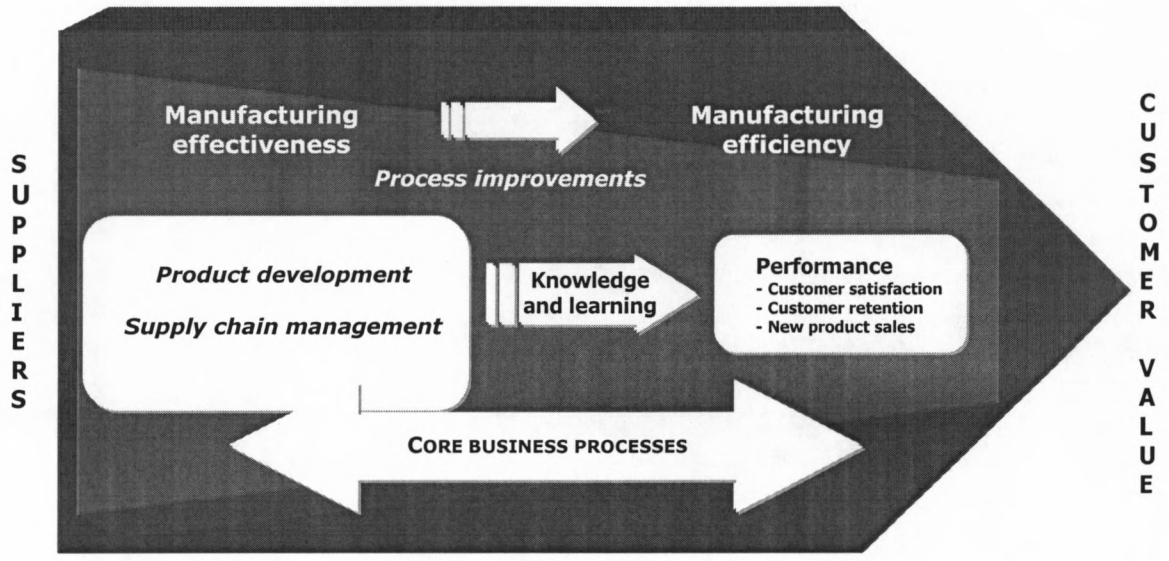


Fig. 10

A framework for Adopting a Knowledge-Orientation in Manufacturing

Source: Adapted from Basu and Wright's (1997, p.5) "Total Manufacturing Solutions" and Sullivan's (1998, p.42) "Intellectual Capital Value Matrix", and Woodruff's (1997, p.147) "Translating Customer Value Learning Into Action".

Summation

In this framework, both manufacturing effectiveness and efficiency determine business performance (Skinner, 1986). Product development and supply chain management are core business processes aligned to manufacturing effectiveness. Similarly, process improvements are integral to manufacturing efficiencies (Basu and Wright, 1997).

Product development practices may impact on customer satisfaction and customer retention (Han, Kim and Srivastava, 1998). Product development is effective when sales are increasingly generated from new products. Supply chain dynamics can be effective when used to create customer value in terms of customer satisfaction, customer retention and new product sales (Basu and Wright, 1997). Similarly, assuming that effective manufacturing practices are implemented, customer value, in the form of customer satisfaction and customer retention, can be extracted from the "transfer of best practices" (O'Dell and Grayson, 1998) through ongoing process improvements.

Therefore, customer value is extracted when manufacturing efficiency is achieved, and may be synonymous with knowledge optimisation. Similarly, customer value is created when manufacturing effectiveness is attained, and may be synonymous with knowledge creation.

To reiterate, product development, supply chain management, and process improvements are chosen from the framework because of their proximity to extracting and creating customer value (Basu and Wright, 1997; Woodruff, 1997). This view is support by Roth, Giffi and Seal (1992), and similarly, is corroborated in Vermeulen's (1998) research.

The future of knowledge management in manufacturing

Clearly then, knowledge management is not an off-the-shelf package. Rather it is a journey towards ongoing world class manufacturing and an integrated business model (Buckman, 1999; Davenport, 1997; Wiig, 1997).

Often it begins with mapping where information and knowledge reside in the organisation and creating awareness of these locations (Davenport, 1997).

Another process is deciding whether to share information and knowledge with customers and suppliers (Davenport, 1997) and create what is termed here as "value networks". Some manufacturing organisations may even decide to sell their knowledge as a total solution or add-on to their products (Davenport, 1997; O'Dell and Grayson, 1998; Sveiby, 1997).

Knowledge management may enable manufacturers to capture current and future know-how around customer processes and applications (Sveiby, 1997). Thus, manufacturing organisations should implement knowledge management practices and technology in ways that are consistent with their manufacturing strategy. Whereas an information-focused strategy comprises a low degree of customisation, a knowledge-focused strategy comprises a high degree of customisation. Knowledge residing in people are sources of revenue (Sveiby, 1997). These knowledge management principles are relevant to manufacturing and will ensure that the factory is drawn closer to the customer.

A knowledge-sharing enterprise will implement culture and business process changes. According to Burlton (1999) and O'Dell and Grayson (1999), critical business issues that will need to be resolved include:

- how leadership rises to value created through sound knowledge management practices.

- what business processes and training will ensure successful implementation.
- how organisations will drive operating standardisation of knowledge management platforms.
- how quality information will be controlled.
- how knowledge management practices will be measured for effective business returns.
- how knowledge sharing practices will be rewarded for their impact on value added.

It is little wonder then that the consulting market in the United States for knowledge management is expected to rise to nearly $50 billion by the year 2000 (Harreld in Tapscott, Lowy and Ticoll, 1998).

The benefits of knowledge management, as listed by Teltech (1999), a major research and knowledge management consulting firm in the United States, are:

- improved business strategy.
- new product innovation.
- streamlined research and development processes.
- faster products to market.
- increased productivity.
- improved profitability by customers, products, divisions, and the overall business (This benefit is supported by Gadiesh and Gilbert, 1998; Rust, Zeithaml, and Lemon, 1999).

These are relevant as to how manufacturing practices should incorporate ongoing customer value creation by implementing a knowledge orientation.

Neef (1999) argues that knowledge is the foundation for high-road companies, and comprises aspects such as:

- a knowledge-based business strategy.
- knowledge-based process planning.
- knowledge sharing culture.
- technical infrastructure.
- stewardship.
- business research and analysis.
- measuring and valuing intangibles.

"Accordingly, those organizations that are best able to capture and disseminate that information, to put it at the fingertips of knowledgeable workers, and then to subsequently encourage those workers to use that knowledge innovatively, will be the main force of economic growth in the future. This is the reason why knowledge management has become so important at the organizational level", writes Neef (1999, p. 81).

Chapter Three Research Methodology

Introduction

The approach to this research is based on the following objectives and propositions as shown in Table 1 below:

Table 1.

Research objectives and propositions

RESEARCH OBJECTIVES	PROPOSITIONS
A. Evaluate how a knowledge-orientation in manufacturing influences *customer value learning*	A1. A knowledge-orientation in manufacturing will influence the *implementation* of customer value learning
B. Evaluate how a knowledge-orientation in *manufacturing product development* influences customer value indices	B1. A knowledge-orientation in manufacturing product development processes will influence *performance* on customer satisfaction, customer retention and new product sales
C. Evaluate how a knowledge-orientation in *manufacturing supply chain management* influences customer value indices	C1. A knowledge-orientation in manufacturing supply chain practices will influence the *performance* on customer satisfaction, customer retention and new product sales
D. Evaluate how a knowledge-orientation in *manufacturing process improvements* influences customer value indices	D1. A knowledge-orientation in manufacturing process improvements will influence *performance* on customer satisfaction and customer retention
E. Construct a *knowledge-orientation model* in manufacturing with emphasis on customer value	
F. Explore *future roles of knowledge management* in manufacturing with emphasis on customer value	

Further, the methodology employed in this research contains certain approaches to data collection, sampling and data analysis.

Data collection method

Key themes on knowledge management and customer value learning, and manufacturing business processes were identified from the literature search. These formed the basis for formulating the propositions noted in Chapter 3. Therefore, the researcher was able to systematically design the data collection method using a questionnaire, and test these propositions using a quantitative approach (Sohal, Simon and Lu, 1996).

The questionnaire found in Appendix A was designed to some extent on Li and Calontone's (1998) constructs on market knowledge competence. Additional input was based on key literature findings from Basu and Wright (1997), Davenport (1997), Li and Calantone (1998), O'Dell and Grayson (1997), Parasuraman, Zeithaml and Berry (1985), Reicheld and Sasser (1990), Roth and Griffi (1987), Slater and Narver (1995), Sullivan (1998) and Woodruff (1997).

Further, it was possible to construct the questionnaire as it was known from Roth and Giffi (1987) and Vermeulen (1998) that world-class manufacturing organisations often share "best practices" that support customer value learning. It was then possible to test the extent to which knowledge sharing in these organisations influenced core manufacturing business

processes, such as product development, supply chain and process improvements.

The questionnaire comprised four sections including:

- Background information
- Importance to your organisation
- Product development
- Supply chain management
- Process improvements
- Customer value learning

The approach to each section was to measure the responses on the actual business practice (for example, "Manufacturing persons are in direct contact with customers"). The next set of questions measured knowledge-orientation practices that record, analyse, access and update "key lessons" on core manufacturing practices. In other words, respondents were asked to judge whether a knowledge-orientation was applied to their manufacturing practices.

Further, the respondent was asked to judge whether a knowledge-orientation applied to any of their core manufacturing business processes resulted in improvements in customer value indices. For example, "Since applying key lessons to new product development, the % sales from new products has increased". The last section determined respondents' open-ended

responses towards the future role of a knowledge-orientation applied to manufacturing.

The questionnaire design included measures of validity as follows:

- *Construct validity* was based on the questionnaire design that would test the attitudes towards a knowledge-orientation in core manufacturing practices using a five-point Likert scale, ranging from strongly disagree to strongly agree. Dependent and independent variables were identified by applying quantitative data analysis techniques, such as Pearson's Correlation. For example, customer satisfaction as a "performance indicator", as the dependent variable, vs. knowledge-orientation that is actually applied to manufacturing practices, as the independent variable.
- *Criterion validity* considered measures that could be correlated with other measures of the same construct. For example, measuring the importance of knowledge-orientation in business strategy vs. knowledge-orientation actually applied to manufacturing practices.
- *External validity* was not tested for cause and effect. Certain generalisations, however, to the sampled manufacturing organisations were considered.
- The questionnaire was approved by the teaching staff at the Faculty of Management, University of the Witwatersrand, in order to achieve high face validity.

- The questionnaire was piloted amongst a small group of persons mostly excluded from the total respondents. This ensured that the questions were meaningful in order to support the need for construct validity.

The questionnaire design included measures of reliability as follows:

- Where the questionnaire is re-administered to a similar sample, the results should be consistent with these findings and conclusions.
- Internal consistency was considered as questions have been asked in a similar way across core manufacturing practices. For example, "We record key lessons on new product development processes", is similarly asked as "We record key lessons on suppliers' processes".

The above approach guided the data collection and subsequent quantitative data analysis techniques.

Sampling

Given the nature of the research question and objectives, a convenience sample was chosen from amongst three high-profile manufacturing organisations in the United States of America, as well as three blue chip manufacturing organisations in South Africa. The 6 sampled organisations were Xerox Corporation, E.I. du Pont de Nemours and Company, Buckman Laboratories, Nampak Limited, South African Breweries, and Plate Glass.

As previously mentioned, these organisations were chosen because they had previously embarked on world-class manufacturing practices whereby sharing of "best practices" has been entrenched in their ways of working. Further, implementing relationship marketing principles has been part of their strategic intent, as was determined from desk and exploratory research on these companies. The desk and exploratory research was based on annual reports, web sites, and discussions with representatives from these companies.

It was felt also that the research exercise would be beneficial where it included global organisations that have embarked on a knowledge management initiative in the past 5 years. This explains to some extent why the United States sample was chosen. A total of 185 questionnaires were distributed by e-mail to these 6 organisations using a key contact person from each organisation.

Data Analysis

Most questionnaires were returned by e-mail, though some from the South African sampled organisations were returned by fax, often because of the computer illiteracy of these respondents. The returned questionnaires were captured in an Excel spreadsheet and analysed using a software package called, Number Crunching Statistical System (NCSS). After rescaling the ordinal data in the questionnaire into interval data, descriptive statistical techniques were applied such as visual analysis, Correspondence Analysis, Pearson's Correlation Analysis, and a Two-Sample t-test.

Visual analysis

The results of the questionnaire were visually analysed to determine if any anomalies existed in the data set. A printout of the means, standard deviation and histogram charts from NCSS in this regard as part of a descriptive statistical approach.

Correspondence Analysis

Correspondence analysis is a descriptive and exploratory technique designed to analyse simple two-way and multi-way tables containing some measure of correspondence between the rows and columns. Correspondence analysis allows the researcher to explore the structure of categorical variables included in a table, such as a two-way frequency cross tabulation table. The goal of a typical correspondence analysis is to represent the entries in the table of relative frequencies in terms of the distances between individual rows and/or columns in a low-dimensional space.

Bendixen and Sandler (1995, p. 32) write: "It would thus be of considerable practical value to be able to convert these verbal scales into interval data easily. The application of correspondence analysis is a technique that be used to rescale such data". Bendixen and Sandler (1995) propose that ordinal scales are rescaled using a 2-dimensional output of Correspondence Analysis. The outputs are shown in Appendix B.

Pearson's Correlation Analysis

Pearson's Correlation Analysis is a technique that can be used to describe the extent to which one variable is linearly related to another (Zikmund, 1997). It can be used to measure the degree of association between two variables, or as part of a regression analysis, where the aim is to determine how well the regression line explains the variation of the dependent variable. The outputs from NCSS are shown in Appendix C.

Correspondence analysis assisted in rescaling the data from an ordinal scale into an interval scale. Thereafter, Pearson's correlation analysis was used. Correlation is a measure of the relation between two or more variables, where a correlation ranges from -1.00 to +1.00. The value of -1.00 represents a perfect negative correlation, while a value of +1.00 represents a perfect positive correlation. A value of 0.00 represents a lack of correlation.

In this research exercise, Pearson's correlation analysis was used to measure the:

- association between a knowledge-orientation applied to customer value learning and the way additional revenue is generated.
- association between a knowledge-orientation applied to product development and customer satisfaction.
- association between a knowledge-orientation applied to product development and customer loyalty.
- association between a knowledge-orientation applied to product development and sales from new products.

- association between a knowledge-orientation applied to supply chain management and customer satisfaction.
- association between a knowledge-orientation applied to supply chain management and customer loyalty.
- association between a knowledge-orientation applied to supply chain management and sales from new products.
- association between a knowledge-orientation applied to process improvements and customer satisfaction.
- association between a knowledge-orientation applied to process improvements and customer loyalty.

A t-test was not used in this regard as the sample size was above 30.

Two Sample T-Test

A Two Sample t-test was used to determine the extent of differences between scores of importance vs. performance. This formed part of a "gap analysis" across the core manufacturing business processes. The results were tested at a 95% significance level using NCSS. The outputs from NCSS are shown in Appendix D.

Chapter Four Findings

Introduction

The findings are presented in this chapter, and are further discussed and interpreted in Chapter 5. The format of this chapter is to present the findings from the data analysis techniques in the following sequence: background information, results of two-dimensional rescaling, and overview of the findings using descriptive statistics.

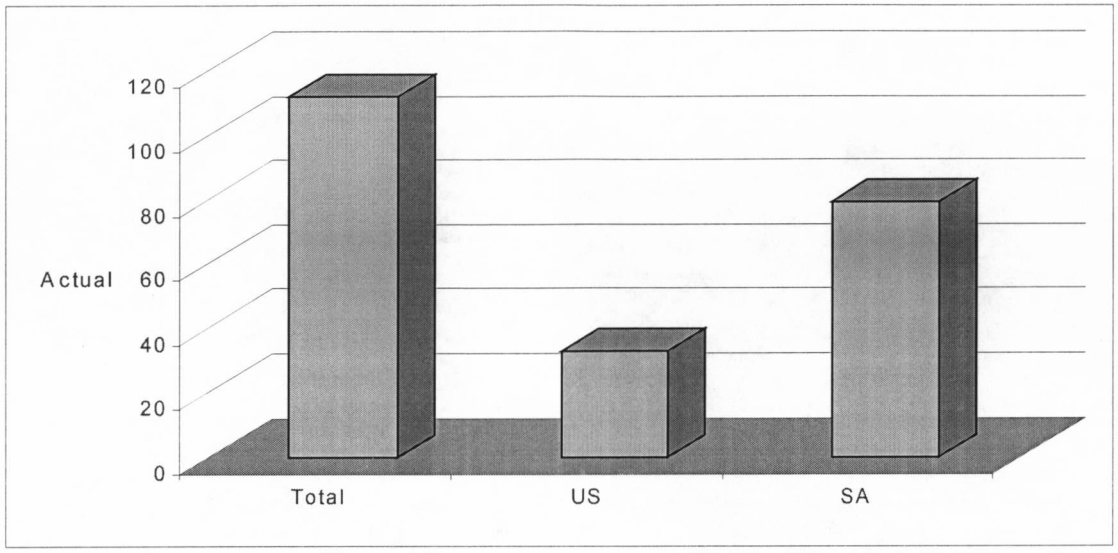
Background Information

Sample size

One hundred and twelve (112) persons from the expected 185 from the 6 global manufacturing organisations returned a completed questionnaire. This equates to a response rate of 60,5%. Twenty-nine comma five percent (29,5%), or 33 of the 112 respondents are from the United States sampled organisations, and 70,5% or 79 of the 112 respondents are from the South African sampled organisations. A sample size of over 100 respondents, according to Cooper and Emory (1995), elevates the validity of the findings. Refer to Fig. 11 overleaf.

Fig. 11

Sample Size



Job and functional roles

Of the 112 respondents, 80,4% are in a managerial role, whereas 19,6% are in a specialist role. The emphasis of the functional roles includes executive management (17%), management / production (16,1%), sales (12,5%), research & development (12,5%), marketing (8,9%), and information systems (8,9%). Refer to Figures 12 and 13 overleaf.

Fig. 12

Job Role

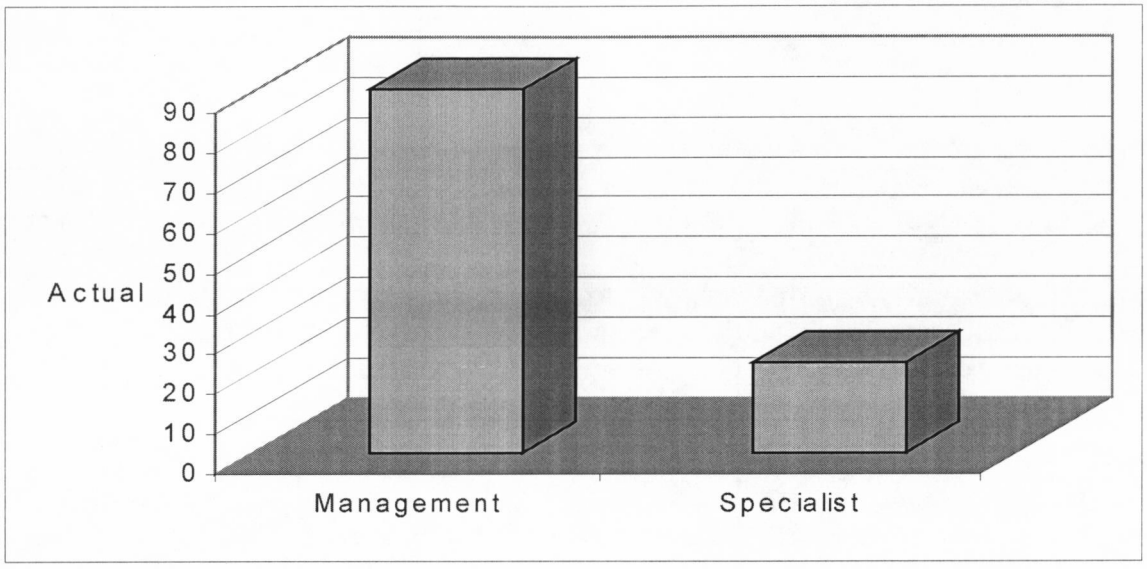
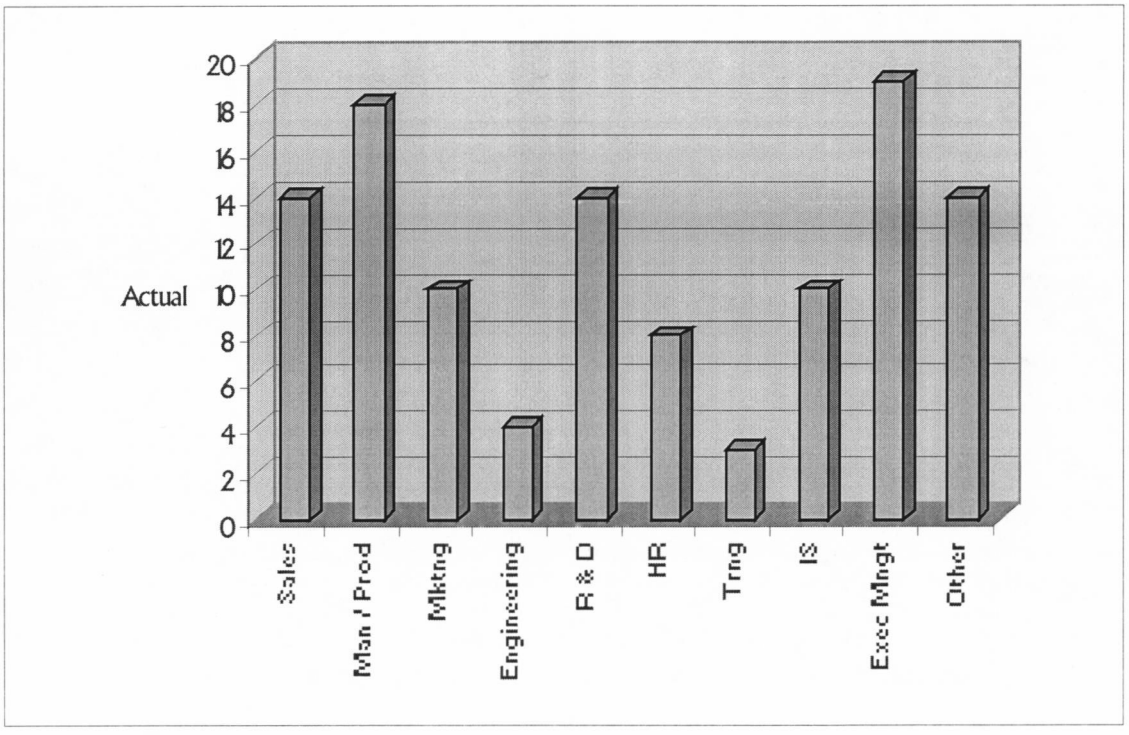


Fig. 13

Functional Role

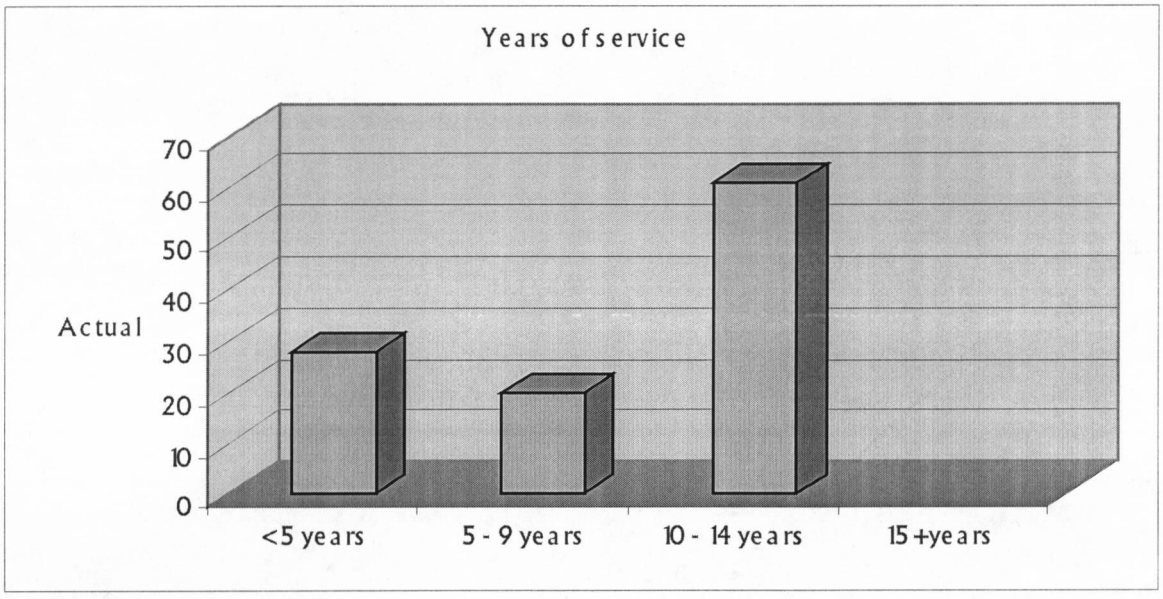


Years of service

In descending order, 54,5% of the 112 respondents have 10 years' or more service; 25% have up to 5 years' service, and 17,9% have between 5 and 9 years' service. Refer to Fig. 14 below. Therefore it is reasonable to assume that the findings meaningfully represent the views amongst employees in these organisations.

Fig. 14

Years of Service



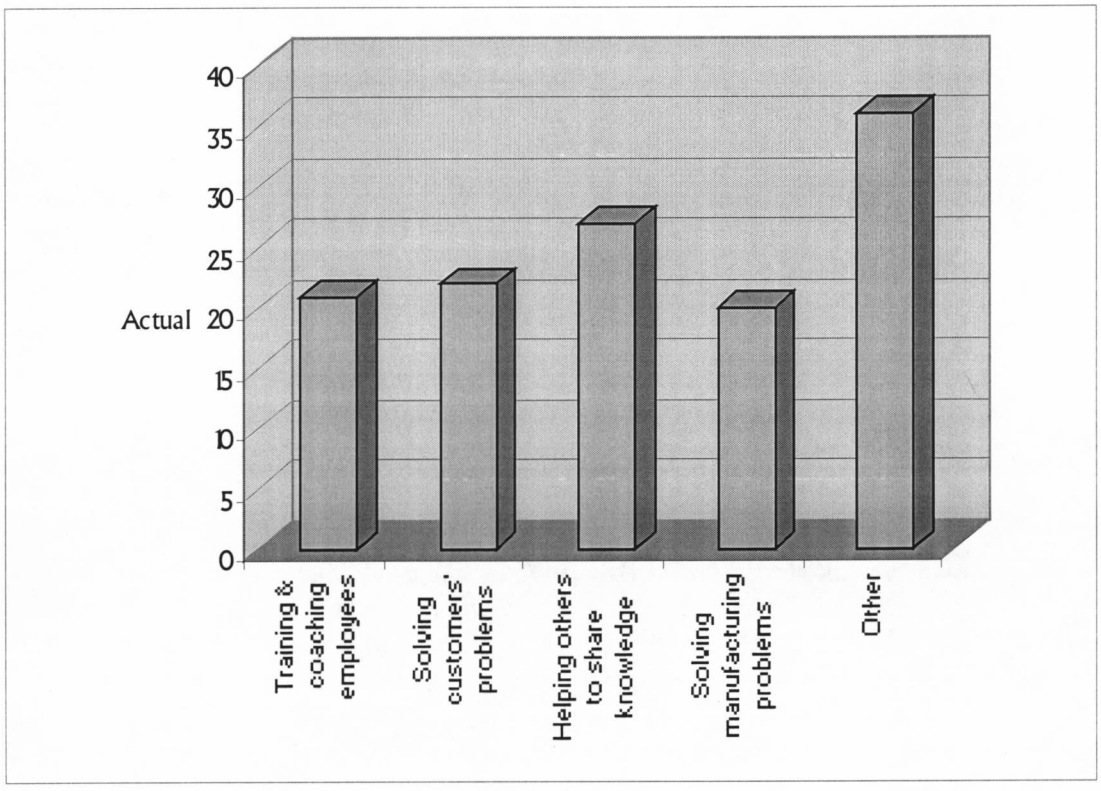
Knowledge-sharing activity most relevant to the respondents' average day

Twenty-four comma one percent (24,1%) of the 112 respondents spend their average day helping others to share their experience and knowledge. Nineteen comma six percent (19,6%) of the respondents spend their average day solving customers' problems; 18,8% are training and coaching employees;

and 17,9% are solving manufacturing problems. Thirty-two comma one percent (32,1%) however, spend their average day on other functional activities not related to knowledge-sharing. Refer to Fig. 15 below. Therefore, in these organisations there is a fair emphasis on sharing knowledge that is congruent with business imperatives such as solving customers' or manufacturing problems.

Fig. 15

Knowledge-sharing activity

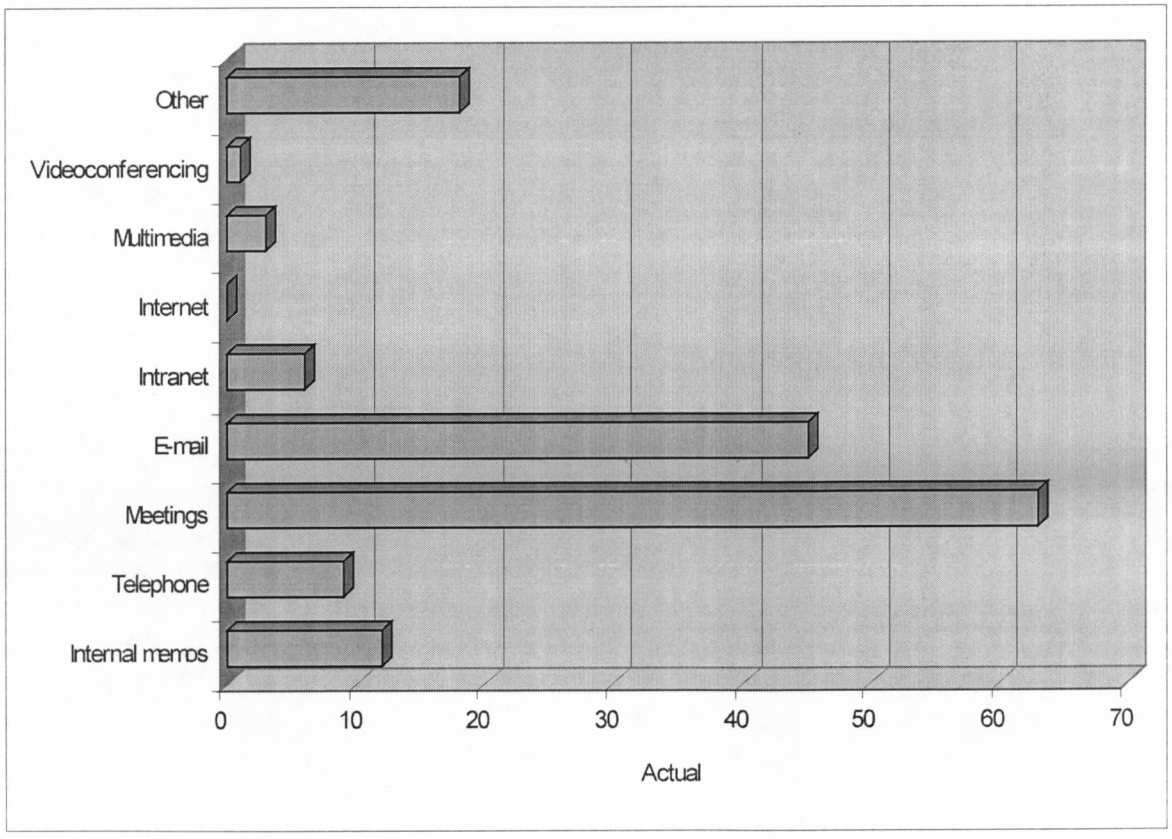


Knowledge-sharing methods

Knowledge-sharing amongst the 6 organisations happens mostly by holding meetings (56,3%); using e-mail (40,2%); distributing internal memoranda (10,7%); using the telephone (8,0%); or using an Intranet (5,3%). Refer to Fig. 16 overleaf. Interestingly, 16,1% of the 112 respondents indicated that they use some other method to share knowledge, for example informal discussions, or open forums.

Fig. 16

Knowledge-sharing methods



Summation

Therefore, the 6 sampled organisations are represented mostly by management in a production or sales role with extensive years' service. The respondents spend a fair proportion of their average day helping others to share their knowledge and experience by means of meetings or e-mail.

No answer

Respondents in various job roles were unable to answer certain sections as they felt that they lacked the appropriate knowledge. It can be seen from Table 2 below that some respondents have the least knowledge and understanding in process improvements, then customer value learning, then supply chain management. In other words, it seems that widespread knowledge-sharing across functions is least effective in process improvements.

Table 2.

Knowledge sharing across functions

Section	% Unanswered
Importance to your organisation	1,4%
Product Development	7,2%
Supply Chain	9,3%
Process Improvements	12%
Customer Value Learning	11,5%

Results of Two-Dimensional Rescaling

Using Correspondence Analysis, the 5-point ordinal scale was rescaled into an interval scale. This would ensure that statistical techniques such as means, Pearson's Correlation Analysis and Two Sample t-tests could be utilised.

A two-dimensional rescaling technique found in NCSS Correspondence Analysis was employed, based on Bendixen and Sandler (1995). The rescaling was achieved by calculating the Euclidean distance between the scale points, and then apportioning the distance between the intended "length" across the scale. Thereafter, the numerical values of the scale points were recalculated. Refer to the Correspondence Report in Appendix B. The summarised output from the Correspondence Analysis is shown in Table 3 below:

Table 3.

Eigenvalue report

Axis	**Eigenvalue**	**%**	**Cumulative %**
1	0,2968	69,98	69,98
2	0,0756	17,83	87,81
3	0,0420	9,91	97,71
4	0,0097	2,29	100,00
Trace	**0,4242**		

It should be noted that the raw data input into Correspondence Analysis was reversed in order to arrive at the expected "horse-shoe plot", based on the advice of Mr. Maxwell at the Faculty of Management, University of the Witwatersrand. Refer to the Raw Data and Frequency Table in Appendix B. The principal co-ordinates for axes 1 and 2 only are shown in Table 4 overleaf.

Table 4.

Principal co-ordinates

	Axis 1	**Axis 2**
I	-0,654	-0,346
II	-0,5	-0,401
III	-0,378	0,319
IV	0,339	0,086
V	1,066	-0,189

Based on the Frequency Table in Appendix B, the two-dimensional rescaled values are shown in Table 5 below.

Table 5.

Two-dimensional rescaled values

Scale Point	**Ordinal Value**	**Interval Value**
Strongly disagree	I	1
Disagree	II	2,282
Neither agree, nor disagree	III	3,526
Agree	IV	4,730
Strongly disagree	V	5

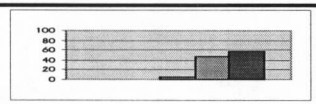
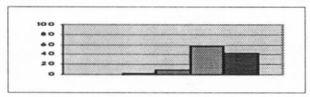
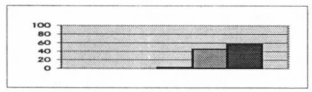
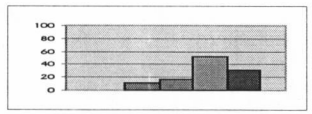
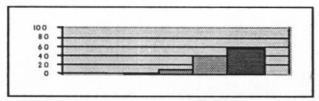
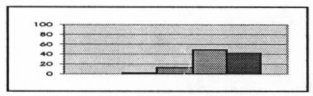
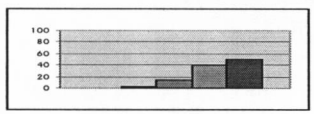
It can be seen from Table 5 that the rescaled values still range from 1 to 5, though the interval points have changed. It was not necessary to combine scale points because of the relative equal distances between the scale points.

Overview of findings using descriptive statistics

This section presents the findings on the importance of knowledge-orientation activities to the respondents. The findings are illustrated in the histograms by frequency of the rescaled interval data. Refer to Table 6 overleaf.

Table 6.

Questionnaire construct: "Importance to your organisation"

Question	Mean	Standard Deviation	Histogram Shape	Comment
B1. People should record key business lessons across our organisation	4,751	0,598		Distribution curve is skewed left with a low dispersion, as shown by the low standard deviation. Most data is located around the mean. In other words, most respondents agree with the statement in B1.
B2. Key business lessons should be analysed	4,642	0,678		Most data is located around the mean Most respondents agree with the statement in B2.
B3. People should have ongoing access to key business lessons across our organisation	4,690	0,857		Most respondents agree with the statement in B3.
B4. Internal experts should update the usefulness of key business lessons	4,346	0,941		Distribution curve is nearly symmetrical with a high dispersion, as shown by the high standard deviation. Most data is not located around the mean. Most respondents agree with the statement in B4.
B5. Our corporate business strategy should use knowledge from key business lessons to improve customer satisfaction	4,678	0,689		Distribution curve is skewed left with a low dispersion, as shown by the low standard deviation. Most data is located around the mean. In other words, most respondents agree with the statement in B5.
B6. Our corporate business strategy should use knowledge from key business lessons to improve customer loyalty	4,536	0,858		Most respondents agree with the statement in B6.
B7. Our corporate business strategy should use knowledge from key business lessons to increase sales from new products	4,568	0,845		Most respondents agree with the statement in B7.

As Table 6 above shows on a Likert scale of 1 to 5, most respondents agree with the statements in each question, implying that incorporating and managing "key business lessons" is very important to these companies' corporate business strategy. The scores range from 4,346 to 4,751, with low standard deviations from the mean. In particular, using the mean scores, the 6 sampled companies rate questions B1, B3, and B5 as the major priorities.

Therefore, in these organisations, corporate business strategy needs to involve processes whereby key business lessons are recorded and accessed across the organisation. Further, collectively the respondents feel that it is important to use knowledge from key business lessons to improve customer satisfaction. Interestingly, the role of internal experts, B4, in updating the usefulness of key business lessons has the lowest mean score or priority for the corporate business strategy from the seven questions measured.

Country Comparison

The mean scores for knowledge-orientation activities, questions B1 to B7, for the United States sampled organisations are found mostly above the sample mean scores. The United States sampled organisations' mean scores are higher than the South African organisations' mean scores.

Proposition One

A knowledge orientation in manufacturing will influence the implementation of customer value learning.

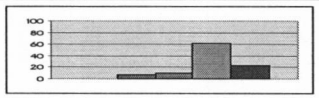
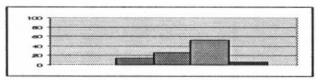
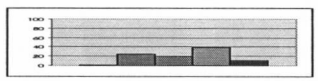
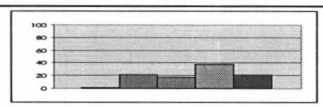
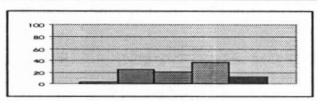
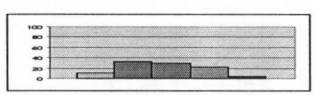
This section is a presentation of the findings on the extent to which a knowledge-orientation influences the implementation of customer value learning practices in manufacturing. Recall that customer value learning practices may be measured in terms of customer satisfaction (Anderson, Fornell and Lehmann, 1994; Parasuraman, Berry and Zeithaml, 1985), and customer retention (Jaworski and Kohli, 1993; Narver and Slater, 1995, Reicheld and Sasser, 1990), and sales from new products (Han, Kim and Srivastava, 1998). Based on Woodruff (1997), customer value learning practices comprise meeting with customers to learn about their current and future needs; building and mining information, knowledge and insight on customers' needs; systematically analysing changing customer needs from market research; and measuring customer satisfaction each year.

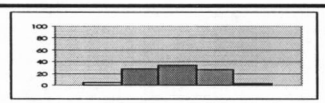
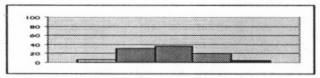
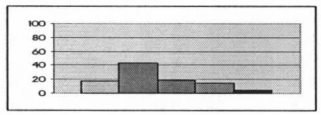
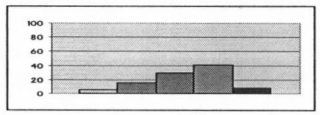
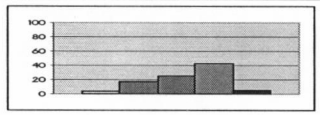
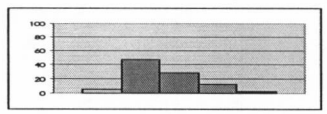
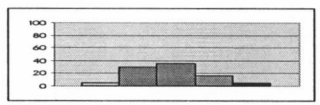
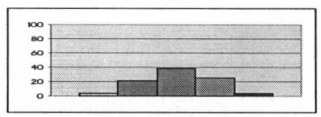
Presentation of findings using visual data analysis

This section presents the findings on the importance of knowledge-orientation activities to the respondents. The findings are illustrated in the histograms by frequency of the rescaled interval data, and are shown in Table 7 overleaf.

Table 7.

Questionnaire construct: "Customer value learning"

Question	Mean	Standard Deviation	Histogram Shape	Comment
CV1. We meet with customers often to learn about their current and future needs	4.134	1,411		Most respondents agree with the statement in CV1, though the data is symmetrically dispersed, as is shown by the high standard deviation. Most data is located around the mean.
CV2. Our knowledge of customers is thorough	3,706	1,458		High dispersion of data. Most respondents neither agree, nor disagree with the statement in CV2.
CV3. We systematically analyse customer information from market research	3,338	1,645		High dispersion of data. Most respondents neither disagree, nor agree with the statement in CV3.
CV4. We measure customer satisfaction each year	3,523	1,665		Distribution curve is nearly symmetrical with a high dispersion, as shown by the high standard deviation. Most data is not located around the mean. Most respondents neither agree, nor disagree with the statement in CV4.
CV5. Across functions, our culture encourages creativity and sharing of key lessons	3,369	1,604		Distribution curve is nearly symmetrical with a high dispersion, as shown by the high standard deviation. Most data is not located around the mean. Most respondents neither agree, nor disagree with the statement in CV5.
CV6. People are rewarded for sharing and applying key lessons	2,899	1,484		Distribution curve is skewed right. Most respondents disagree with the statement in CV6.

CV7. The latest key lessons are included in on-the-job training	3,011	1,514		Distribution curve tends towards symmetrical with a high dispersion, as is shown by the high standard deviation. Most data is not located around the mean. Most respondents disagree with the statement in CV7.
CV8. People spend part of their day finding new business opportunities	2,981	1,447		Distribution curve is skewed right. Most respondents disagree with the statement in CV8.
CV9. Key lessons are recorded in a useful computerised system	2,514	1,477		Distribution curve is skewed right. Most respondents disagree with the statement in CV9.
CV10. We record key lessons on what customers value [eg. product use, product quality features, product pricing, flexibility]	3,372	1,623		Distribution curve is skewed left. Most respondents neither agree, nor disagree with the statement in CV10.
CV11. We analyse key lessons on what customers value	3,305	1,671		Distribution curve is skewed left. Most respondents neither agree, nor disagree with the statement in CV11.
CV12. Employees easily access key lessons on customers needs	2,607	1,395		Distribution curve is skewed right. Most respondents disagree with the statement in CV12.
CV13. Key lessons on customer needs are often updated	2,815	1,545		Distribution curve tends towards symmetrical with a high dispersion, as shown by the high standard deviation. Most data is not located around the mean. Most respondents disagree with the statement in CV13.
CV14. Since applying key lessons on what customers value, the way additional revenue is generated has improved	2,957	1,617		Distribution curve tends towards symmetrical with a high dispersion, as shown by the high standard deviation. Most data is not located around the mean. Most respondents disagree with the statement in CV14.

Overview of findings on customer value learning

As the histograms in Table 7 above show, the shape of the distributions vary widely. This implies that the respondents are not uniform in their understanding of the extent to which knowledge sharing happens on customer value learning practices. The high standard deviations further supports this view. In most cases, respondents' answers to the statements tended towards the mean, in this case, "neither agree, nor disagree".

The collective sample mean scores for customer value learning, CV1 to CV14, range from 2,514 to 4,134. Based on the aggregated mean scores, the sampled organisations rated their performance in certain areas higher than in other customer value learning areas. For example, these organisations meet with customers often to learn about their current and future needs [CV1]; these organisations have a thorough knowledge of their customers [CV2]; and, these organisations measure customer satisfaction each year [CV4]. It seems that key lessons are not extensively recorded in a computerised system amongst these 6 organisations [CV9].

It should be noted that the aggregated score of 3,675 for CV1 to CV4, based on Woodruff (1997), may be an aggregate assessment of the sampled organisations' customer value-orientation. The aggregate score of CV5 to CV9 is 2,955, and may be an aggregate assessment of the sampled organisations' culture. On average, the sampled organisations rated their performance in customer value learning only slightly above 3.

The performance indicator, CV14, is a low mean score of 2,957, implying that these organisations do not currently attribute the way additional revenue is generated to applying "key lessons" on what customers value.

Country comparisons

The mean scores for customer value learning for the United States companies are marginally higher than the South African companies. There is little difference in mean scores between the United States sampled organisations and the South African sampled organisations on the extent to which they meet with customers to learn about their current and future needs [CV1].

The South African organisations seem to have a better knowledge of their customers' needs than the United States organisations [CV2]. The United States organisations seem to measure customer satisfaction each year more effectively than the South African organisations [CV4]. The United States sampled organisations seem to encourage creativity and sharing of "key lessons" better than the South African sample mean scores [CV5]. The United States organisations seem to reward employees for knowledge-sharing to a greater extent than the South African organisations [CV6]. South African sampled organisations seem to pay significantly less attention to recording "key lessons" in a useful computerised system than the United States sampled organisations' mean scores [CV9].

The aggregated mean score for the South African sampled organisations [3,696] is similar to the United States sampled mean score [3,627]. The

aggregated mean "culture score" for the South African sampled organisations [2,784] is significantly lower than the United States organisations' sampled mean score [3,365]. The performance indicator, CV14, for the United States organisations is lower, with a mean score of 2,526, compared to the South African mean score of 3,138.

Pearson's Correlation Analysis

Performance indicator: additional revenue vs. a knowledge-orientation

Pearson's Correlation Analysis is used to measure the extent to which high performance on customer value indicators in customer value learning practices is influenced by implementing a knowledge-orientation. No test for significance is required as the sample size is larger than 30. From the Pearson Correlation Report shown in Appendix C, there is a positive linear **correlation of 0,785** between the way additional revenue is generated [CV14] and a knowledge-orientation applied to customer value learning practices [aggregated mean score for CV10 to CV13].

A gap analysis of a proxy for customer value learning

Though there is a positive relationship between the way additional revenue is generated [CV14] and a knowledge-orientation applied to customer value learning, the sample mean performance rating [CV14] is low at 2,957.

The aggregated mean score for the entire sample of the importance of using key business lessons to collectively improve customer value learning, in

terms of improved customer satisfaction [B5], and improved customer loyalty [B6], and increased sales from new products [B7], is high at 4,592. *By comparing CV14, (the customer value performance indicator), to a collective aggregate of B5, B6 and B7, (the mean score for the importance of customer value learning), the gap of 35,7% (1,64) is the extent to which the sampled organisations feel that they need to improve in this area. This gap is found to be significant based on a Two-Sample t-test administered at 95% confidence level.* Refer to Appendix D.

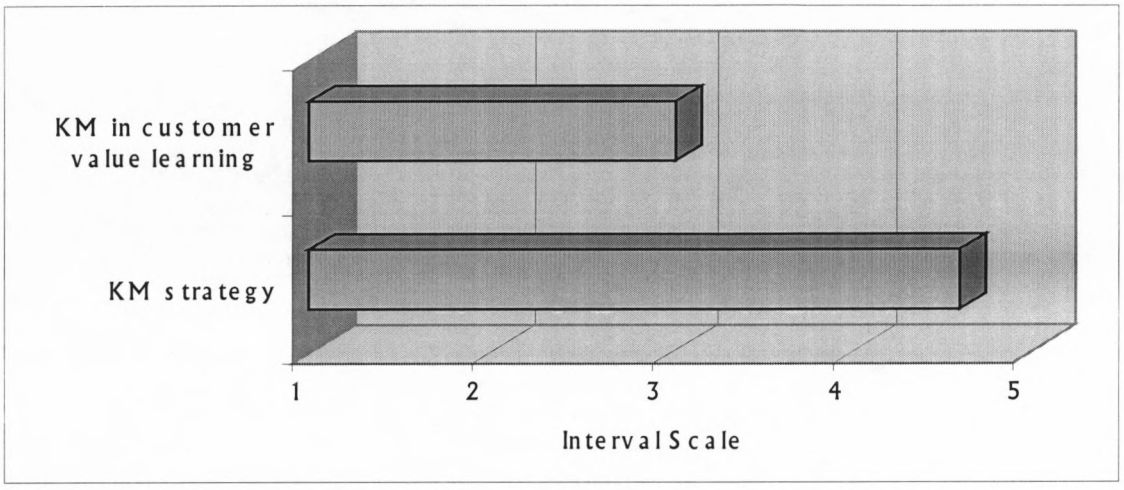
Further, the aggregated mean score for CV1 to CV4, customer value practices, for the entire sample is 3,675. *Measured against the "importance" of the aggregate of customer value learning, B5 to B7 [4,592], the gap is at least 20% (0.92). This gap is found to be significant based on a Two-Sample t-test administered at 95% confidence level.* Refer to Appendix D.

Knowledge-orientation gap analysis

The aggregate score of 3,025 for CV10 to CV13, is an assessment of the sampled organisations' knowledge-orientation ["performance"]. *Measured against the "importance" of the aggregate of knowledge-orientation activities, B1 to B4 [4,065], the gap is at least 25,6% (1,04).* Refer to Fig. 17 overleaf, and Appendix D.

Fig. 17

Strategic importance of knowledge-sharing vs. implementation in customer value learning practices



KM herein is an abbreviation for Knowledge Management.

Proposition Two

A knowledge orientation in manufacturing product development processes will influence the performance on customer satisfaction, customer retention and new product sales.

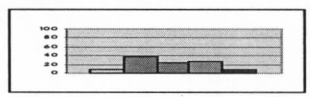
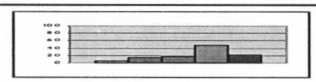
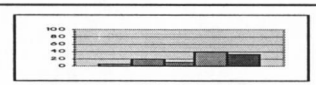
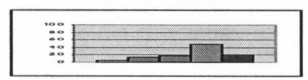
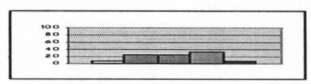
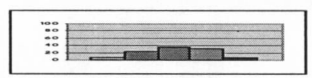
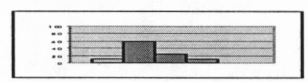
This section is a presentation of the findings on the extent to which a knowledge-orientation influences the implementation of product development practices in manufacturing.

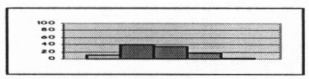
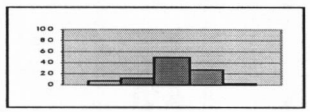
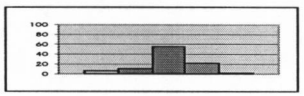
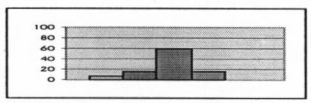
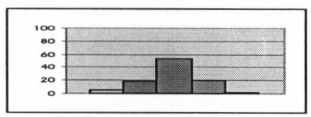
Presentation of findings using visual data analysis

The findings are illustrated in the histograms by frequency of the rescaled interval data. Refer to Table 8 overleaf, and Appendix D.

Table 8.

Questionnaire construct: "Product development"

Question	Mean	Standard Deviation	Histogram Shape	Comment
PD1. Our new products are unique for customers across industries	3,143	1,441		Distribution curve tends towards symmetrical with a high dispersion, as shown by the high standard deviation. Most data is not located around the mean. Most respondents neither agree, nor disagree with the statement in PD1.
PD2. We use cross-functional teams to speed up product development	3,906	1,398		High dispersion of data. Most respondents neither agree, nor disagree with the statement in PD2.
PD3. Our organisation launches new products each year	3,916	1,437		High dispersion of data. Most respondents neither agree, nor disagree with the statement in PD3.
PD4. Customers are involved in new product development processes	3,884	1,416		Distribution curve is skewed left. Most respondents neither agree, nor disagree with the statement in PD4.
PD5. We record key lessons on new product development processes	3,523	1,517		High dispersion of data. Most respondents neither agree, nor disagree with the statement in PD5.
PD6. We analyse key lessons on new product development	3,309	1,422		High dispersion of data. Most respondents neither agree, nor disagree with the statement in PD6.
PD7. Employees easily access key lessons on new product development processes	2,514	1,187		Distribution curve is skewed right. Most respondents disagree with the statement in PD7.

PD8. Key lessons on new product development are often updated	2,769	1,333		Distribution curve is skewed right. Symmetrical distribution. Most respondents disagree with the statement in PD8.
PD9. Since applying key lessons on new product development, new products are developed faster	3,239	1,425		High dispersion of data. Most respondents neither agree, nor disagree with the statement in PD9.
PD10. Since applying key lessons on new product development, customer satisfaction ratings have improved	3,165	1,419		High dispersion of data. Most respondents neither agree, nor disagree with the statement in PD10.
PD11. Since applying key lessons on new product development, customer repeat buying has improved	3,020	1,372		High dispersion of data. Most respondents neither agree, nor disagree with the statement in PD11.
PD12. Since applying key lessons on new product development, the % sales from new products has increased	3,085	1,399		High dispersion of data. Symmetrical distribution. Most respondent neither agree, nor disagree with the statement in PD12.

Overview of findings on product development

As the histograms in Table 8 above show, there are high standard deviations which suggests that respondents were varying widely in their responses. In most cases, respondents' answers to the statements tended towards the mean, in this case, "neither agree, nor disagree".

The collective sample mean scores for product development range from 2,514 to 3,916. Based on the aggregated mean scores, the entire sampled organisations rated their performance in certain product development processes higher than in others. For example, using cross-functional teams to speed up new product development [PD2] and launching new products each year [PD3].

It can be assumed that PD5 to PD8 is a proxy for knowledge-orientation as applied to product development processes. As shown from the low mean aggregated scores of 2,961 for PD5 to PD8, these organisations do not currently rate their performance highly on knowledge-orientation practices in new product development processes. *Similarly, each of the "performance indicators", PD9 to PD12, has a low mean score.* Refer to Appendix D.

Country comparisons

The mean scores on customer value learning for the United States sampled companies are marginally higher than the South African sampled companies. Based on the aggregated mean scores, the United States sampled organisations seem to use cross-functional teams to speed up new product development better than the South African sample organisations [PD2]. The

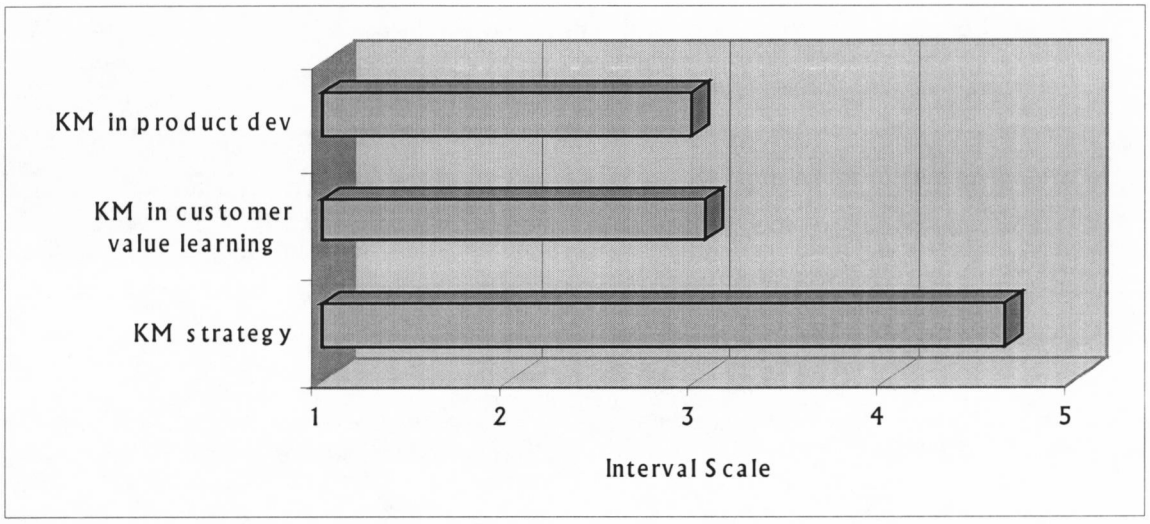
United States sampled organisations seem to launch new products to a greater extent than the South African sampled organisations. The South African sampled organisations seem to involve customers in new product development processes better than United States sampled organisations [PD4]. The scores for the performance indicators, customer satisfaction [PD10], customer retention [PD11], and sales from new products [PD12], are as low amongst the United States sampled organisations, as they are amongst the South African sampled organisations.

Knowledge-orientation gap analysis

The aggregated mean score for a **knowledge-orientation applied to product development**, PD5 to PD8, is 2,961. The comparative and aggregated mean score for the **"importance" of a knowledge-orientation**, B1 to B4, is 4,605. *Therefore the gap of 35,6% (1,64) is the extent to which the sampled organisations feel that they need to improve in this area. This gap is found to be significant at 95% confidence level using a Two-Sample t-test in NCSS.* Refer to Fig. 18 overleaf, as well as Appendix D.

Fig. 18

Implementation of knowledge-sharing in product development vs. strategic importance



Pearson Correlation Analysis

Customer satisfaction performance indicator

From the Pearson Correlation Report, the **correlation of 0,674** between customer satisfaction [PD10] and a knowledge-orientation applied to product development [aggregated mean score for PD5 to PD8] is linear.

Gap analysis for customer satisfaction

Though there seems to be a linear relationship between customer satisfaction [PD10] and a knowledge-orientation applied to product development, the aggregated mean score for customer satisfaction for the entire sample [PD10] is low at 3,165. Recall that customer satisfaction is a performance indicator of customer value learning. The aggregated mean score

for the entire sample of the "importance" of using key business lessons in these organisations' business strategy to improve customer satisfaction [B5] is high at 4,676. *Therefore the gap of 32,3% (1,51) is the extent to which the sampled organisations feel that they need to improve in this area. This gap is found to be significant at 95% confidence level using a two-sample t-test in NCSS.* Refer to Appendix D.

Customer retention performance indicator

From the Pearson Correlation Report, the **correlation of 0,616** between customer retention [PD11] and a knowledge-orientation applied to product development [aggregated mean score for PD5 to PD8] is linear. This implies that where the sampled manufacturing organisations apply a knowledge-orientation to their product development processes, customer retention levels may be positively influenced.

Gap analysis for customer retention

Though there is a linear relationship between customer retention [PD11] and a knowledge-orientation applied to product development, the aggregated mean score for the entire sample [PD11] is low at 3,020. Recall that customer retention is a performance indicator of customer value learning. The aggregated mean score for the entire sample of the "importance" of using key business lessons in their business strategy to improve customer loyalty [B6] is high at 4,533. *The gap of 33,3% (1,51) is the extent to which the sampled organisations feel they need to improve in this area. This gap is found to be*

significant at 95% confidence level using a Two-Sample t-test in NCSS. Refer to Appendix D.

Sales from new products performance indicator

From the Pearson Correlation Report, there is a linear **correlation of 0,622** between sales from new products [PD12] and a knowledge-orientation applied to product development [aggregated mean score for PD5 to PD8]. This implies that where the sampled manufacturing organisations have applied a knowledge-orientation to their product development processes, sales from new products may be influenced or improve.

Gap analysis for sales from new products

Though there is a linear relationship between sales from new products [PD12] and a knowledge-orientation applied to product development, the aggregated mean score for the entire sample [PD12] is low at 3,085. Recall that sales from new products is a performance indicator of customer value learning. The aggregated mean score for the entire sample of the importance of using key business lessons in business strategy to improve sales from new products [B7] is high at 4,566. *Therefore the gap of 32,4% (1,48) is the extent to which the sampled organisations feel they need to improve in this area. This gap is found to be significant at 95% confidence level using a Two-Sample t-test in NCSS.* Refer to Appendix D.

Proposition Three

A knowledge orientation in manufacturing supply chain practices will influence the performance on customer satisfaction, customer retention and new product sales.

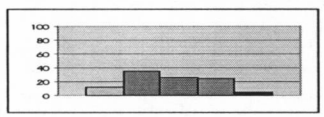
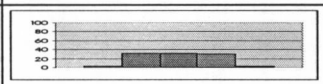
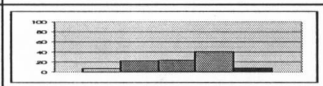
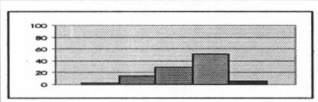
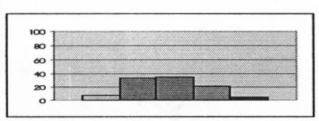
This section is a presentation of the findings on the extent to which a knowledge-orientation influences the implementation of supply chain practices in manufacturing.

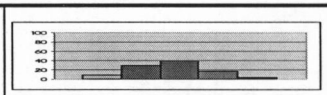
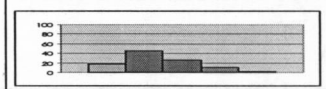
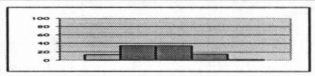
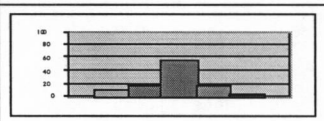
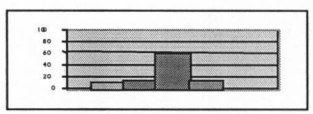
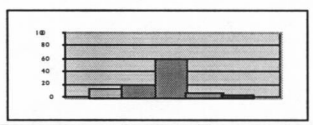
Presentation of findings using visual data analysis

The findings are illustrated in the histograms by frequency of the rescaled interval data. Refer to Table 9 overleaf.

Table 9.

Questionnaire construct: "Supply chain management"

Question	Mean	Standard Deviation	Histogram Shape	Comment
SC1. We partner with suppliers using real-time information management systems	2,925	1,447		Distribution curve tends towards symmetrical with a high dispersion, as is shown by the high standard deviation. Most data is not located around the mean. Most respondents disagree with the statement in SC1.
SC2. Suppliers mostly understand our customers' needs	3,190	1,391		High dispersion of data. Most respondents neither agree, nor disagree with the statement in SC2.
SC3. Suppliers are often involved in product development	3,407	1,505		Distribution curve is skewed left. Most respondents neither agree, nor disagree with the statement in SC3.
SC4. Suppliers mostly understand the impact of their technology and processes on our manufacturing processes	3,687	1,392		Distribution curve is skewed left. Most respondents neither agree, nor disagree with the statement in SC4.
SC5. We record key lessons on suppliers' processes [eg. how they shorten their lead times or improve product quality]	2,974	1,394		High dispersion of data. Most respondents disagree with the statement in SC5.

SC6. We analyse key lessons on suppliers' processes	2,888	1,415		High dispersion of data. Most respondents disagree with the statement in SC6.
SC7. Employees easily access key lessons on suppliers' technology and processes	2,415	1,293		Distribution curve is skewed right. Most respondents disagree with the statement in SC7.
SC8. Key lessons on suppliers' technology and processes are often updated	2,659	1,377		High dispersion of data. Most respondents disagree with the statement in SC8.
SC9. Since applying key lessons on suppliers' technology and processes, satisfaction ratings by our customers have improved	2,869	1,483		High dispersion of data. Most respondents disagree with the statement in SC9.
SC10. Since applying key lessons on suppliers' technology and processes, repeat buying by our customers has improved	2,812	1,460		High dispersion of data. Most respondents disagree with the statement in SC10.
SC11. Since applying key lessons on suppliers' technology and processes, the % sales from new products has increased	2,663	1,404		High dispersion of data. Most respondents disagree with the statement in SC11.

Overview of findings on supply chain practices

As the histograms in Table 9 above show there are high standard deviations which suggests that respondents were varying widely in their responses. In most cases respondents disagreed with the statements implying that knowledge sharing is not entrenched in supply chain management practices.

The collective sample mean scores for supply chain practices range from 2,415 to 3,687. Based on the aggregated mean scores, the entire sampled organisations rated their performance in certain supply chain practices higher than in others. For example, where suppliers mostly understand the impact of their technology and processes of the organisation's manufacturing processes [SC4], or where suppliers are mostly involved in product development [SC3].

It can be assumed that SC5 to SC8 is a proxy for knowledge-orientation as applied to supply chain practices. As shown from the low mean aggregated score of 2,734 for SC5 to SC8, these organisations do not currently rate their performance highly on knowledge-orientation practices in supply chain practices. *Similarly, on average, each of the "performance indicators", SC9 to SC11, has a low mean score that is below 3.*

Country comparisons

The mean scores on customer value learning for the United States sampled companies are similar to the South African sampled companies. The South African sampled manufacturing organisations seem better than the United

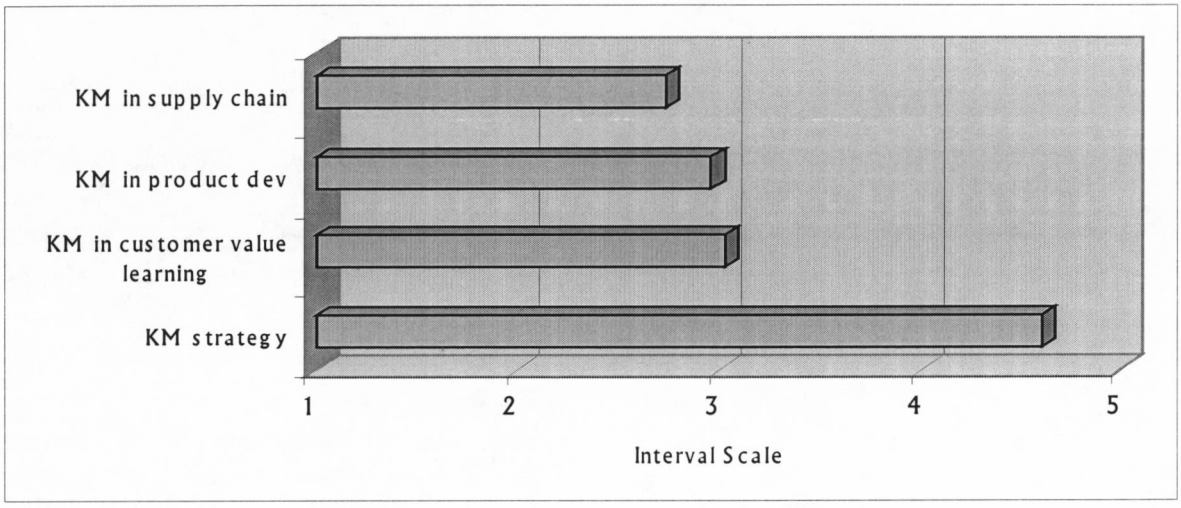
States sampled organisations in ensuring that their suppliers understand the impact of supplier technology and processes on their manufacturing processes [SC4]. The scores for the performance indicators, customer satisfaction [SC9], customer retention [SC10], and sales from new products [SC11], are as low amongst the United States organisations, as they are amongst the South African organisations.

Knowledge-orientation gap analysis

The aggregated mean score for a **knowledge-orientation applied to supply chain practices**, SC5 to SC8, is 2,734. The comparative and aggregated mean score for **"importance" of a knowledge-orientation**, B1 to B4, is 4,605. *Therefore, the gap of 40,6% (1,87) is the extent to which the sampled organisations feel they need to improve in this area. This gap is found to be significant at 95% confidence level using a Two-Sample t-test in NCSS.* Refer to Fig. 19 overleaf, as well as Refer to Appendix D.

Fig. 19

Implementation of knowledge-sharing in supply chain management vs. strategic importance



Pearson Correlation Analysis

Customer satisfaction performance indicator

From the Pearson Correlation Report, the **correlation of 0,773** between customer satisfaction [SC9] and a knowledge-orientation applied to supply chain practices [aggregated mean score for SC5 to SC8] is linear and high.

Gap analysis for customer satisfaction

Though there seems to be a high and positive linear relationship between customer satisfaction [SC9] and a knowledge-orientation applied to supply chain practices, the aggregated mean score for customer satisfaction for the entire sample [SC9] is also low at 2,869. Recall that customer satisfaction is a performance indicator of customer value learning. The aggregated mean score

for the entire sample of the "importance" of using key business lessons in the business strategy to improve customer satisfaction [B5] is high at 4,676. *Therefore, the gap of 38,7% (1,81) is the extent to which the sampled organisations feel they need to improve in this area. This gap is found to be significant at 95% confidence level using a Two-Sample t-test in NCSS.* Refer to Appendix D.

Customer retention performance indicator

From the Pearson Correlation Report, the **correlation of 0,774** between customer retention [SC10] and a knowledge-orientation applied to supply chain practices [aggregated mean score for SC5 to SC8] is positive and linear. This implies that where the sampled manufacturing organisations have applied a knowledge-orientation to their supply chain practices, customer retention levels may be positively influenced.

Gap analysis for customer retention

Though there is a high positive linear relationship between customer retention [SC10] and a knowledge-orientation applied to supply chain practices, the aggregated mean score for the entire sample [SC10] is low at 2,812. Recall that customer retention is a performance indicator of customer value learning. The aggregated mean score for the entire sample of the "importance" of using key business lessons in their business strategy to improve customer loyalty [B6] is high at 4,533. *Therefore, the gap of 37,9% (1,72) is the extent to which the sampled organisations feel they need to improve in this area. This gap is found*

to be significant at 95% confidence level using a Two-Sample t-test in NCSS. Refer to Appendix D.

Sales from new products performance indicator

From the Pearson Correlation Report, there is a linear **correlation of 0,733** between sales from new products [SC12] and a knowledge-orientation applied to supply chain practices [aggregated mean of SC5 to SC8]. This implies that where the sampled manufacturing organisations have applied a knowledge-orientation to their supply chain practices, sales from new products may be positively influenced.

Gap analysis for sales from new products

Though there is a high positive linear relationship between sales from new products [SC12] and a knowledge-orientation applied to supply chain practices, the aggregated mean score for the entire sample [SC12] is low at 2,663. Recall that sales from new products is a performance indicator of customer value learning. The aggregated mean score for the entire sample of the "importance" of using key business lessons in business strategy to improve sales from new products [B7] is high at 4,566. *Therefore, the gap of 41,6% (1,90) is the extent to which the sampled organisations feel they need to improve in this area. This gap is found to be significant at 95% confidence level using a Two-Sample t-test in NCSS.* Refer to Appendix D.

Proposition Four

A knowledge orientation in manufacturing process improvements will influence the performance on customer satisfaction and customer retention.

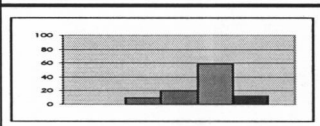
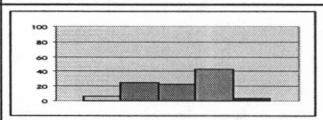
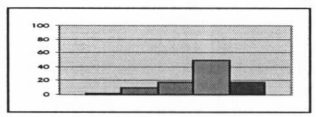
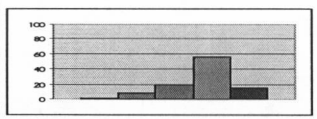
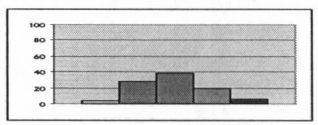
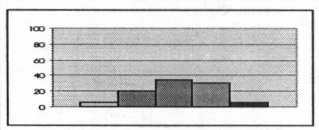
This section is a presentation on the findings on the extent to which a knowledge-orientation influences the implementation of process improvements in manufacturing.

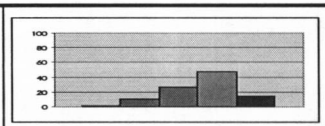
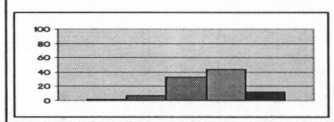
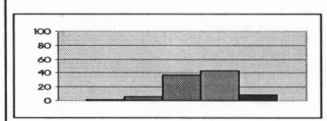
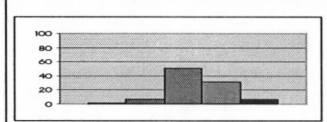
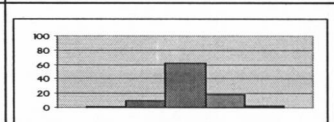
Presentation of findings using visual data analysis

The findings are illustrated in the histograms by frequency of the rescaled interval data. Refer to Table 10 overleaf.

Table 10.

Questionnaire construct: "Process improvements"

Question	Mean	Standard Deviation	Histogram Shape	Comment
PR1. Manufacturing persons continuously eliminate non-value-adding production activities	3,861	1,504		Distribution curve is skewed left. Most respondents neither agree, nor disagree with the statement in PR1.
PR2. Manufacturing persons are in direct contact with customers	3,282	1,582		High dispersion of data. Most respondents neither agree, nor disagree with the statement in PR2.
PR3. We record key lessons on process improvements [eg. how to reduce cycle times, or improve quality, or remove bottlenecks]	3,672	1,708		Distribution curve is skewed left. High standard deviation. Most respondents neither agree, nor disagree with the statement in PR3.
PR4. We analyse key lessons on process improvements	3,771	1,622		Distribution curve is skewed left. Most respondents neither agree, nor disagree with the statement in PR4.
PR5. Employees easily access key lessons on process improvements	2,991	1,515		Distribution curve is skewed right. Symmetrical distribution. Most respondents disagree with the statement in PR5.
PR6. Key lessons on process improvements are often updated	3,140	1,601		High dispersion of data. Most respondents neither agree, nor disagree with the statement in PR6.

PR7. Since applying key lessons on process improvements, production cycle time has been reduced	3,641	1,625		Distribution curve is skewed right. Most respondents neither agree, nor disagree with the statement in PR7.
PR8. Since applying key lessons on process improvements, product and process quality have improved	3,629	1,594		Distribution curve is skewed right. Most respondents neither agree, nor disagree with the statement in PR8.
PR9. Since applying key lessons on process improvements, production rework has been reduced	3,588	1,567		High dispersion of data. Most respondents neither agree, nor disagree with the statement in PR9.
PR10. Since applying key lessons on process improvements, customer satisfaction ratings have improved	3,410	1,500		High dispersion of data. Most respondents neither agree, nor disagree with the statement in PR10.
PR11. Since applying key lessons on process improvements, customer repeat buying has improved	3,132	1,463		High dispersion of data. Most respondents neither agree, nor disagree with the statement in PR11.

Overview of findings on process improvements

As the histograms in Table 10 above show, there are high standard deviations which suggests that respondents were varying widely in their responses. Most respondents' answers to the statements tended towards the mean, in this case, "neither agree, nor disagree".

The collective sample mean scores for process improvements range from 2,991 to 3,861. Based on the aggregated mean scores, the entire sampled organisations rated their performance in certain process improvements higher than in others. The following examples for the sampled organisations attained a mean score of 3,6 and higher:

- manufacturing persons continuously eliminate non-value-adding production activities [PR1]
- recording key lessons on process improvements [PR3]
- analysing key lessons on process improvements [PR4]
- since applying key lessons in process improvements, production cycle time has been reduced [PR7]
- since applying key lessons in process improvements, production and process quality have improved [PR8]

It can be assumed that PR3 to PR6 is a proxy for knowledge-orientation as applied to process improvements. As is shown from the mean aggregated score of 3,394 for PR3 to PR6, these organisations do not currently rate their performance highly on knowledge-orientation practices in process improvements. This is however, where knowledge sharing has had the highest

impact on their manufacturing practices amongst the sampled organisations. *Similarly, on average, each of the "performance indicators", PR7 to PR11, has a mean score higher than those for product development, supply chain, and customer value learning practices.*

Country comparisons

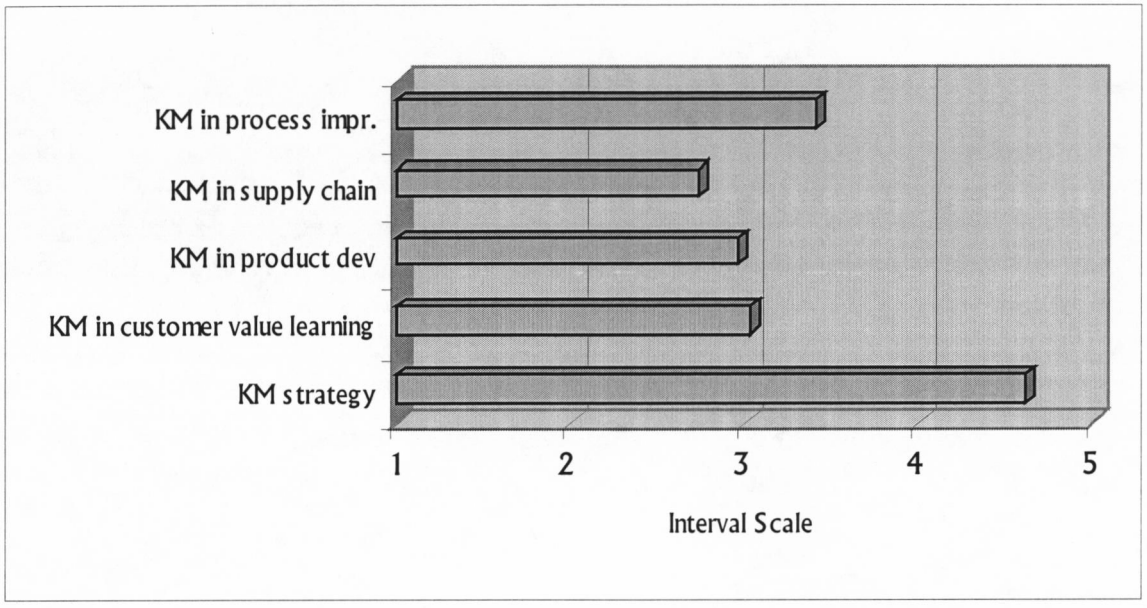
The mean scores on process improvements for the United States sampled companies are similar to the South African sampled companies. The United States sampled organisations seem better than the South African sampled organisations in analysing key lessons from process improvements [PR4]. The South African sampled organisations seem to have better contact with customers than the United States sampled organisations [PR2]. The scores for the performance indicators, customer satisfaction [PR10], and customer retention [PR11], are as low amongst the United States organisations, as they are amongst the South African organisations.

Knowledge-orientation gap analysis

The aggregated mean score "performance" for a **knowledge-orientation applied to process improvements**, PR3 to PR6, is 3,394. The comparative and aggregated mean score for **"importance" of a knowledge-orientation**, B1 to B4, is 4,605. *The gap of 26,3% (1,21) is the extent to which the sampled organisations feel they need to improve in this area. This gap is found to be significant at 95% confidence level using a two-sample t-test in NCSS.* Refer to Fig. 20 overleaf, as well as Appendix D.

Fig. 20

Implementation of knowledge-sharing in process improvements vs. strategic importance



Pearson Correlation Analysis

Customer satisfaction performance indicator

From the Pearson Correlation Report, the **correlation of 0,817** between customer satisfaction [PR10] and a knowledge-orientation applied to process improvements [aggregated mean of PR3 to PR6] is positive, linear and very high.

Gap analysis for customer satisfaction

In addition to a strong positive linear relationship between customer satisfaction [SC9] and a knowledge-orientation applied to process improvements, the aggregated mean score for customer satisfaction for the

entire sample [PR10] is reasonably high at 3,410. Recall that customer satisfaction is a performance indicator of customer value learning. The aggregated mean score for the entire sample of the "importance" of using key business lessons in the business strategy to improve customer satisfaction [B5] is high at 4,676. *Therefore, the gap of 27,2% (1,27) is the extent to which the sampled organisations feel they need to improve in this area. This gap is found to be significant at 95% confidence level using a Two-Sample t-test in NCSS.* Refer to Appendix D.

Customer retention performance indicator

From the Pearson Correlation Report, the **correlation of 0,721** between customer retention [PR11] and a knowledge-orientation applied to process improvements [aggregated mean score for PR3 to PR6] is positive and linear. This implies that where the sampled manufacturing organisations have applied a knowledge-orientation to their process improvements, customer retention levels may be positively influenced.

Gap analysis for customer retention

Though there is a linear relationship between customer retention [SC10] and a knowledge-orientation applied to process improvements, the aggregated mean score for the entire sample [PR11] is 3,132. Recall that customer retention is a performance indicator of customer value learning. The aggregated mean score for the entire sample of the "importance" of using key business lessons in their business strategy to improve customer loyalty [B6] is high at 4,533. *Therefore, the gap of 30,8% (1,40) is the extent to which the sampled*

organisations feel they need to improve in this area. This gap is found to be significant at 95% confidence level using a Two-Sample t-test in NCSS. Refer to Appendix D.

Chapter Five Evaluation of Findings

This section of the research report is an evaluation and interpretation of the findings for each proposition against the literature cited.

Background Information

The need for a Chief Knowledge Officer

From the findings, only one company acknowledged that a formal chief knowledge officer (CKO) position exists in their organisation. Yet, from desk research, 2 of the 3 United States companies have a similar position, whereas only 1 out of the 3 South African companies has such a position. This indicates that most respondents are not aware that their organisation has implemented knowledge-sharing that may align with current business strategy and processes.

Recall that Earl and Scott (1999, p. 37) suggest that: "Appointing a CKO is one way of galvanizing, directing and coordinating a knowledge management program or initiative". Further, these authors conclude, however, that a future scenario is where knowledge management becomes a source of value creation and competitiveness and the need for a CKO declines.

Knowledge-sharing technology

From desk research, 1 of the United States companies uses a combined intranet and web-enabled platform to share knowledge. In other words, the use of an Intranet or Internet as a knowledge-sharing method should have been higher amongst the United States respondents. This demonstrates a possible lack of understanding amongst respondents on the term "Intranet" and "Internet" in the questionnaire. Recall that Davenport (1997) suggests that technology should become an enabler of knowledge-sharing, as a part of a knowledge management initiative, rather than as a strategy in itself. This may explain why meetings was a major way the respondents share knowledge.

"Importance to your organisation"

As was found from the mean scores on Section A in the administered questionnaire, knowledge-orientation activities are less strategically important for the South African sampled organisations than the United States sampled organisations.

Summation of the "Importance to your organisation"

In sum from the above section in the questionnaire:

- Identifying and managing "key business lessons" are important for the 6 organisations in this research. Recall that Earl and Scott's (1999) study found that leaders in the sampled organisations felt that knowledge is a major source of sustainable competitive advantage, particularly where knowledge is consistently created and shared.

These organisations tend to not know what they know because they are not systematically managing their knowledge.

- A knowledge-orientation needs to be incorporated into a manufacturing organisation's corporate business strategy. Based on Oliver (1999) and Roth, Giffi and Seal (1992), given that manufacturing should take on a more strategic role, this would be meaningful where knowledge-sharing focuses on how products win orders in the market. World-class manufacturing is based on managing effectiveness and efficiency, according to Basu and Wright (1997), and these need to entrench knowledge optimisation and knowledge creation practices (Sullivan, 1998).
- Collectively there is a need to entrench customer value learning into these organisations' corporate business strategy. World-class manufacturers have unique close customer relationships and highly satisfied customers, according to Roth, Giffi and Seal (1992), and Vermeulen (1998).
- In general, performance ratings on customer value indices can be improved if these organisations apply "key business lessons" across core manufacturing business processes as strategic business goals. This supports the view held by Roth, Giffi and Seal (1992, p. 153) that: " . . . world-class manufacturers adopt a balanced perspective to managing competition, creating unique value for customers, and creating knowledge".

Proposition One

A knowledge orientation in manufacturing will influence the implementation of customer value learning

Customer value learning

Given, that on average, the sampled organisations have rated their performance in questions CV1 to CV4 only slightly above 3, it is possible that customer value learning and a knowledge-orientation culture are not comprehensively entrenched in these organisations. The findings must be treated with caution as most of the sampled companies have implemented sound market-orientation practices. The respondents were possibly under-rating their organisations, or could have rushed the completion of this section, or misunderstood the questions.

Culture indices

It is a concern that these sampled world-class organisations did not rate their performance on knowledge-sharing culture indices, CV5 to CV9, any higher. The performance ratings on organisational culture should have been higher, given that these organisations are known to adopt progressive human resources practices.

This finding supports the views held by Drucker, (1999); Kanter, Kao, and Wiersema (1997); and Woodruff (1997) that an organisation will achieve better customer value learning in a knowledge-sharing and entrepreneurial climate. In

particular, a knowledge-orientation culture needs to encourage creativity and sharing of "key lessons". A knowledge-orientation culture needs to reward employees for sharing their experience and knowledge. Finally, a knowledge-orientation culture will ensure that on-the-job training incorporates real-time "key lessons".

Proposition One Summation

In sum from the above section in the questionnaire:

- Given that CV14 has a low mean score, amongst these organisations there is no causal relationship between applying "key lessons", [or a knowledge-orientation], and the way additional revenue is generated in customer value learning practices. Yet, Peppers, Rogers, and Dorf (1999) posit that an organisation that adopts a customer learning relationship has adapted its behaviour to meet individual customer needs. This low mean score suggests that these organisations are not adopting a comprehensive customer-of-one, or mass customisation relationship.
- From the Pearson's Correlation Analysis, there is a positive linear relationship of 0,785 between the way additional revenue is generated and adopting a knowledge-orientation in customer value learning practices.
- A knowledge-orientation implemented in customer value learning practices may influence the way additional revenue is generated, but this has not been fully implemented amongst the sampled

organisations. It was found that some respondents do not have a clear understanding of customer value learning practices [11,5% unanswered].

- **Therefore, this proposition is not supported.**

There is a need to entrench knowledge-sharing in customer value learning practices amongst these organisations. Reflecting on Woodruff's (1997) **"Translating Customer Value Learning Into Action"** model, the sampled manufacturing organisations are not synthesising information and their knowledge on customer needs, or customer feedback. In this situation, continuous organisational learning will happen when information and knowledge are shared with those closest to the customer, business problem or decision (O'Dell and Grayson, 1997; Sveiby, 1997). The respondents are not aware of the likely impact of knowledge-sharing on customer value learning practices.

To this end, sharing the assimilated information and knowledge on what customers value with manufacturing and frontline sales persons may result in more effective ways to generate additional income, especially from profitable customers. Therefore, there is a need to ensure that the organisation's manufacturing strategy leverages "best practices", or knowledge optimisation, and increased revenue, or knowledge creation. This would enable manufacturing organisations to reorient their strategies around customer value delivery (Day, 1994; Peppers and Rogers, 1997; and Knox and Maklan, 1998).

Proposition Two

A knowledge orientation in manufacturing product development processes will influence the performance on customer satisfaction, customer retention and new product sales.

On average, these organisations are not necessarily attributing faster product development to the implementation of knowledge-sharing practices. These organisations are not necessarily attributing higher customer satisfaction ratings or higher customer retention levels to the implementation of knowledge-sharing practices. Finally, these organisations are not necessarily attributing increased percentage of sales from new products to the implementation of knowledge sharing practices.

Proposition Two Summation

In sum from the above section in the questionnaire:

- Given the low aggregated mean score for each performance indicator, PD10 and PD11 and PD12, there is no causal relationship amongst these organisations between applying "key lessons" in product development, and improved performance in customer satisfaction or customer retention or new product sales.
- From the Pearson's Correlation Analysis, there is a positive linear relationship amongst these organisations between improved customer satisfaction or improved customer retention or increases sales from new products, and adopting a knowledge-orientation in product development

practices. This supports the view held by Han, Kim and Srivastava (1998) that innovations happen in a market-oriented culture. Further, product development based on customer knowledge processes are precursors to value creation and business growth (Kanter, Kao and Wiersema, 1998; Leonard, 1998; Li and Calantone, 1998; Madhavan and Grover, 1998).

- Although a knowledge-orientation, when implemented in product development practices, may influence the performance on customer satisfaction or customer retention or sales from new products, this has not been extensively implemented amongst the sampled organisations. These organisations do not currently rate their performance highly on knowledge-orientation practices in new product development processes. Similarly, each of the "performance indicators", PD9 to PD12, has a low mean score. It was found that some respondents do not have a clear understanding of product development practices [7,2% unanswered].
- There is a large gap (35,5%) between knowledge-sharing practices as a strategic goal, and the way it is implemented in product development processes. The gap between knowledge-sharing as a strategic intent and implementation in product development is the highest in customer retention as a performance indicator of customer value learning. The respondents are not aware of the likely impact of knowledge-sharing on product development practices. Leonard's (1998) view herein is that organisations need to grow explicit and tacit capabilities, while ensuring that core rigidities do not stifle the organisation.
- **In other words, this proposition is not supported.**

Therefore, when applying knowledge-sharing to product development, the impact on improved customer satisfaction ratings and increases sales from new products will be felt before the impact on customer retention levels. This may support the view held by Jones and Sasser (1995) that satisfied customers are not always loyal. Clearly then, manufacturing strategy should embrace knowledge-sharing processes in product development that focus not only on customer satisfaction, but also on customer retention.

Proposition Three

A knowledge orientation in manufacturing supply chain practices will influence the performance on customer satisfaction, customer retention and new product sales.

The sampled manufacturing organisations do not currently rate their performance highly on knowledge-orientation practices in supply chain practices. Similarly, on average, each of the "performance indicators", SC9 to SC11, has a low mean score that is below 3.

On average, these organisations are not necessarily attributing higher customer satisfaction ratings or higher customer retention levels to the implementation of knowledge-sharing in supply chain practices. These organisations are not necessarily attributing increased percentage of sales from new products to the implementation of knowledge sharing in supply chain practices. Yet, sharing knowledge with suppliers can leverage ongoing customer

value learning (Clemon and Row, 1993; Woodruff, 1997). There is a need amongst the sampled organisations to integrate their suppliers in the innovation and customer value creation cycle (Laseter, 1998; Robertson and Ulrich, 1998). Knox and Maklan (1998, p.38) state: "Customer value is created by directing the entire efforts of an organization and its networks of alliance partners and suppliers towards that aim".

Proposition Three Summation

In sum from the above section in the questionnaire:

- Given that each performance indicator, SC10 and SC11 and SC12, has a low mean score, there is no causal relationship amongst the sampled organisations between applying "key lessons" in supply chain practices, and improved performance in customer satisfaction or customer retention or new product sales
- From the Pearson's Correlation Analysis, there is a high positive linear relationship amongst these organisations between customer satisfaction or customer retention or new product sales, and adopting a knowledge-orientation in supply chain practices.
- Although a knowledge-orientation, when implemented in supply chain practices, may influence the performance on customer satisfaction or customer retention or sales from new products, this has not been extensively implemented amongst the sampled organisations. It was found that some respondents do not have a clear understanding of supply chain management practices [9,3% unanswered].

- There is a large gap (41,6%) between knowledge-sharing practices as a strategic goal and the way it is implemented in supply chain management. The gap between knowledge-sharing as a strategic intent and implementation in supply chain management is the highest in sales from new products as a performance indicator of customer value learning. Therefore, the respondents are not aware of the likely impact of knowledge-sharing on supply chain practices.
- **In other words, this proposition is not supported.**

It seems that the sampled manufacturing organisations are not sufficiently agile whereby they have leveraged customer value learning networks in the supply chain, as described by Laseter, 1998. Supply chain responsiveness, founded on knowledge-sharing with supplier partners, needs to improve amongst the sampled organisations. Lastly, knowledge should be shared on technology, production processes, customers and market dynamics that impact on inventory holdings and planning (Billington, Lee and Tang, 1998).

Proposition Four

A knowledge orientation in manufacturing process improvements will influence the performance on customer satisfaction and customer retention.

The sampled manufacturing organisations currently rate their performance the highest on knowledge-orientation practices in process improvements, compared to supply chain, product development, and customer value learning practices.

On average, these organisations attribute higher customer satisfaction ratings or higher customer retention levels to the implementation of knowledge-sharing in process improvements. This may be synonymous with sharing of "best practices" in world-class manufacturing.

Proposition Four Summation

In sum from the above section in the questionnaire:

- Although each performance indicator, PR10 and PR11, has a reasonably high mean score, amongst these organisations there is no causal relationship between applying "key lessons" in process improvements, and improved performance in customer satisfaction or customer retention.

- From the Pearson's Correlation Analysis, there is a high positive linear relationship between customer satisfaction or customer retention, and adopting a knowledge-orientation in process improvements.
- Therefore, a knowledge-orientation implemented in process improvements may influence the performance on customer satisfaction or customer retention, which has been largely implemented amongst the sampled organisations. This is the case, in spite of a previous finding that some respondents do not have a clear understanding of process improvements [12% unanswered].
- There is a small gap (26,3%) between knowledge-sharing practices as a strategic goal, and the way it is implemented in process improvements. The gap between knowledge-sharing as a strategic intent and implementation in process improvements is the highest in customer retention as a performance indicator of customer value learning.
- **In other words, this proposition is largely supported.**

Process improvements may comprise quality management programmes wherein process knowledge is critical. Often this is derived from customer feedback and knowledge of customers' needs (Berry, Parasuraman, and Zeithaml, 1993; Garvin, 1987). Amongst the sampled organisations continuous process improvements aimed at eliminating non-value-adding activities, and an ongoing flow of value-adding information, are indicative of sharing of knowledge and "best practices" (Basu and Wright, 1997). The respondents' awareness of these operational efficiencies may explain why they are confident that

knowledge-sharing has helped improve customer satisfaction ratings. This is surprising, given Davenport's (1997) view that knowledge sharing is not often the focus of rigorous continuous process improvement programmes. Based on Khurana (1999) in these situations production staff would have begun to develop problem-solving and analytical skills, as well as an understanding of cause-and-effect.

Constructing a knowledge-orientation model in manufacturing with emphasis on customer value

Considering the findings and evaluation against the literature review and the framework shown as Fig. 21 below, it is possible to construct a knowledge-orientation model in manufacturing which guides the attainment of high performance on customer value indices.

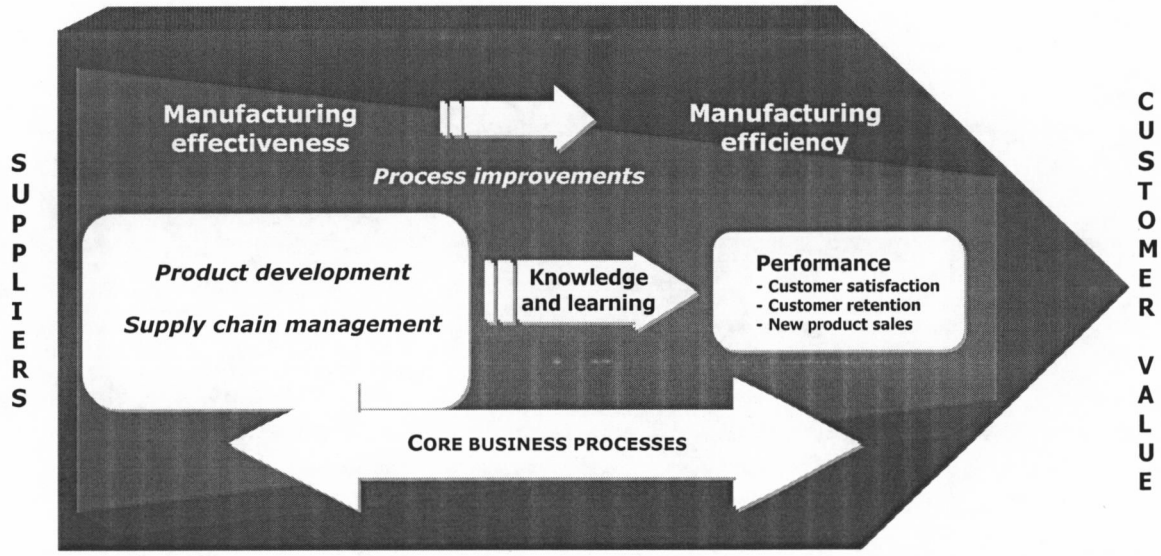


Fig. 21

A framework for Adopting a Knowledge-Orientation in Manufacturing

Source: Adapted from Basu and Wright's (1997, p.5) "Total Manufacturing Solutions" and Sullivan's (1998, p.42) "Intellectual Capital Value Matrix", and Woodruff's (1997, p.147) "Translating Customer Value Learning Into Action".

Table 12 overleaf shows the basis for constructing this model.

Table 12.

The basis for constructing "knowledge-orientation leverage points in manufacturing"

Construct	Pearson's Correlation Analysis	Leverage Area (Based on Performance Indicators)	KM Strategy "Importance" vs. "Performance" (Gap Analysis)	Customer Value Learning (Gap Analysis)	Comments
Customer Value Learning Practices	0,785	Medium	25,6%	35,7%	Low gap analysis score in the way knowledge sharing happens. High potential to deploy customer value learning practices where knowledge-orientation activities are implemented.
Product Development [Customer Satisfaction]	0,674	Medium	35,6%	32,2%	High gap analysis score in the way knowledge sharing happens. Can improve customer satisfaction ratings by deploying knowledge-sharing practices in product development.
Product Development [Customer Retention]	0,616	Medium	35,6%	33,3%	High gap analysis score in the way knowledge sharing happens. Can improve customer retention levels by deploying knowledge-sharing practices in product development.
Product Development [New Product Sales]	0,622	High	35,6%	32,4%	High gap analysis score in the way knowledge sharing happens. Can improve sales from new products levels by deploying knowledge-sharing practices in product development.

Supply Chain [Customer Satisfaction]	0,773	Medium	40,6%	38,7%	High gap analysis score in the way knowledge sharing happens. Can increase customer satisfaction by deploying knowledge-sharing practices in supply chain management.
Supply Chain [Customer Retention]	0,774	Medium	40,6%	37,9%	High gap analysis score in the way knowledge sharing happens. Can increase customer retention levels by deploying knowledge-sharing practices in supply chain management.
Supply Chain [New Product Sales]	0,773	Low	40,6%	41,6%	High gap analysis score in the way knowledge sharing happens. Can increase sales from new products by deploying knowledge-sharing practices in supply chain management.
Process Improvements [Customer Satisfaction]	0,817	High	26,3%	27,2%	Low gap analysis score in the way knowledge sharing happens. High potential to leverage "best practices" that increase customer satisfaction ratings where knowledge-orientation activities are implemented.
Process Improvements [Customer Retention]	0,721	High	26,3%	30,8%	Low gap analysis score in the way knowledge sharing happens. High potential to leverage "best practices" that increase customer retention levels where knowledge-orientation activities are implemented.

Therefore, it is possible to construct a knowledge-orientation model in manufacturing which guides the attainment of high performance on customer value indices, as is shown in Fig. 22 below:

"Knowledge-Orientation Leverage Points in Manufacturing"

Knowledge-Orientation Implementation	Customer Value Indice *Leverage Points*		
	Customer Satisfaction	Customer Retention	New Product Sales
Process Improvements	High	High	N / A
Product Development	Medium	Medium	High
Supply Chain Management	Medium	Medium	Low

Fig. 22

Knowledge-orientation leverage points in manufacturing

Future Roles Of Knowledge Management In Manufacturing

Based on the qualitative views from the respondents in the questionnaire, certain key themes have emerged on the future roles of knowledge management in manufacturing. The key themes are found in Appendix E, and are summarised below:

- This is an industry differentiation factor that will ensure long range sustainable competitive advantage.
- This is important for our future business expansion as a key business driver and the full integration in a global environment.
- This is a better way of solving customer problems because of knowledge of customer processes as a unique advantage and involves building customer databases.
- It involves ways of managing knowledge and employee productivity (before employees leave).
- It is important to document, share and implement knowledge and information.
- It involves the ways of building quality into products and processes – eliminating defects and ensuring continuous improvements.
- The culture must be conducive – it is a myth that some people cannot handle certain information.
- It is a way of not repeating the same mistakes.

In terms of the literature findings on the future of knowledge management in manufacturing, Davenport (1997) suggests that the business process owners need to be made responsible for how they create value from information content and knowledge. Neef (1999, p. 142) comments: "It is these types of knowledge management practices that will increasingly differentiate high-road from low-road companies and are the key to the transformation of a company into a strategically agile, global learning organization".

Chapter Six Conclusion

Introduction

The research objectives were to evaluate the impact on a knowledge-orientation when applied to core manufacturing business processes on customer value, herein defined as customer satisfaction, customer retention and sales from new products.

Research objectives

The research objectives have been achieved in the following way:

Objective 1: Evaluate how a knowledge-orientation in manufacturing influences customer value learning.

After constructing a knowledge-orientation framework, this objective was tested using Section C in the Likert scale questionnaire. Respondents were asked to rate the extent to which a knowledge-orientation influences customer value learning practices in their organisation. Thereafter, the ordinal data was rescaled into interval data, and was analysed using Pearson's Correlation Analysis and Two-Sample t-tests. In this way it was possible to achieve this research objective.

Objective 2: **Evaluate how a knowledge-orientation in manufacturing product development influences customer value indices.**

This objective was tested using Section C in the Likert scale questionnaire against the abovementioned knowledge-orientation framework. Respondents were asked to rate the extent to which a knowledge-orientation applied to product development influences performance on customer value indices in their organisation influences. Thereafter, the ordinal data was rescaled into interval data, and was analysed using Pearson's Correlation Analysis and Two-Sample t-tests. In this way it was possible to achieve this research objective.

Objective 3: **Evaluate how a knowledge-orientation in manufacturing supply chain management influences customer value indices.**

This objective was tested using Section C in the Likert scale questionnaire against the abovementioned knowledge-orientation framework. Respondents were asked to rate the extent to which a knowledge-orientation applied to supply chain management influences performance on customer value indices in their organisation influences. Thereafter, the ordinal data was rescaled into interval data, and was analysed using Pearson's Correlation Analysis and Two-Sample t-tests. In this way it was possible to achieve this research objective.

Objective 4: **Evaluate how a knowledge-orientation in manufacturing process improvements influences customer value indices.**

This objective was tested using Section C in the Likert scale questionnaire against the abovementioned knowledge-orientation framework. Respondents were asked to rate the extent to which a knowledge-orientation applied to process improvements influences performance on customer value indices in their organisation influences. Thereafter, the ordinal data was rescaled into interval data, and was analysed using Pearson's Correlation Analysis and Two-Sample t-tests. In this way it was possible to achieve this research objective.

Objective 5: **Construct a knowledge-orientation model in manufacturing with emphasis on customer value.**

By assimilating the findings from the first four research objectives and propositions, it was possible to achieve this objective. In other words, the model was designed to determine the leverage points in manufacturing where a knowledge-orientation is applied.

Objective 6: **Explore future roles of knowledge management in manufacturing with emphasis on customer value.**

This objective was tested using Section D in the questionnaire against the abovementioned knowledge-orientation framework. Respondents were asked to comment on the future roles of knowledge management in their organisation and the likely impact on customer value. Thereafter, the qualitative data was tabulated for frequency and common trends.

Conclusions

Considering the research objectives and above findings, the following conclusions are reached, and can be generalised to the sampled organisations.

Knowledge management is seen to be strategically important for the sampled global manufacturing organisations. This is particularly the case where knowledge management is entrenched in corporate strategy in order to meaningfully impact on customer satisfaction or customer retention or increased sales from new products. This strategic intent is aligned to elevating the role of manufacturing strategy.

Customer value learning

Knowledge sharing can have a meaningful impact on customer value learning practices, for example understanding current and future customer

needs. This however, is yet to be extensively implemented amongst the sampled organisations. Therefore, there is a need to reorient manufacturing strategy around customer value learning practices that entrench knowledge sharing. The sampled organisations' culture should reward knowledge sharing around what customers value. The correlation between improved ways in which additional sales are generated and applying a knowledge-orientation to customer value learning practices is linear. This should be implemented amongst global manufacturing organisations as standard practice. In addition to optimising knowledge extraction, this may be synonymous with value creation and knowledge creation.

Product development

Knowledge sharing can have a meaningful impact on product development. This however, is yet to be extensively implemented amongst the sampled organisations. The sampled organisations' product development processes need to incorporate multiple internal and external inputs on customer and market knowledge. The correlation between customer satisfaction and applying a knowledge-orientation to product development is linear. This should be implemented amongst global manufacturing organisations as standard practice. Similarly for sales from new products.

These global manufacturing organisations have an opportunity to entrench a knowledge-orientation in product development in order to increase sales from new products or raise customer retention levels or increase

customer satisfaction ratings. Similarly, in addition to optimising knowledge extraction, this may be synonymous with value creation and knowledge creation.

Supply chain

Knowledge sharing can have a meaningful impact on supply chain management. However, this is yet to be extensively implemented amongst the sampled organisations. The correlation between customer satisfaction and applying a knowledge-orientation to supply chain is linear. This should be implemented amongst global manufacturing organisations as standard practice. Similarly for customer retention and sales from new products.

It seems that the sampled manufacturing organisations can further leverage customer value learning networks in the supply chain, where it is founded on knowledge-sharing with supplier partners. This is where the sampled organisations share knowledge on technology, production processes, customers and market dynamics that impact on inventory holdings and planning.

These global manufacturing organisations have an opportunity to entrench a knowledge-orientation in supply chain management in order to increase sales from new products or raise customer retention levels or increase customer satisfaction ratings. Similarly, in addition to optimising knowledge extraction, this may be synonymous with value creation and knowledge creation.

Process improvements

Knowledge sharing has had a meaningful impact on process improvements, in terms of world-class manufacturing "best practices" sharing. The correlation between customer satisfaction and applying a knowledge-orientation to process improvements is linear and can be further optimised. Similarly for customer retention. This would be synonymous with leveraging and sharing best practices, or knowledge optimisation. "Best operating practices" can be documented and accessed by all operations staff across the global organisation.

Leverage points

Based on the constructed "Knowledge-Orientation Leverage Points in Manufacturing", it is possible to generalise to global manufacturing organisations certain business performance opportunities.

It is suggested from the above model that where an organisation's manufacturing strategy focuses on **increasing customer satisfaction**, this may achieve maximum benefit where **knowledge-sharing is integral mainly to continuous process improvements, though also to product development and supply chain management.**

Where an organisation's manufacturing strategy focuses on **increasing customer retention or repeat buying**, it would achieve maximum benefit where **knowledge-sharing is integral mainly to continuous process**

improvements, though also to product development and supply chain management.

Lastly, where an organisation's manufacturing strategy focuses on **increasing sales from new products**, it would achieve maximum benefit where **knowledge-sharing is integral to effective product development processes** advocated by Leonard (1998), and Li and Calantone (1998).

Recommendations

It is recommended that manufacturing organisations should focus in the short-term on sharing of best practices or optimising knowledge sharing that are aligned with world-class manufacturing practices and continuous process improvements. In the long-run however, manufacturing organisations should focus on how knowledge can be created from product development practices and dynamics arising out the supply chain. The objective should be to extract existing knowledge and identify new knowledge that can become a new business opportunity or total solution.

Further research

Based on the research findings, opportunities for further research include the following:

- Conduct the same research by applying a case study approach to understand the context and meaning around which a knowledge-

orientation may impact on core manufacturing business practices and customer value.

- Evaluate the product development, sales, customer interface in order to determine what knowledge processes and critical knowledge lead to improved customer value practices.
- Evaluate the supply chain management dynamics in order to determine what knowledge processes and critical knowledge lead to improved customer value practices.

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List of Appendices

Appendix A Questionnaire: "Business research on manufacturing practices"

Appendix B Correspondence Analysis Outputs

- Frequency table
- Raw data
- "Horse-shoe plot"

Appendix C Pearson's Correlation Analysis

Appendix D Two-Sample t-tests

Appendix E Tabulation of the future role of a knowledge-orientation in manufacturing

Appendix A

Questionnaire

"Business research in manufacturing"

Business Research in Manufacturing

This questionnaire is **ANONYMOUS** and is part of research into manufacturing practices. Your time is valuable, and your support in completing this questionnaire in the next 20 minutes is sincerely appreciated. The sections deal with product development, supply chain, process improvements, customer value learning and the future role of a knowledge-orientation in manufacturing. **Please answer ALL questions in Background Information; Importance to Your Organisation; and Customer Value Learning. Where possible answer ALL questions in the other sections. If you feel that you do not have the knowledge to answer a section or question, then leave that section or question blank.**

Please note that "key lessons" refers to learning from better ways of working. It is often said that the real value in an organization lies in "peoples' heads". In other words, knowledge, experience, insight and learning are found with people, as well as processes and technology. In this research, this is defined as a knowledge-orientation, especially when people continuously share their knowledge. Please click on the area or box where you type your answers.

SECTION A: BACKGROUND INFORMATION

A1. Please indicate the name of your organization

A2. Please indicate the industry in which your organization operates

A3. Please mark with an X whether you are in a management or specialist role

A3.1. Management		A3.2. Specialist	

A4. Please mark with an X the *major emphasis* in your current function / strategic business unit [ONE choice only]

A4.1. Sales		A4.2. Manufacturing/ Production	
A4.3. Marketing		A4.4. Engineering	
A4.5. Research & Development		A4.6. Human Resources	
A4.7. Training		A4.8. Information Systems	
A4.9. Executive Management		A4.10. Other (please specify)	

A5. Please mark with an X how long you have been with your organization

A5.1. Less than 5 years		A5.2. 5 to 9 years	
A5.3. 10 years, or more			

SECTION A: BACKGROUND INFORMATION *(continued)*

A6. Please mark with an X the activity *most relevant* to your average day

A6.1. training & coaching employees		A6.2. solving customers' problems	
A6.3. helping others to share their experiences and knowledge		A6.4. solving manufacturing problems	
A6.5. other (please specify)			

A7. In this question, please mark with an X the ONE method *most often* used in your organization to share "key lessons"

A7.1. internal memos		A7.2. telephone	
A7.3. meetings		A7.4. e-mail	
A7.5. intranet		A7.6. internet	
A7.7. multimedia		A7.8. videoconferencing	
A7.9. other (please specify)			

SECTION B: I) IMPORTANCE TO YOUR ORGANIZATION

Please rate these items on their importance to your organization using the scale 1 to 5

1 = Strongly disagree 2 = Disagree 3 = Neither disagree, nor agree 4 = Agree 5 = Strongly agree

B1. People should record "key business lessons" across our organization	
B2. "Key business lessons" should be analysed	
B3. People should have ongoing access to "key business lessons" across our organization	
B4. Internal experts should update the usefulness of "key business lessons"	
B5. Our corporate business strategy should use knowledge from "key business lessons" to improve customer satisfaction	
B6. Our corporate business strategy should use knowledge from "key business lessons" to improve customer loyalty	
B7. Our corporate strategy should use knowledge from "key business lessons" to increase sales from new products	

SECTION C: I) PRODUCT DEVELOPMENT

Please rate your organization's current performance using the scale 1 to 5

*1 = **STRONGLY DISAGREE** 2 = **DISAGREE** 3 = **NEITHER DISAGREE, NOR AGREE** 4 = **AGREE***
*5 = **STRONGLY AGREE***

PD1. Our new products are unique for customers across industries	
PD2. We use cross-functional teams to speed up product development	
PD3. Our organization launches new products each year	
PD4. Customers are involved in new product development processes	

PD5. We record "key lessons" on new product development processes	
PD6. We analyse "key lessons" on new product development processes	
PD7. Employees easily access "key lessons" on new product development processes	
PD8. "Key lessons" on new product development are often updated	

PD9. Since applying "key lessons" on new product development, new products are developed faster	
PD10. Since applying "key lessons" on new product development, customer satisfaction ratings have improved	
PD11. Since applying "key lessons" on new product development, customer repeat buying has improved	
PD12. Since applying "key lessons" on new product development, the % sales from new products has increased	

SECTION C: II) SUPPLY CHAIN MANAGEMENT

Please rate your organization's current performance using the scale 1 to 5

1 = STRONGLY DISAGREE **2** = DISAGREE **3** = NEITHER DISAGREE, NOR AGREE **4** = AGREE
5 = STRONGLY AGREE

SC1. We partner with suppliers using real-time information management systems	
SC2. Suppliers mostly understand our customers' needs	
SC3. Suppliers are often involved in product development	
SC4. Suppliers mostly understand the impact of their technology and processes on our manufacturing processes	

SC5. We record "key lessons" on suppliers' processes [eg. how they shorten their lead times or improve product quality]	
SC6. We analyse "key lessons" on suppliers' processes	
SC7. Employees easily access "key lessons" on suppliers' technology and processes	
SC8. "Key lessons" on suppliers' technology and processes are often updated	

SC9. Since applying "key lessons" on suppliers' technology and processes, satisfaction ratings by our customers have improved	
SC10. Since applying "key lessons" on suppliers' technology and processes, repeat buying by our customers has improved	
SC11. Since applying "key lessons" on suppliers' technology and processes, our % sales from new products has increased	

SECTION C: III) PROCESS IMPROVEMENTS

PI Please rate your organization's current performance using the scale 1 to 5

*1 = **STRONGLY DISAGREE** 2 = **DISAGREE** 3 = **NEITHER DISAGREE, NOR AGREE** 4 = **AGREE***
*5 = **STRONGLY AGREE***

PR1. Manufacturing persons continuously eliminate non-value-adding production activities	
PR2. Manufacturing persons are in direct contact with customers	

PR3. We record "key lessons" on process improvements [eg. how to reduce cycle time, or improve quality, or remove bottlenecks, etc]	
PR4. We analyse "key lessons" on process improvements	
PR5. Employees easily access "key lessons" on process improvements	
PR6. "Key lessons" on process improvements are often updated	

PR7. Since applying "key lessons" on process improvements, production cycle time has been reduced	
PR8. Since applying "key lessons" on process improvements, product and process quality have improved	
PR9. Since applying "key lessons" on process improvements, production rework has been reduced	
PR10. Since applying "key lessons" on process improvements, customer satisfaction ratings have improved	
PR11. Since applying "key lessons" on process improvements, customer repeat buying has improved	

SECTION C: IV) CUSTOMER VALUE LEARNING

PI Please rate your organization's current performance using the same scale 1 to 5

1 = STRONGLY DISAGREE **2** = DISAGREE **3** = NEITHER DISAGREE, NOR AGREE **4** = AGREE
5 = STRONGLY AGREE

CV1. We meet with customers often to learn about their current and future needs	
CV2. Our knowledge of customer needs is thorough	
CV3. We systematically analyse customer information from market research	
CV4. We measure customer satisfaction each year	
CV5. Across functions, our culture encourages creativity and sharing of "key lessons"	
CV6. People are rewarded for sharing and applying "key lessons"	
CV7. The latest "key lessons" are included in on-the-job training	
CV8. People spend part of their day finding new business opportunities	
CV9. "Key lessons" are recorded in a useful computerised system [eg. an enterprise-wide system]	

CV10. We record "key lessons" on what customers value [eg. product use, product quality features, product pricing, flexibility, etc]	
CV11. We analyse "key lessons" on what customers value	
CV12. Employees easily access "key lessons" on customer needs	
CV13. "Key lessons" on customer needs are often updated	

CV14. Since applying "key lessons" on what customers value, the way additional revenue is generated has improved	

SECTION D: THE FUTURE ROLE OF A KNOWLEDGE-ORIENTATION IN MANUFACTURING

Consider the definition of a knowledge-orientation on page 1: "It is often said that the real value in an organization lies in "peoples' heads". In other words, knowledge, experience, insight and learning are found with people, as well as processes and technology. This is defined as a knowledge-orientation, especially when people share their knowledge".

D1. What do you think is the role of a knowledge-orientation in building your organization's future?

If you have any queries in completing this questionnaire please contact XXX , XXX on XXX, or Caesar Tonkin on 082 573 2166. ***Once again, your time taken to complete this important questionnaire is greatly appreciated***. Please be assured that your company will receive feedback from this research by end July 1999. Once you have completed the questionnaire **please send it as an attached file by e-mail to ctonkin@icon.co.za by 7th June 1999**.

Kind regards,
Caesar Tonkin

Appendix B

Correspondence Analysis Outputs

Raw Data

	B1	B2	B3	B4	B5	B6	B7
1	4.73	4.73	4.73	5	5	5	5
2	5	3.526	4.73	5	2.282	3.526	5
3	5	5	3.526	5	5	4.73	4.73
4	4.73	4.73	5	4.73	4.73	4.73	4.73
5	3.526	4.73	2.282	2.282	3.526	2.282	2.282
6	4.73	5	5	5	5	5	5
7	5	4.73	5	5	5	5	5
8	5	5	5	5	5	5	5
9	5	5	4.73	4.73	5	4.73	4.73
10	4.73	5	5	4.73	5	5	5
11	5	5	5	4.73	5	5	5
12	5	4.73	5	4.73	5	5	4.73
13	5	4.73	5	4.73	5	4.73	3.526
14	4.73	4.73	5	5	4.73	4.73	4.73
15	5	5	5	3.526	2.282	2.282	2.282
16	4.73	4.73	4.73	4.73	4.73	4.73	4.73
17	4.73	3.526	4.73	4.73	4.73	4.73	4.73
18	4.73	4.73	4.73	4.73	4.73	4.73	3.526
19	4.73	4.73	4.73	4.73	5	5	5
20	5	4.73	4.73	2.282	4.73	4.73	3.526
21	5	5	5	3.526	5	5	5
22	3.526	4.73	4.73	2.282	3.526	4.73	4.73
23	2.282	5	5	5	5	5	5
24	4.73	3.526	4.73	3.526	3.526	4.73	4.73
25	5	5	5	4.73	5	3.526	3.526
26	4.73	4.73	4.73	3.526	5	5	5
27	3.526	4.73	4.73	2.282	5	5	5
28	5	5	5	5	4.73	4.73	5
29	5	3.526	5	5	4.73	4.73	4.73
30	4.73	4.73	4.73	4.73	4.73	4.73	4.73
31	4.73	4.73	4.73	3.526	4.73	4.73	4.73
32	0	0	0	0	0	0	0
33	4.73	4.73	4.73	4.73	4.73	4.73	4.73
34	4.73	3.526	4.73	4.73	4.73	4.73	4.73
35	4.73	5	5	4.73	4.73	4.73	4.73
36	5	4.73	4.73	4.73	4.73	4.73	5
37	5	5	5	3.526	5	4.73	4.73
38	4.73	4.73	4.73	4.73	3.526	3.526	3.526
39	4.73	2.282	4.73	2.282	4.73	4.73	5
40	4.73	4.73	5	3.526	4.73	4.73	5
41	4.73	4.73	5	3.526	5	4.73	3.526
42	5	5	5	5	5	4.73	5
43	5	4.73	5	4.73	4.73	4.73	4.73
44	4.73	4.73	4.73	4.73	5	5	5
45	5	4.73	4.73	4.73	5	5	5

	B1	B2	B3	B4	B5	B6	B7
46	4.73	4.73	4.73	4.73	4.73	4.73	4.73
47	4.73	3.526	5	4.73	5	3.526	4.73
48	4.73	5	4.73	4.73	5	5	5
49	5	5	5	5	5	5	5
50	4.73	4.73	4.73	4.73	4.73	4.73	4.73
51	5	5	5	5	5	5	5
52	5	4.73	5	4.73	5	5	5
53	5	5	5	4.73	5	4.73	4.73
54	5	5	5	5	5	5	5
55	4.73	4.73	4.73	3.526	3.526	3.526	3.526
56	5	5	4.73	3.526	4.73	4.73	4.73
57	5	4.73	4.73	4.73	5	4.73	3.526
58	4.73	4.73	3.526	3.526	4.73	4.73	5
59	4.73	3.526	0	4.73	4.73	4.73	4.73
60	3.526	4.73	4.73	3.526	4.73	4.73	4.73
61	5	5	5	5	5	5	5
62	5	5	5	5	5	5	5
63	4.73	4.73	4.73	4.73	5	4.73	4.73
64	4.73	4.73	0	4.73	5	5	5
65	4.73	4.73	4.73	4.73	5	5	5
66	5	5	5	5	5	5	5
67	4.73	5	5	4.73	5	4.73	5
68	5	5	5	3.526	5	3.526	5
69	5	5	5	5	5	5	5
70	4.73	4.73	4.73	4.73	4.73	4.73	4.73
71	4.73	4.73	5	4.73	4.73	3.526	4.73
72	5	4.73	5	5	5	5	5
73	4.73	4.73	4.73	4.73	4.73	4.73	4.73
74	4.73	4.73	4.73	5	4.73	4.73	3.526
75	5	5	5	4.73	5	5	5
76	4.73	4.73	3.526	2.282	4.73	3.526	3.526
77	4.73	4.73	4.73	4.73	5	3.526	4.73
78	3.526	4.73	4.73	2.282	3.526	2.282	3.526
79	5	4.73	4.73	4.73	5	4.73	3.526
80	5	5	5	5	5	5	5
81	4.73	3.526	4.73	3.526	4.73	4.73	4.73
82	5	5	5	5	5	5	5
83	4.73	4.73	4.73	4.73	4.73	4.73	4.73

	B1	B2	B3	B4	B5	B6	B7
84	5	5	5	5	5	5	5
85	5	5	5	5	5	5	5
86	5	4.73	5	5	5	5	5
87	5	5	5	5	5	5	5
88	4.73	4.73	4.73	4.73	4.73	3.526	3.526
89	5	5	5	3.526	4.73	5	5
90	4.73	4.73	4.73	2.282	4.73	4.73	4.73
91	4.73	4.73	4.73	3.526	4.73	4.73	4.73
92	5	4.73	5	5	4.73	4.73	4.73
93	5	4.73	5	2.282	5	5	5
94	5	5	5	5	5	5	5
95	4.73	4.73	4.73	4.73	4.73	3.526	3.526
96	4.73	4.73	4.73	3.526	4.73	5	5
97	5	5	5	5	5	5	5
98	5	5	5	4.73	5	4.73	5
99	5	4.73	5	2.282	5	5	5
100	5	5	5	4.73	5	4.73	5
101	5	5	5	5	5	5	5
102	5	3.526	4.73	4.73	5	5	4.73
103	5	4.73	4.73	5	4.73	5	4.73
104	5	2.282	5	4.73	4.73	4.73	4.73
105	4.73	5	4.73	2.282	3.526	3.526	4.73
106	5	5	5	4.73	3.526	3.526	4.73
107	5	4.73	5	4.73	5	4.73	5
108	5	5	4.73	4.73	3.526	0	0
109	5	5	5	5	4.73	4.73	3.526
110	5	5	5	4.73	5	5	4.73
111	4.73	3.526	5	4.73	4.73	4.73	5
112	4.73	4.73	5	4.73	3.526	3.526	4.73

	PD1	PD2	PD3	PD4	PD5	PD6	PD7	PD8	PD9	PD10	PD11	PD12
1	3.526	4.73	4.73	4.73	3.526	3.526	2.282	2.282	3.526	3.526	3.526	3.526
2	5	5	5	2.282	4.73	4.73	4.73	3.526	4.73	3.526	4.73	3.526
3	4.73	5	4.73	4.73	4.73	4.73	2.282	4.73	3.526	3.526	3.526	3.526
4	2.282	3.526	4.73	2.282	3.526	3.526	2.282	3.526	3.526	3.526	3.526	3.526
5	1	3.526	5	4.73	3.526	4.73	1	3.526	0	0	0	0
6	4.73	4.73	4.73	4.73	4.73	4.73	4.73	4.73	4.73	3.526	4.73	4.73
7	3.526	4.73	5	4.73	3.526	3.526	3.526	3.526	3.526	3.526	3.526	3.526
8	4.73	3.526	5	3.526	4.73	4.73	3.526	4.73	4.73	3.526	3.526	3.526
9	0	5	4.73	0	0	4.73	0	0	4.73	0	0	0
10	1	5	5	4.73	5	5	2.282	3.526	3.526	4.73	2.282	2.282
11	5	4.73	4.73	5	0	0	0	0	0	0	0	0
12	3.526	3.526	4.73	2.282	4.73	4.73	2.282	2.282	4.73	4.73	4.73	3.526
13	2.282	5	4.73	5	4.73	4.73	3.526	4.73	4.73	3.526	4.73	4.73
14	2.282	4.73	4.73	5	5	5	3.526	4.73	3.526	3.526	3.526	4.73
15	5	5	5	5	5	5	4.73	4.73	4.73	4.73	3.526	3.526
16	3.526	5	5	1	4.73	5	4.73	5	4.73	3.526	3.526	4.73
17	2.282	4.73	4.73	5	4.73	4.73	2.282	3.526	4.73	4.73	3.526	3.526
18	3.526	2.282	2.282	3.526	3.526	3.526	2.282	2.282	2.282	2.282	2.282	3.526
19	1	4.73	4.73	4.73	4.73	4.73	3.526	3.526	3.526	3.526	3.526	3.526
20	4.73	2.282	2.282	2.282	1	1	2.282	1	1	1	1	1
21	1	5	5	5	3.526	4.73	3.526	3.526	5	5	5	1
22	5	5	5	5	4.73	4.73	2.282	4.73	4.73	4.73	4.73	3.526
23	2.282	1	3.526	4.73	4.73	4.73	2.282	2.282	5	5	2.282	2.282
24	2.282	2.282	3.526	2.282	1	3.526	1	3.526	3.526	2.282	3.526	4.73
25	2.282	2.282	2.282	4.73	3.526	3.526	3.526	3.526	3.526	3.526	3.526	3.526
26	2.282	2.282	3.526	3.526	2.282	2.282	1	1	1	1	1	1
27	2.282	2.282	4.73	2.282	2.282	2.282	2.282	2.282	4.73	4.73	4.73	4.73
28	2.282	2.282	5	1	4.73	4.73	2.282	4.73	4.73	1	0	2.282
29	2.282	3.526	5	5	2.282	3.526	1	1	3.526	3.526	3.526	3.526
30	2.282	2.282	2.282	1	1	1	2.282	2.282	3.526	3.526	3.526	3.526
31	3.526	4.73	4.73	4.73	3.526	3.526	2.282	2.282	3.526	2.282	2.282	2.282
32	4.73	4.73	5	5	4.73	4.73	3.526	4.73	4.73	4.73	4.73	5
33	2.282	4.73	4.73	4.73	4.73	4.73	3.526	3.526	4.73	3.526	2.282	2.282
34	4.73	3.526	2.282	2.282	2.282	3.526	2.282	2.282	2.282	2.282	2.282	2.282
35	0	0	0	0	0	0	0	0	0	0	0	0
36	2.282	4.73	5	5	4.73	4.73	4.73	4.73	4.73	4.73	4.73	3.526
37	3.526	3.526	2.282	4.73	2.282	2.282	2.282	2.282	3.526	3.526	3.526	3.526
38	3.526	4.73	3.526	4.73	3.526	3.526	3.526	3.526	3.526	3.526	3.526	3.526
39	5	2.282	4.73	5	4.73	2.282	2.282	4.73	3.526	4.73	4.73	4.73
40	3.526	4.73	4.73	4.73	3.526	3.526	2.282	3.526	4.73	3.526	4.73	3.526
41	4.73	4.73	4.73	4.73	1	1	2.282	1	3.526	3.526	3.526	3.526
42	2.282	3.526	2.282	4.73	3.526	3.526	2.282	2.282	3.526	3.526	3.526	3.526
43	2.282	2.282	3.526	3.526	3.526	3.526	2.282	2.282	3.526	3.526	3.526	3.526
44	4.73	3.526	4.73	3.526	3.526	3.526	2.282	3.526	3.526	3.526	3.526	3.526
45	2.282	1	1	3.526	4.73	2.282	2.282	2.282	1	3.526	3.526	2.282

	PD1	PD2	PD3	PD4	PD5	PD6	PD7	PD8	PD9	PD10	PD11	PD12
46	2.282	1	1	3.526	1	1	1	1	1	1	1	1
47	2.282	3.526	4.73	4.73	2.282	2.282	2.282	2.282	2.282	4.73	4.73	4.73
48	1	5	5	4.73	1	2.282	2.282	1	3.526	3.526	3.526	3.526
49	4.73	1	1	4.73	1	1	1	1	1	1	1	3.526
50	2.282	4.73	2.282	4.73	2.282	2.282	3.526	3.526	3.526	3.526	3.526	3.526
51	3.526	4.73	5	3.526	2.282	2.282	2.282	2.282	2.282	2.282	2.282	2.282
52	2.282	4.73	2.282	4.73	4.73	4.73	2.282	2.282	2.282	3.526	3.526	2.282
53	4.73	5	2.282	5	1	1	1	1	4.73	4.73	4.73	5
54	2.282	4.73	5	3.526	4.73	4.73	2.282	2.282	3.526	3.526	2.282	3.526
55	2.282	3.526	3.526	2.282	3.526	3.526	3.526	3.526	3.526	2.282	2.282	2.282
56	2.282	4.73	4.73	4.73	2.282	2.282	2.282	2.282	2.282	2.282	2.282	2.282
57	0	4.73	4.73	4.73	5	4.73	4.73	4.73	3.526	4.73	3.526	4.73
58	2.282	4.73	1	5	4.73	3.526	2.282	3.526	4.73	3.526	3.526	2.282
59	2.282	3.526	2.282	4.73	2.282	2.282	2.282	2.282	0	0	0	0
60	3.526	5	4.73	4.73	3.526	3.526	2.282	2.282	3.526	3.526	3.526	3.526
61	3.526	4.73	2.282	4.73	2.282	2.282	2.282	2.282	3.526	3.526	3.526	3.526
62	3.526	3.526	5	4.73	4.73	4.73	3.526	3.526	3.526	3.526	3.526	3.526
63	4.73	4.73	4.73	5	2.282	4.73	2.282	3.526	3.526	4.73	4.73	4.73
64	2.282	2.282	4.73	4.73	3.526	2.282	2.282	3.526	3.526	3.526	3.526	3.526
65	4.73	4.73	4.73	5	2.282	2.282	2.282	2.282	3.526	3.526	3.526	3.526
66	3.526	2.282	2.282	4.73	2.282	4.73	2.282	2.282	0	0	0	0
67	2.282	4.73	4.73	4.73	3.526	4.73	2.282	3.526	3.526	3.526	4.73	3.526
68	1	1	3.526	5	3.526	3.526	3.526	3.526	3.526	3.526	3.526	3.526
69	2.282	4.73	1	4.73	4.73	3.526	2.282	2.282	3.526	3.526	3.526	3.526
70	3.526	3.526	2.282	3.526	2.282	2.282	2.282	2.282	2.282	3.526	2.282	3.526
71	5	2.282	1	5	3.526	4.73	3.526	3.526	3.526	3.526	3.526	2.282
72	5	4.73	2.282	3.526	2.282	2.282	2.282	2.282	2.282	2.282	2.282	2.282
73	2.282	5	5	4.73	2.282	2.282	2.282	2.282	3.526	3.526	3.526	3.526
74	4.73	4.73	2.282	4.73	2.282	2.282	2.282	2.282	2.282	2.282	2.282	2.282
75	3.526	3.526	3.526	4.73	2.282	3.526	2.282	2.282	2.282	2.282	2.282	2.282
76	3.526	4.73	2.282	4.73	4.73	3.526	3.526	3.526	3.526	4.73	3.526	3.526
77	2.282	4.73	2.282	4.73	2.282	2.282	2.282	2.282	4.73	4.73	4.73	4.73
78	1	3.526	2.282	1	1	1	1	1	1	1	1	1
79	0	4.73	4.73	4.73	5	4.73	4.73	4.73	3.526	4.73	3.526	4.73
80	3.526	4.73	5	3.526	3.526	3.526	2.282	3.526	3.526	3.526	3.526	3.526
81	2.282	3.526	3.526	4.73	3.526	3.526	2.282	3.526	3.526	3.526	3.526	3.526
82	4.73	4.73	4.73	3.526	2.282	3.526	2.282	3.526	3.526	4.73	3.526	4.73
83	2.282	4.73	4.73	4.73	4.73	4.73	2.282	2.282	3.526	3.526	3.526	3.526

	PD1	PD2	PD3	PD4	PD5	PD6	PD7	PD8	PD9	PD10	PD11	PD12
84	4.73	4.73	4.73	2.282	3.526	3.526	2.282	2.282	2.282	2.282	2.282	2.282
85	5	5	5	5	5	5	5	5	5	5	3.526	4.73
86	3.526	5	4.73	5	4.73	3.526	3.526	3.526	4.73	3.526	3.526	4.73
87	4.73	5	5	4.73	4.73	3.526	2.282	2.282	3.526	3.526	3.526	3.526
88	0	0	0	0	0	0	0	0	0	0	0	0
89	3.526	4.73	5	4.73	2.282	4.73	2.282	3.526	3.526	3.526	3.526	4.73
90	2.282	0	4.73	0	0	0	0	0	0	0	0	0
91	3.526	4.73	5	2.282	2.282	2.282	1	1	1	1	1	1
92	0	0	0	0	0	0	0	0	0	0	0	0
93	2.282	4.73	5	3.526	2.282	2.282	2.282	2.282	2.282	3.526	3.526	2.282
94	3.526	4.73	4.73	2.282	3.526	3.526	3.526	3.526	3.526	3.526	3.526	3.526
95	4.73	4.73	4.73	2.282	3.526	3.526	3.526	3.526	3.526	3.526	3.526	3.526
96	4.73	2.282	3.526	4.73	0	0	0	0	0	0	0	0
97	2.282	4.73	4.73	4.73	4.73	3.526	2.282	2.282	4.73	4.73	3.526	3.526
98	4.73	5	5	5	4.73	3.526	3.526	3.526	4.73	3.526	3.526	4.73
99	4.73	4.73	4.73	3.526	5	5	2.282	2.282	3.526	4.73	3.526	3.526
100	3.526	4.73	5	4.73	4.73	4.73	4.73	4.73	4.73	3.526	3.526	4.73
101	4.73	5	5	4.73	3.526	3.526	2.282	2.282	3.526	3.526	3.526	3.526
102	3.526	4.73	4.73	4.73	4.73	3.526	3.526	3.526	3.526	4.73	3.526	3.526
103	2.282	5	5	3.526	2.282	2.282	1	1	4.73	2.282	2.282	2.282
104	4.73	5	5	2.282	3.526	3.526	2.282	2.282	3.526	3.526	3.526	3.526
105	3.526	4.73	5	4.73	5	5	4.73	2.282	4.73	4.73	3.526	4.73
106	4.73	3.526	4.73	2.282	4.73	2.282	2.282	2.282	2.282	4.73	3.526	3.526
107	4.73	4.73	4.73	3.526	2.282	2.282	2.282	2.282	3.526	3.526	3.526	3.526
108	0	0	0	0	0	0	0	0	0	0	0	0
109	4.73	4.73	4.73	3.526	4.73	3.526	3.526	4.73	4.73	3.526	3.526	3.526
110	4.73	4.73	4.73	4.73	4.73	3.526	3.526	2.282	4.73	3.526	4.73	4.73
111	4.73	5	5	5	4.73	4.73	3.526	3.526	3.526	3.526	3.526	3.526
112	4.73	5	5	3.526	3.526	5	4.73	4.73	3.526	3.526	3.526	4.73

	SC1	SC2	SC3	SC4	SC5	SC6	SC7	SC8	SC9	SC10	SC11
1	4.73	4.73	3.526	4.73	3.526	3.526	2.282	3.526	3.526	3.526	3.526
2	5	4.73	4.73	4.73	3.526	4.73	3.526	3.526	3.526	3.526	3.526
3	4.73	3.526	2.282	2.282	3.526	3.526	1	3.526	3.526	3.526	3.526
4	4.73	4.73	3.526	4.73	3.526	3.526	3.526	3.526	3.526	3.526	3.526
5	0	0	0	0	0	0	0	0	0	0	0
6	2.282	2.282	4.73	2.282	2.282	2.282	2.282	2.282	2.282	2.282	2.282
7	2.282	4.73	4.73	3.526	3.526	3.526	3.526	3.526	3.526	3.526	3.526
8	2.282	4.73	3.526	4.73	4.73	4.73	3.526	3.526	3.526	3.526	3.526
9	0	0	0	0	0	0	0	0	0	0	0
10	4.73	5	5	3.526	2.282	2.282	1	2.282	3.526	1	1
11	2.282	0	0	4.73	3.526	0	0	0	0	0	0
12	2.282	3.526	3.526	4.73	3.526	3.526	2.282	3.526	3.526	3.526	3.526
13	2.282	3.526	5	4.73	4.73	3.526	2.282	3.526	4.73	3.526	4.73
14	2.282	3.526	4.73	4.73	3.526	3.526	2.282	2.282	2.282	2.282	2.282
15	1	3.526	4.73	5	4.73	4.73	3.526	3.526	4.73	3.526	3.526
16	1	2.282	4.73	4.73	4.73	4.73	3.526	3.526	3.526	3.526	3.526
17	3.526	2.282	2.282	2.282	4.73	2.282	2.282	2.282	3.526	3.526	3.526
18	2.282	2.282	2.282	2.282	2.282	2.282	1	1	3.526	3.526	3.526
19	4.73	5	4.73	4.73	4.73	4.73	4.73	4.73	4.73	3.526	3.526
20	4.73	3.526	4.73	4.73	3.526	4.73	4.73	4.73	4.73	4.73	2.282
21	1	3.526	5	5	2.282	2.282	3.526	4.73	3.526	3.526	1
22	4.73	2.282	2.282	2.282	4.73	4.73	2.282	4.73	4.73	4.73	2.282
23	1	2.282	1	3.526	1	1	1	1	1	1	1
24	2.282	3.526	1	3.526	4.73	4.73	2.282	4.73	3.526	3.526	3.526
25	2.282	3.526	2.282	4.73	2.282	2.282	2.282	2.282	3.526	3.526	3.526
26	3.526	3.526	3.526	3.526	2.282	1	1	1	1	1	1
27	2.282	2.282	4.73	4.73	2.282	2.282	2.282	2.282	3.526	3.526	3.526
28	1	1	1	1	2.282	1	1	1	1	1	1
29	1	3.526	2.282	3.526	2.282	1	1	1	1	1	1
30	4.73	2.282	1	4.73	2.282	2.282	2.282	2.282	3.526	3.526	3.526
31	4.73	4.73	4.73	4.73	2.282	3.526	2.282	3.526	3.526	3.526	2.282
32	3.526	2.282	3.526	3.526	4.73	3.526	3.526	2.282	4.73	3.526	3.526
33	4.73	4.73	4.73	4.73	2.282	3.526	3.526	3.526	3.526	3.526	2.282
34	2.282	2.282	4.73	4.73	2.282	2.282	2.282	2.282	2.282	2.282	2.282
35	3.526	3.526	3.526	3.526	2.282	2.282	2.282	2.282	3.526	3.526	3.526
36	4.73	4.73	4.73	4.73	3.526	3.526	2.282	2.282	3.526	3.526	2.282
37	2.282	2.282	4.73	2.282	2.282	2.282	2.282	2.282	1	1	1
38	4.73	3.526	4.73	3.526	3.526	3.526	3.526	3.526	3.526	3.526	3.526
39	2.282	4.73	2.282	4.73	5	4.73	2.282	2.282	3.526	3.526	3.526
40	3.526	2.282	5	2.282	3.526	2.282	3.526	3.526	4.73	4.73	3.526
41	3.526	4.73	4.73	4.73	1	1	1	1	3.526	3.526	3.526
42	3.526	2.282	2.282	2.282	4.73	3.526	2.282	2.282	2.282	2.282	2.282
43	3.526	3.526	3.526	3.526	4.73	3.526	3.526	3.526	3.526	3.526	3.526
44	2.282	2.282	3.526	3.526	2.282	2.282	2.282	2.282	2.282	2.282	2.282
45	1	2.282	3.526	3.526	1	1	1	1	2.282	2.282	2.282

	SC1	SC2	SC3	SC4	SC5	SC6	SC7	SC8	SC9	SC10	SC11
46	3.526	1	2.282	1	2.282	2.282	1	1	1	1	1
47	2.282	3.526	2.282	3.526	4.73	3.526	2.282	2.282	4.73	4.73	4.73
48	5	4.73	3.526	4.73	2.282	4.73	1	2.282	4.73	4.73	3.526
49	2.282	2.282	2.282	2.282	3.526	3.526	3.526	3.526	3.526	3.526	3.526
50	4.73	3.526	2.282	2.282	1	2.282	2.282	2.282	3.526	3.526	3.526
51	2.282	3.526	4.73	4.73	3.526	3.526	3.526	3.526	3.526	3.526	3.526
52	2.282	2.282	2.282	4.73	2.282	2.282	2.282	2.282	2.282	3.526	2.282
53	1	2.282	3.526	4.73	1	1	1	1	2.282	2.282	2.282
54	2.282	4.73	3.526	3.526	4.73	4.73	2.282	2.282	3.526	3.526	3.526
55	4.73	3.526	4.73	3.526	2.282	2.282	2.282	2.282	2.282	2.282	2.282
56	1	1	1	1	1	1	1	1	1	1	1
57	2.282	2.282	4.73	3.526	3.526	4.73	4.73	4.73	3.526	4.73	3.526
58	4.73	4.73	4.73	4.73	3.526	3.526	2.282	3.526	3.526	2.282	2.282
59	2.282	2.282	2.282	4.73	2.282	2.282	2.282	2.282	0	0	0
60	3.526	3.526	2.282	4.73	3.526	3.526	3.526	3.526	3.526	3.526	3.526
61	2.282	2.282	2.282	4.73	2.282	2.282	2.282	2.282	3.526	3.526	3.526
62	2.282	2.282	4.73	2.282	3.526	4.73	4.73	4.73	3.526	4.73	4.73
63	3.526	3.526	3.526	4.73	2.282	3.526	2.282	3.526	3.526	3.526	3.526
64	1	3.526	2.282	4.73	5	5	3.526	5	4.73	4.73	4.73
65	2.282	3.526	4.73	4.73	4.73	4.73	4.73	4.73	3.526	3.526	3.526
66	3.526	4.73	5	4.73	2.282	3.526	2.282	2.282	0	0	0
67	2.282	2.282	4.73	2.282	4.73	4.73	4.73	4.73	4.73	4.73	4.73
68	3.526	4.73	5	5	3.526	3.526	3.526	3.526	3.526	3.526	3.526
69	2.282	4.73	4.73	5	2.282	2.282	2.282	3.526	3.526	3.526	3.526
70	2.282	3.526	3.526	3.526	2.282	2.282	2.282	2.282	2.282	2.282	2.282
71	4.73	4.73	3.526	4.73	4.73	3.526	2.282	3.526	3.526	3.526	3.526
72	4.73	4.73	4.73	4.73	4.73	3.526	2.282	2.282	3.526	3.526	3.526
73	1	2.282	4.73	4.73	2.282	2.282	2.282	2.282	3.526	3.526	3.526
74	3.526	4.73	4.73	4.73	3.526	3.526	2.282	2.282	3.526	3.526	3.526
75	2.282	3.526	4.73	4.73	2.282	2.282	1	1	0	0	0
76	1	1	4.73	2.282	3.526	2.282	5	4.73	2.282	2.282	2.282
77	2.282	4.73	3.526	4.73	2.282	2.282	2.282	2.282	4.73	3.526	3.526
78	1	4.73	2.282	4.73	1	1	1	1	1	1	1
79	2.282	2.282	4.73	3.526	3.526	4.73	4.73	4.73	3.526	4.73	3.526
80	2.282	3.526	4.73	4.73	3.526	3.526	3.526	3.526	3.526	3.526	3.526
81	2.282	3.526	3.526	4.73	2.282	3.526	2.282	3.526	2.282	2.282	2.282
82	3.526	2.282	4.73	3.526	3.526	4.73	2.282	3.526	3.526	3.526	4.73
83	0	0	0	0	0	0	0	0	0	0	0

	SC1	SC2	SC3	SC4	SC5	SC6	SC7	SC8	SC9	SC10	SC11
84	3.526	3.526	3.526	4.73	3.526	3.526	2.282	2.282	3.526	3.526	3.526
85	5	4.73	4.73	5	5	5	4.73	4.73	4.73	3.526	3.526
86	3.526	3.526	3.526	3.526	3.526	3.526	3.526	3.526	3.526	3.526	3.526
87	5	5	4.73	4.73	5	5	4.73	4.73	4.73	4.73	5
88	3.526	2.282	2.282	3.526	2.282	1	1	1	0	0	0
89	4.73	4.73	4.73	3.526	3.526	3.526	2.282	3.526	3.526	2.282	3.526
90	0	0	0	0	0	0	0	0	0	0	0
91	3.526	2.282	1	3.526	3.526	3.526	3.526	3.526	1	1	1
92	0	0	0	0	0	0	0	0	0	0	0
93	2.282	4.73	4.73	4.73	4.73	3.526	2.282	3.526	3.526	3.526	2.282
94	2.282	3.526	2.282	4.73	3.526	3.526	3.526	3.526	3.526	3.526	3.526
95	3.526	2.282	2.282	2.282	2.282	2.282	2.282	2.282	3.526	3.526	3.526
96	0	4.73	3.526	3.526	0	0	0	0	0	0	0
97	3.526	3.526	2.282	3.526	3.526	3.526	3.526	3.526	3.526	3.526	3.526
98	4.73	4.73	5	5	4.73	3.526	4.73	4.73	4.73	4.73	5
99	4.73	3.526	3.526	4.73	4.73	3.526	3.526	2.282	4.73	4.73	3.526
100	4.73	4.73	4.73	4.73	3.526	3.526	2.282	2.282	3.526	3.526	3.526
101	0	0	0	0	0	0	0	0	0	0	0
102	4.73	4.73	4.73	4.73	0	0	0	0	0	0	0
103	3.526	2.282	3.526	3.526	2.282	2.282	1	1	3.526	3.526	3.526
104	4.73	2.282	4.73	3.526	2.282	2.282	2.282	3.526	2.282	3.526	3.526
105	2.282	2.282	4.73	4.73	3.526	3.526	3.526	3.526	3.526	3.526	3.526
106	3.526	2.282	4.73	4.73	3.526	3.526	2.282	2.282	3.526	3.526	3.526
107	5	4.73	5	4.73	4.73	5	3.526	4.73	5	4.73	3.526
108	3.526	0	0	0	0	0	0	0	0	0	0
109	3.526	3.526	3.526	3.526	3.526	3.526	3.526	3.526	2.282	2.282	2.282
110	3.526	4.73	2.282	2.282	3.526	2.282	2.282	2.282	3.526	3.526	3.526
111	2.282	3.526	2.282	3.526	2.282	2.282	2.282	2.282	0	0	0
112	4.73	4.73	2.282	2.282	3.526	3.526	2.282	2.282	2.282	2.282	2.282

	PR1	PR2	PR3	PR4	PR5	PR6	PR7	PR8	PR9	PR10	PR11
1	3.526	2.282	2.282	2.282	2.282	2.282	4.73	3.526	3.526	3.526	3.526
2	5	4.73	5	5	4.73	4.73	4.73	4.73	4.73	3.526	3.526
3	2.282	1	4.73	4.73	2.282	3.526	3.526	2.282	3.526	3.526	3.526
4	4.73	3.526	4.73	4.73	3.526	3.526	2.282	4.73	4.73	3.526	3.526
5	0	0	0	0	0	0	0	0	0	0	0
6	4.73	1	4.73	4.73	3.526	3.526	3.526	3.526	3.526	3.526	3.526
7	3.526	3.526	3.526	3.526	3.526	3.526	3.526	3.526	3.526	3.526	3.526
8	3.526	3.526	3.526	4.73	3.526	3.526	4.73	4.73	4.73	4.73	3.526
9	0	0	0	0	0	0	0	0	0	0	0
10	5	3.526	5	5	3.526	4.73	5	5	5	5	4.73
11	3.526	4.73	4.73	3.526	2.282	1	4.73	4.73	4.73	3.526	0
12	4.73	4.73	4.73	4.73	3.526	4.73	4.73	4.73	4.73	3.526	3.526
13	4.73	2.282	5	4.73	4.73	4.73	5	4.73	4.73	4.73	4.73
14	4.73	3.526	5	5	2.282	4.73	4.73	3.526	4.73	3.526	3.526
15	4.73	4.73	4.73	5	5	5	4.73	5	5	5	4.73
16	5	4.73	5	5	3.526	4.73	5	5	3.526	3.526	3.526
17	3.526	4.73	4.73	4.73	2.282	2.282	3.526	3.526	3.526	3.526	3.526
18	2.282	3.526	4.73	4.73	3.526	3.526	4.73	4.73	4.73	4.73	4.73
19	4.73	3.526	4.73	4.73	4.73	4.73	5	4.73	5	4.73	3.526
20	3.526	4.73	4.73	4.73	4.73	4.73	4.73	4.73	4.73	4.73	4.73
21	5	3.526	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0
23	3.526	5	5	5	5	3.526	5	5	5	5	2.282
24	3.526	4.73	4.73	4.73	2.282	3.526	4.73	4.73	4.73	4.73	3.526
25	4.73	4.73	0	0	0	0	0	0	0	0	0
26	2.282	1	2.282	1	1	1	1	1	1	1	1
27	2.282	2.282	4.73	4.73	3.526	3.526	3.526	3.526	3.526	3.526	3.526
28	4.73	4.73	3.526	4.73	2.282	4.73	4.73	5	4.73	2.282	2.282
29	4.73	4.73	4.73	4.73	3.526	2.282	3.526	4.73	4.73	4.73	3.526
30	4.73	4.73	4.73	4.73	2.282	4.73	4.73	4.73	4.73	4.73	4.73
31	4.73	3.526	4.73	4.73	3.526	3.526	4.73	4.73	4.73	4.73	3.526
32	5	0	5	5	5	5	5	5	5	4.73	0
33	4.73	4.73	4.73	4.73	3.526	3.526	4.73	4.73	4.73	4.73	2.282
34	3.526	4.73	3.526	3.526	2.282	2.282	2.282	2.282	2.282	2.282	2.282
35	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0
37	4.73	4.73	4.73	4.73	3.526	4.73	4.73	4.73	4.73	4.73	4.73
38	4.73	4.73	3.526	3.526	3.526	3.526	3.526	3.526	3.526	3.526	3.526
39	4.73	4.73	4.73	2.282	2.282	4.73	4.73	4.73	4.73	4.73	4.73
40	3.526	4.73	5	4.73	4.73	3.526	4.73	3.526	3.526	3.526	4.73
41	4.73	4.73	4.73	3.526	3.526	3.526	4.73	3.526	3.526	3.526	3.526
42	4.73	4.73	4.73	4.73	4.73	3.526	3.526	3.526	4.73	3.526	3.526
43	3.526	2.282	3.526	3.526	3.526	3.526	3.526	3.526	3.526	3.526	3.526
44	4.73	2.282	4.73	4.73	3.526	3.526	4.73	3.526	3.526	3.526	3.526
45	2.282	3.526	2.282	3.526	2.282	2.282	2.282	2.282	2.282	2.282	2.282

	PR1	PR2	PR3	PR4	PR5	PR6	PR7	PR8	PR9	PR10	PR11
46	0	0	0	0	0	0	0	0	0	0	0
47	4.73	4.73	4.73	4.73	3.526	3.526	4.73	4.73	4.73	5	5
48	2.282	2.282	2.282	5	2.282	2.282	5	4.73	4.73	4.73	4.73
49	4.73	5	3.526	3.526	2.282	2.282	2.282	2.282	3.526	3.526	3.526
50	4.73	3.526	4.73	4.73	3.526	3.526	3.526	3.526	3.526	3.526	3.526
51	3.526	2.282	4.73	3.526	2.282	3.526	3.526	3.526	3.526	3.526	3.526
52	4.73	4.73	4.73	4.73	2.282	2.282	4.73	4.73	4.73	3.526	3.526
53	2.282	4.73	1	2.282	1	1	3.526	3.526	3.526	3.526	3.526
54	4.73	2.282	4.73	4.73	4.73	4.73	4.73	4.73	4.73	3.526	3.526
55	4.73	2.282	2.282	2.282	2.282	2.282	2.282	2.282	2.282	2.282	2.282
56	4.73	4.73	2.282	2.282	2.282	2.282	2.282	2.282	2.282	2.282	2.282
57	4.73	3.526	0	4.73	4.73	4.73	4.73	4.73	3.526	3.526	3.526
58	4.73	2.282	4.73	5	3.526	4.73	4.73	3.526	4.73	3.526	2.282
59	3.526	2.282	3.526	3.526	2.282	2.282	3.526	3.526	3.526	3.526	3.526
60	3.526	4.73	3.526	4.73	4.73	4.73	3.526	3.526	3.526	3.526	3.526
61	4.73	4.73	4.73	4.73	2.282	2.282	4.73	4.73	4.73	3.526	3.526
62	4.73	4.73	4.73	4.73	3.526	4.73	2.282	3.526	3.526	4.73	4.73
63	4.73	2.282	3.526	4.73	3.526	3.526	4.73	4.73	4.73	4.73	4.73
64	4.73	2.282	5	4.73	4.73	0	5	5	5	4.73	4.73
65	4.73	2.282	3.526	3.526	3.526	3.526	3.526	3.526	3.526	3.526	3.526
66	0	0	0	0	0	0	0	0	0	0	0
67	4.73	2.282	2.282	2.282	2.282	2.282	2.282	4.73	3.526	4.73	4.73
68	4.73	4.73	4.73	4.73	3.526	3.526	4.73	4.73	4.73	3.526	3.526
69	2.282	4.73	4.73	4.73	2.282	2.282	3.526	3.526	4.73	3.526	3.526
70	4.73	3.526	4.73	4.73	3.526	3.526	4.73	4.73	4.73	4.73	3.526
71	5	5	4.73	4.73	4.73	3.526	4.73	4.73	4.73	4.73	3.526
72	4.73	4.73	3.526	3.526	3.526	3.526	3.526	3.526	3.526	3.526	3.526
73	4.73	4.73	2.282	2.282	2.282	2.282	3.526	3.526	3.526	3.526	3.526
74	4.73	4.73	4.73	3.526	3.526	4.73	4.73	4.73	4.73	3.526	4.73
75	4.73	4.73	2.282	3.526	2.282	2.282	3.526	3.526	3.526	3.526	3.526
76	4.73	4.73	5	4.73	5	4.73	4.73	4.73	2.282	4.73	3.526
77	4.73	4.73	4.73	4.73	3.526	3.526	4.73	4.73	4.73	4.73	4.73
78	4.73	2.282	1	1	1	1	3.526	3.526	3.526	3.526	3.526
79	4.73	3.526	0	4.73	4.73	4.73	4.73	4.73	3.526	3.526	3.526
80	2.282	2.282	3.526	4.73	2.282	3.526	4.73	3.526	3.526	3.526	3.526
81	3.526	4.73	4.73	4.73	3.526	3.526	4.73	4.73	3.526	3.526	3.526
82	4.73	3.526	5	5	5	5	4.73	4.73	4.73	4.73	4.73
83	0	0	0	0	0	0	0	0	0	0	0

	PR1	PR2	PR3	PR4	PR5	PR6	PR7	PR8	PR9	PR10	PR11
84	4.73	2.282	3.526	3.526	3.526	3.526	3.526	3.526	3.526	3.526	3.526
85	5	5	5	5	5	5	5	5	5	5	5
86	4.73	3.526	4.73	3.526	3.526	3.526	3.526	3.526	3.526	3.526	3.526
87	4.73	1	4.73	4.73	3.526	4.73	4.73	4.73	4.73	4.73	4.73
88	4.73	3.526	4.73	4.73	4.73	4.73	4.73	4.73	4.73	4.73	3.526
89	5	4.73	5	5	4.73	5	5	5	4.73	4.73	3.526
90	5	4.73	4.73	4.73	3.526	4.73	5	5	5	5	3.526
91	3.526	2.282	3.526	2.282	1	1	2.282	2.282	2.282	2.282	2.282
92	0	0	0	0	0	0	0	0	0	0	0
93	2.282	2.282	4.73	4.73	4.73	4.73	3.526	4.73	4.73	3.526	3.526
94	3.526	2.282	4.73	4.73	3.526	4.73	4.73	4.73	3.526	4.73	3.526
95	3.526	3.526	3.526	3.526	2.282	2.282	2.282	3.526	3.526	3.526	3.526
96	3.526	1	4.73	4.73	4.73	4.73	0	0	0	0	0
97	3.526	3.526	4.73	4.73	4.73	4.73	3.526	3.526	3.526	3.526	3.526
98	4.73	4.73	5	4.73	4.73	4.73	5	5	4.73	3.526	3.526
99	4.73	2.282	5	5	3.526	2.282	5	5	4.73	4.73	4.73
100	4.73	4.73	4.73	4.73	4.73	4.73	4.73	4.73	4.73	4.73	3.526
101	0	0	0	0	0	0	0	0	0	0	0
102	0	2.282	0	0	0	0	0	0	0	0	0
103	5	4.73	4.73	4.73	2.282	1	4.73	4.73	4.73	3.526	2.282
104	4.73	2.282	2.282	4.73	2.282	2.282	4.73	4.73	3.526	2.282	3.526
105	4.73	1	4.73	4.73	2.282	2.282	3.526	3.526	3.526	3.526	3.526
106	4.73	2.282	3.526	3.526	3.526	3.526	4.73	4.73	4.73	4.73	3.526
107	4.73	3.526	4.73	4.73	3.526	4.73	4.73	3.526	3.526	3.526	3.526
108	5	3.526	4.73	3.526	0	3.526	5	5	5	5	5
109	5	3.526	5	5	3.526	3.526	4.73	4.73	4.73	4.73	3.526
110	4.73	3.526	4.73	4.73	3.526	3.526	4.73	4.73	4.73	3.526	3.526
111	4.73	4.73	5	4.73	5	4.73	3.526	3.526	3.526	3.526	3.526
112	4.73	4.73	5	5	4.73	5	4.73	4.73	4.73	3.526	3.526

	CV1	CV2	CV3	CV4	CV5	CV6	CV7	CV8	CV9	CV10	CV11	CV12	CV13	CV14
1	3.526	2.282	4.73	4.73	2.282	2.282	2.282	2.282	2.282	3.526	3.526	2.282	2.282	3.526
2	3.526	3.526	4.73	5	5	4.73	4.73	4.73	4.73	5	5	3.526	5	4.73
3	3.526	3.526	4.73	4.73	4.73	2.282	3.526	2.282	0	5	4.73	2.282	3.526	3.526
4	4.73	4.73	4.73	4.73	4.73	3.526	4.73	4.73	3.526	3.526	4.73	3.526	3.526	4.73
5	4.73	4.73	4.73	5	2.282	2.282	2.282	2.282	1	4.73	4.73	3.526	3.526	3.526
6	4.73	4.73	4.73	4.73	3.526	1	2.282	3.526	4.73	4.73	4.73	4.73	4.73	4.73
7	4.73	4.73	4.73	5	4.73	4.73	3.526	3.526	4.73	3.526	3.526	3.526	3.526	3.526
8	3.526	4.73	4.73	4.73	3.526	4.73	3.526	3.526	3.526	4.73	4.73	3.526	4.73	4.73
9	4.73	4.73	4.73	5	4.73	3.526	3.526	3.526	3.526	4.73	4.73	2.282	4.73	3.526
10	4.73	4.73	5	5	4.73	5	5	2.282	2.282	5	5	2.282	5	5
11	4.73	3.526	5	4.73	4.73	2.282	3.526	2.282	3.526	4.73	4.73	2.282	4.73	3.526
12	4.73	4.73	5	5	4.73	4.73	4.73	3.526	2.282	4.73	4.73	3.526	4.73	4.73
13	4.73	5	5	5	5	4.73	5	3.526	2.282	4.73	4.73	4.73	5	5
14	4.73	4.73	5	5	4.73	2.282	2.282	2.282	1	4.73	4.73	2.282	4.73	4.73
15	4.73	4.73	5	5	4.73	4.73	4.73	4.73	3.526	4.73	4.73	4.73	4.73	5
16	5	4.73	5	5	4.73	4.73	4.73	4.73	2.282	5	5	4.73	4.73	4.73
17	4.73	3.526	3.526	4.73	4.73	3.526	2.282	3.526	2.282	4.73	3.526	2.282	4.73	4.73
18	3.526	3.526	2.282	2.282	2.282	2.282	3.526	2.282	2.282	2.282	2.282	2.282	2.282	2.282
19	5	4.73	4.73	4.73	4.73	3.526	4.73	4.73	3.526	4.73	4.73	4.73	4.73	4.73
20	4.73	4.73	3.526	2.282	2.282	2.282	2.282	3.526	2.282	3.526	3.526	2.282	2.282	2.282
21	5	5	0	0	0	0	0	0	0	0	0	0	0	0
22	4.73	4.73	0	4.73	4.73	4.73	3.526	2.282	2.282	3.526	3.526	2.282	3.526	3.526
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	3.526	3.526	3.526	2.282	2.282	2.282	2.282	3.526	2.282	4.73	2.282	2.282	2.282	2.282
25	4.73	4.73	3.526	0	0	0	0	0	0	0	0	0	0	0
26	2.282	2.282	2.282	1	1	1	1	1	1	1	1	1	1	1
27	4.73	2.282	2.282	2.282	2.282	2.282	2.282	2.282	2.282	3.526	3.526	3.526	3.526	3.526
28	4.73	2.282	3.526	4.73	1	1	1	1	1	1	1	1	1	1
29	4.73	4.73	2.282	2.282	2.282	2.282	2.282	2.282	1	1	1	1	1	2.282
30	4.73	4.73	2.282	2.282	2.282	2.282	2.282	2.282	2.282	2.282	2.282	2.282	2.282	3.526
31	4.73	4.73	4.73	3.526	3.526	3.526	4.73	3.526	3.526	4.73	4.73	3.526	3.526	4.73
32	4.73	4.73	4.73	4.73	4.73	3.526	3.526	3.526	4.73	3.526	3.526	3.526	4.73	0
33	5	4.73	4.73	4.73	4.73	4.73	4.73	4.73	3.526	4.73	4.73	3.526	4.73	4.73
34	4.73	4.73	4.73	4.73	3.526	3.526	3.526	3.526	2.282	4.73	4.73	2.282	4.73	4.73
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	4.73	3.526	4.73	2.282	2.282	2.282	2.282	3.526	2.282	3.526	3.526	2.282	2.282	3.526
38	4.73	4.73	4.73	3.526	3.526	2.282	3.526	2.282	2.282	2.282	2.282	2.282	2.282	2.282
39	4.73	4.73	2.282	2.282	4.73	4.73	2.282	4.73	2.282	4.73	2.282	4.73	4.73	4.73
40	4.73	3.526	3.526	2.282	4.73	3.526	3.526	3.526	4.73	5	4.73	4.73	3.526	3.526
41	5	4.73	4.73	4.73	3.526	3.526	4.73	4.73	1	3.526	3.526	3.526	3.526	3.526
42	4.73	4.73	4.73	3.526	3.526	4.73	4.73	3.526	2.282	4.73	4.73	3.526	2.282	2.282
43	2.282	3.526	3.526	3.526	3.526	2.282	3.526	2.282	2.282	2.282	2.282	2.282	2.282	2.282
44	2.282	2.282	3.526	2.282	3.526	2.282	2.282	3.526	2.282	3.526	4.73	2.282	3.526	3.526
45	4.73	3.526	2.282	2.282	1	1	2.282	3.526	2.282	2.282	2.282	2.282	2.282	1

	CV1	CV2	CV3	CV4	CV5	CV6	CV7	CV8	CV9	CV10	CV11	CV12	CV13	CV14
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0
47	4.73	4.73	4.73	2.282	2.282	1	2.282	2.282	1	2.282	3.526	2.282	2.282	4.73
48	5	4.73	5	5	4.73	3.526	1	2.282	1	3.526	4.73	2.282	2.282	3.526
49	4.73	3.526	3.526	3.526	3.526	3.526	3.526	3.526	3.526	3.526	3.526	3.526	3.526	3.526
50	5	5	4.73	4.73	4.73	3.526	4.73	3.526	2.282	4.73	5	4.73	5	4.73
51	3.526	3.526	4.73	3.526	4.73	4.73	4.73	4.73	3.526	4.73	4.73	2.282	3.526	3.526
52	4.73	4.73	4.73	3.526	3.526	4.73	3.526	2.282	1	4.73	4.73	2.282	2.282	4.73
53	4.73	3.526	2.282	4.73	3.526	3.526	1	2.282	1	1	3.526	1	1	3.526
54	3.526	3.526	4.73	4.73	4.73	2.282	2.282	3.526	2.282	3.526	4.73	2.282	3.526	3.526
55	4.73	2.282	3.526	3.526	4.73	3.526	3.526	3.526	2.282	2.282	2.282	2.282	2.282	2.282
56	4.73	4.73	2.282	1	2.282	1	4.73	4.73	2.282	2.282	3.526	2.282	2.282	2.282
57	4.73	4.73	3.526	2.282	4.73	3.526	4.73	3.526	2.282	3.526	4.73	3.526	3.526	3.526
58	4.73	4.73	4.73	4.73	3.526	2.282	4.73	3.526	2.282	3.526	4.73	2.282	3.526	3.526
59	4.73	3.526	2.282	3.526	2.282	2.282	2.282	3.526	2.282	3.526	3.526	2.282	2.282	3.526
60	4.73	4.73	3.526	3.526	3.526	3.526	3.526	4.73	3.526	4.73	4.73	3.526	3.526	3.526
61	4.73	2.282	2.282	4.73	2.282	2.282	2.282	2.282	2.282	4.73	2.282	2.282	2.282	3.526
62	4.73	3.526	4.73	4.73	2.282	1	3.526	2.282	2.282	3.526	3.526	2.282	1	2.282
63	4.73	4.73	3.526	3.526	3.526	3.526	3.526	4.73	3.526	3.526	4.73	3.526	3.526	4.73
64	4.73	4.73	3.526	3.526	2.282	1	2.282	2.282	2.282	3.526	3.526	2.282	3.526	4.73
65	2.282	2.282	2.282	2.282	2.282	2.282	2.282	2.282	2.282	2.282	2.282	2.282	2.282	2.282
66	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	2.282	2.282	4.73	3.526	2.282	2.282	3.526	2.282	2.282	2.282	2.282	2.282	2.282	2.282
68	5	4.73	3.526	3.526	2.282	3.526	3.526	1	1	4.73	4.73	3.526	3.526	3.526
69	5	4.73	2.282	5	2.282	1	2.282	2.282	1	3.526	4.73	2.282	2.282	3.526
70	3.526	2.282	2.282	2.282	2.282	2.282	2.282	2.282	3.526	2.282	2.282	2.282	2.282	2.282
71	5	4.73	4.73	4.73	4.73	3.526	4.73	3.526	2.282	4.73	4.73	3.526	3.526	3.526
72	5	4.73	4.73	4.73	4.73	2.282	3.526	4.73	2.282	2.282	2.282	2.282	2.282	2.282
73	4.73	2.282	2.282	2.282	2.282	2.282	2.282	4.73	2.282	2.282	2.282	2.282	2.282	2.282
74	4.73	4.73	3.526	2.282	3.526	3.526	3.526	4.73	2.282	3.526	2.282	2.282	3.526	3.526
75	4.73	0	0	0	2.282	1	2.282	2.282	1	3.526	2.282	2.282	2.282	0
76	4.73	3.526	2.282	4.73	2.282	2.282	3.526	2.282	2.282	3.526	4.73	2.282	0	4.73
77	4.73	3.526	2.282	4.73	3.526	2.282	2.282	2.282	2.282	2.282	3.526	2.282	2.282	4.73
78	4.73	4.73	1	2.282	4.73	2.282	1	1	1	1	1	1	1	2.282
79	4.73	4.73	3.526	2.282	4.73	3.526	4.73	3.526	2.282	3.526	4.73	3.526	3.526	3.526
80	4.73	3.526	3.526	4.73	3.526	3.526	3.526	4.73	3.526	3.526	3.526	2.282	2.282	2.282
81	4.73	4.73	3.526	2.282	4.73	3.526	3.526	3.526	4.73	3.526	3.526	3.526	3.526	3.526
82	5	4.73	4.73	3.526	4.73	3.526	4.73	3.526	4.73	4.73	3.526	2.282	3.526	3.526
83	5	4.73	4.73	4.73	5	4.73	4.73	4.73	4.73	4.73	3.526	3.526	3.526	3.526

	CV1	CV2	CV3	CV4	CV5	CV6	CV7	CV8	CV9	CV10	CV11	CV12	CV13	CV14
84	5	4.73	4.73	4.73	5	4.73	4.73	4.73	3.526	3.526	3.526	3.526	3.526	3.526
85	5	5	5	5	5	5	5	5	5	5	5	5	5	5
86	5	3.526	3.526	4.73	5	5	3.526	3.526	5	4.73	4.73	4.73	3.526	0
87	5	5	5	4.73	5	4.73	4.73	5	4.73	5	5	5	5	4.73
88	0	0	0	0	0	0	0	0	0	0	0	0	0	0
89	5	4.73	4.73	4.73	5	3.526	4.73	3.526	4.73	4.73	4.73	4.73	4.73	4.73
90	0	0	0	0	0	4.73	4.73	0	0	0	0	0	0	0
91	4.73	4.73	2.282	4.73	5	3.526	4.73	2.282	5	4.73	4.73	4.73	4.73	4.73
92	5	5	0	0	5	4.73	0	5	5	5	0	5	0	4.73
93	0	0	0	0	0	0	0	0	0	0	0	0	0	0
94	4.73	4.73	2.282	4.73	4.73	3.526	3.526	4.73	2.282	3.526	3.526	3.526	3.526	2.282
95	2.282	3.526	2.282	4.73	3.526	2.282	2.282	3.526	3.526	2.282	2.282	2.282	2.282	2.282
96	5	3.526	2.282	3.526	3.526	3.526	0	5	4.73	0	0	0	0	0
97	5	4.73	2.282	4.73	5	2.282	3.526	2.282	4.73	4.73	4.73	2.282	4.73	3.526
98	5	5	4.73	2.282	5	5	4.73	5	4.73	4.73	4.73	4.73	3.526	4.73
99	4.73	4.73	5	5	4.73	4.73	3.526	1	3.526	4.73	4.73	3.526	2.282	3.526
100	4.73	2.282	4.73	5	4.73	4.73	4.73	3.526	2.282	4.73	4.73	4.73	3.526	3.526
101	0	0	0	0	0	0	0	0	0	0	0	0	0	0
102	4.73	3.526	4.73	5	4.73	3.526	0	3.526	4.73	4.73	4.73	3.526	3.526	3.526
103	2.282	2.282	2.282	5	2.282	1	4.73	2.282	1	4.73	0	0	0	0
104	4.73	4.73	4.73	5	4.73	4.73	2.282	3.526	3.526	4.73	4.73	2.282	3.526	3.526
105	4.73	2.282	1	4.73	4.73	2.282	2.282	2.282	1	4.73	4.73	1	2.282	2.282
106	4.73	2.282	2.282	4.73	2.282	2.282	2.282	3.526	2.282	2.282	2.282	2.282	2.282	2.282
107	4.73	3.526	4.73	4.73	4.73	2.282	3.526	3.526	1	4.73	3.526	2.282	3.526	1
108	3.526	3.526	0	5	0	5	3.526	1	4.73	0	0	0	0	0
109	3.526	3.526	3.526	5	4.73	4.73	3.526	3.526	3.526	3.526	3.526	3.526	3.526	3.526
110	4.73	4.73	4.73	5	3.526	2.282	3.526	2.282	2.282	4.73	4.73	3.526	3.526	3.526
111	5	4.73	4.73	3.526	4.73	3.526	3.526	4.73	5	4.73	3.526	3.526	3.526	0
112	4.73	3.526	3.526	4.73	3.526	3.526	3.526	4.73	3.526	4.73	4.73	3.526	3.526	3.526

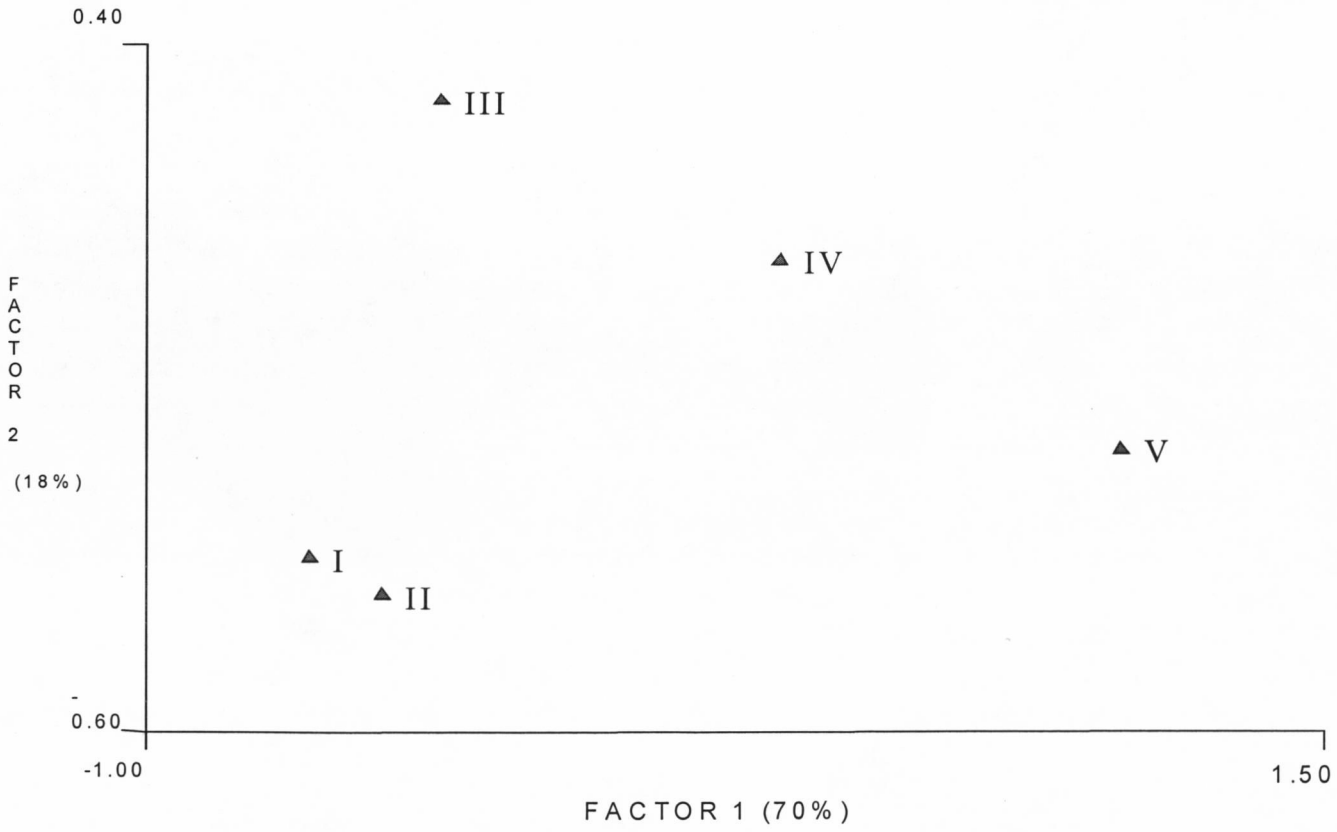
Frequency table

	V	IV	III	II	I
B1	57	48	5	1	0
B2	43	56	10	2	0
B3	58	47	3	1	0
B4	32	51	17	11	0
B5	58	41	10	2	0
B6	43	50	14	3	0
B7	52	41	15	2	0
PD1	8	28	25	37	7
PD2	22	48	18	14	5
PD3	32	41	10	19	6
PD4	21	48	19	14	4
PD5	8	34	27	26	9
PD6	8	30	36	24	7
PD7	1	10	24	59	10
PD8	2	16	34	41	11
PD9	3	27	52	13	7
PD10	3	22	57	12	7
PD11	1	16	61	16	6
PD12	2	21	53	19	6
SC1	5	24	26	37	13
SC2	3	31	33	33	4
SC3	8	41	24	25	6
SC4	6	51	29	16	3
SC5	4	21	36	35	7
SC6	4	17	41	30	10
SC7	1	10	26	48	17
SC8	1	15	35	37	14
SC9	1	16	56	15	9
SC10	0	14	58	15	10
SC11	2	6	57	21	11
PR1	12	59	20	10	0
PR2	4	43	23	25	6
PR3	18	50	17	10	2
PR4	15	55	19	8	2
PR5	7	20	39	28	4
PR6	6	31	35	20	6
PR7	14	47	26	10	1
PR8	13	44	33	7	1
PR9	9	44	38	6	1
PR10	7	31	52	7	1
PR11	3	19	63	10	1
CV1	23	62	11	7	0
CV2	7	53	27	15	0
CV3	11	39	22	24	2
CV4	21	38	17	21	2
CV5	12	38	22	25	3
CV6	5	22	31	33	11
CV7	3	27	35	29	5
CV8	5	21	37	32	6
CV9	5	15	20	43	17
CV10	8	41	29	16	5
CV11	6	43	26	18	4
CV12	3	13	29	47	6
CV13	6	17	37	30	6
CV14	4	25	40	21	4

Rescaled Data

--------	Axis1	--------	--------	Axis2	--------	--------	
Factor	COR	CTR	**Factor**	COR	CTR		
1.066	0.89	0.489	**-0.189**	0.028	0.06		
0.339	0.617	0.126	**0.086**	0.04	0.032		
-0.378	0.538	0.143	**0.319**	0.383	0.399		
-0.5	0.592	0.17	**-0.401**	0.38	0.428		
-0.654	0.591	0.073	**-0.346**	0.166	0.081		
		X Axis	Y Axis	Distance	Index	Rescaled	
					Distance	Data	
	V	**1.066**	**-0.189**	1	1	**1**	**I**
	IV	**0.339**	**0.086**	0.777273	1.282116	**2.282**	**II**
	III	**-0.378**	**0.319**	0.753908	1.243575	**3.526**	**II**
	II	**-0.5**	**-0.401**	0.730263	1.204572	**4.730**	**IV**
	I	**-0.654**	**-0.346**	0.163527	0.269738	**5**	**V**
			Sum	2.424972	5		
			Factor	1.649504			

"Horse-Shoe" Plot



Appendix C

Pearson's Correlation Analysis

Customer value learning

	CV10 - 13	CV14
CV10 - 13	1.000	0,785
CV14	0,785	1.000
Cronbach's Alpha = 0,816 Standardised Cronbach Alpha = 0,879		

Product development

	PD5 - 8	PD10
PD5 - 8	1.000	0,674
PD10	0,674	1.000
Cronbach's Alpha = 0,800 Standardised Cronbach Alpha = 0,805		

Product development

	PD5 - 8	PD11
PD5 - 8	1.000	0,616
PD11	0,616	1.000
Cronbach's Alpha = 0,759 Standardised Cronbach Alpha = 0,763		

Product development

	PD5 - 8	PD12
PD5 - 8	1.000	0,622
PD12	0,622	1.000
Cronbach's Alpha = 0,763 Standardised Cronbach Alpha = 0,767		

Supply chain management

	SC5 –8	SC9
SC5 - 8	1.000	0,773
SC9	0,773	1.000
Cronbach's Alpha = 0,866 Standardised Cronbach Alpha = 0,872		

Supply chain management

	SC5 –8	SC10
SC5 - 8	1.000	0,774
SC10	0,774	1.000
Cronbach's Alpha = 0,868 Standardised Cronbach Alpha = 0,873		

Supply chain management

	SC5 –8	SC11
SC5 - 8	1.000	0,773
SC11	0,773	1.000
Cronbach's Alpha = 0,843 Standardised Cronbach Alpha = 0,846		

Process improvements

	PR3 - 6	PR10
PR3 - 6	1.000	0,817
PR10	0,817	1.000
Cronbach's Alpha = 0,899 Standardised Cronbach Alpha = 0,899		

Process improvements

	PR3 - 6	PR11
PR3 - 6	1.000	0,721
PR11	0,721	1.000
Cronbach's Alpha = 0,838 Standardised Cronbach Alpha = 0,838		

Appendix D

Two-Sample t-test

B5-7 VS. CV1-4: 95% confidence level

Alternative Hypothesis	T-Value	Prob Level	Decision (Alpha=.05)	Power (Alpha=.01)	Power
(B5-7)-(CV1-4)<>0	6.441	0.000	Reject Ho	0.999	0.999
(B5-7)-(CV1-4)<0	6.441	1.000	Accept Ho	0.000	0.000
(B5-7)-(CV1-4)>0	6.441	0.000	Reject Ho	0.999	0.999

Reject null hypothesis. In other words, there is a significant gap.

B1-4 vs. PD5-8: 95% confidence level

Alternative Hypothesis	T-Value	Prob Level	Decision (Alpha=.05)	Power (Alpha=.01)	Power
(B1-4)-(PD5-8)<>0	12.756	0.000	Reject Ho	1.000	1.000
(B1-4)-(PD5-8)<0	12.756	1.000	Accept Ho	0.000	0.000
(B1-4)-(PD5-8)>0	12.756	0.000	Reject Ho	1.000	1.000

Reject null hypothesis. In other words, there is a significant gap.

B5 VS. PD10: 95% confidence level

Alternative Hypothesis	T-Value	Prob Level	Decision (Alpha=.05)	Power (Alpha=.01)	Power
(B5)-(PD10)<>0	10.1370	0.000	Reject Ho	1.000	1.000
(B5)-(PD10)<0	10.1370	1.000	Accept Ho	0.000	0.000
(B5)-(PD10)>0	10.1370	0.000	Reject Ho	1.000	1.000

Reject null hypothesis. In other words, there is a significant gap.

B6 VS. PD11: 95% confidence level

Alternative Hypothesis	T-Value	Prob Level	Decision	Power (Alpha=.05)	Power (Alpha=.01)
(B6)-(PD11)<>0	9.8916	0.000	Reject Ho	1.000	1.000
(B6)-(PD11)<0	9.8916	1.000	Accept Ho	0.000	0.000
(B6)-(PD11)>0	9.8916	0.000	Reject Ho	1.000	1.000

Reject null hypothesis. In other words, there is a significant gap.

B7 VS. PD12: 95% confidence level

Alternative Hypothesis	T-Value	Prob Level	Decision	Power (Alpha=.05)	Power (Alpha=.01)
(B7)-(PD12)<>0	9.5828	0.000	Reject Ho	1.000	1.000
(B7)-(PD12)<0	9.5828	1.000	Accept Ho	0.000	0.000
(B7)-(PD12)>0	9.5828	0.000	Reject Ho	1.000	1.000

Reject null hypothesis. In other words, there is a significant gap.

B1-4 vs. SC5-8: 95% confidence level

Alternative Hypothesis	T-Value	Prob Level	Decision	Power (Alpha=.05)	Power (Alpha=.01)
(B1-4)-(SC5-8)<>0	14.195	0.000	Reject Ho	1.000	1.000
(B1-4)-(SC5-8)<0	14.195	1.000	Accept Ho	0.000	0.000
(B1-4)-(SC5-8)>0	14.195	0.000	Reject Ho	1.000	1.000

Reject null hypothesis. In other words, there is a significant gap.

B5 VS. SC9: 95% confidence level

Alternative Hypothesis	T-Value	Prob Level	Decision	Power (Alpha=.05)	Power (Alpha=.01)
(B5)-(SC9)<>0	11.692	0.000	Reject Ho	1.000	1.000
(B5)-(SC9)<0	11.692	1.000	Accept Ho	0.000	0.000
(B5)-(SC9)>0	11.692	0.000	Reject Ho	1.000	1.000

Reject null hypothesis. In other words, there is a significant gap.

B6 VS. SC10: 95% confidence level

Alternative Hypothesis	T-Value	Prob Level	Decision	Power (Alpha=.05)	Power (Alpha=.01)
(B6)-(SC10)<>0	10.751	0.000	Reject Ho	1.000	1.000
(B6)-(SC10)<0	10.751	1.000	Accept Ho	0.000	0.000
(B6)-(SC10)>0	10.751	0.000	Reject Ho	1.000	1.000

Reject null hypothesis. In other words, there is a significant gap.

B7 VS. SC11: 95% confidence level

Alternative Hypothesis	T-Value	Prob Level	Decision	Power (Alpha=.05)	Power (Alpha=.01)
(B7)-(SC11)<>0	12.287	0.000	Reject Ho	1.000	1.000
(B7)-(SC11)<0	12.287	1.000	Accept Ho	0.000	0.000
(B7)-(SC11)>0	12.287	0.000	Reject Ho	1.000	1.000

Reject null hypothesis. In other words, there is a significant gap.

B1-4 vs. PR3-6: 95% confidence level

Alternative Hypothesis	T-Value	Prob Level	Decision	Power (Alpha=.05)	Power (Alpha=.01)
(B1-4)-(PR3-6)<>0	8.036	0.000	Reject Ho	1.000	1.000
(B1-4)-(PR3-6)<0	8.036	1.000	Accept Ho	0.000	0.000
(B1-4)-(PR3-6)>0	8.036	0.000	Reject Ho	1.000	1.000

Reject null hypothesis. In other words, there is a significant gap.

B5 VS. PR10: 95% confidence level

Alternative Hypothesis	T-Value	Prob Level	Decision	Power (Alpha=.05)	Power (Alpha=.01)
(B5)-(PR10)<>0	8.114	0.000	Reject Ho	1.000	1.000
(B5)-(PR10)<0	8.114	1.000	Accept Ho	0.000	0.000
(B5)-(PR10)>0	8.114	0.000	Reject Ho	1.000	1.000

Reject null hypothesis. In other words, there is a significant gap.

B6 VS. PR11: 95% confidence level

Alternative Hypothesis	T-Value	Prob Level	Decision	Power (Alpha=.05)	Power (Alpha=.01)
(B6)-(PR11)<>0	8.740	0.000	Reject Ho	1.000	1.000
(B6)-(PR11)<0	8.740	1.000	Accept Ho	0.000	0.000
(B6)-(PR11)>0	8.740	0.000	Reject Ho	1.000	1.000

Reject null hypothesis. In other words, there is a significant gap.

Appendix E

Tabulation of the future role of a knowledge-orientation in manufacturing

Tabulation of the future role of a knowledge-orientation in manufacturing

Key theme	Frequency
Industry differentiation factor that will ensure long range sustainable competitive advantage	25
Important for our future business expansion – key business driver; full integration in a global environment	15
Better way of solving customer problems because of knowledge of customer processes as a unique advantage – building customer database	13
Way of managing knowledge and employee productivity (before employees leave)	10
Important to document, share and implement knowledge and information	9
Way of building quality into products and processes – eliminating defects and ensuring continuous improvements	9
Culture must be conducive – it is a myth that some people can't handle certain information	9

Way of not repeating the same mistakes	8
Way of breaking down hierarchies and creating synergies across departments	7
Important to share knowledge in order to improve productivity, communication, solve and customer needs	6
Way of better integrating supply chain – even the value chain	4
Closely linked to organisational competence	4
Way of generating higher revenues from new products or new markets	4
Important that seasoned employees share knowledge with new and less experienced employees – collective knowledge	3
People must be trained to contribute to the organisational knowledge	3
Part of ongoing benchmarking	2
Enables business flexibility when wanting to change direction	1
Quality information is the basis for sound decision making	1