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TITLE: CULTURE, KNOWLEDGE AND COMPETITIVENESS: A KBV APPROACH TO MANUFACTURING FIRMS IN BRAZIL

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ABSTRACT: Competitive advantage is more than ever an important topic during crisis, and a better understanding on how to achieve superior performance is central to the strategic management process. Drawing on the knowledge-based view (KBV) of the firm, on manufacturing strategy and operational performance, and following previous empirical studies), our research explores the influence of a culture of competitiveness (CC) and knowledge development (KD) on firm competitiveness. We reexamine previous links between a CC, KD and cycle time in two ways: adding cost, quality, dependability, delivery, and flexibility as proxies to a manufacturing performance construct; and reviewing scales to immerse KD into a more comprehensive KBV context. Thus we extend the existing scale, proposing a survey to human resource and manufacturing executives of Brazilian firms to be tested empirically in the future.

KEY-WORDS: Knowledge, learning, culture, manufacturing performance.

TRACK: Latin American and Caribbean

INTRODUCTION

The importance of operations to the competitive advantage of the firm is a mature topic. Since Skinner (1969; 1974) and his seminal articles to *Harvard Business Review* (*HBR*) a consistent debate took place on if (PORTER, 1996), how (FERDOWS and DeMEYER, 1990) and with

what intensity (WHEELWRIGHT, 1984) operations contribute to corporate strategy. If a single and definitive conclusion cannot be reached (and even may not be desirable), a relative consonance and a common agenda seem to emerge.

Recent work on operations management see manufacturing as an important contributor, at least as means to deliver what firm's strategy demands. In many industries (e.g. automotive, electronics) there is evidence (KIM and ARNOLD, 1992; NOBLE, 1995; WARD et al, 1996; ADLER et al, 1999) that manufacturing is the base for competitive advantage, being sometimes hard to transfer, copy, substitute or develop. Many studies relate manufacturing to sustainable competitive advantage under the precepts of the resource-based view (RBV) of the firm (WERNERFELT, 1984; BARNEY, 1986; DIERICKX and COOL, 1989). While some authors try to establish how organizations strive to develop an advantageous position through manufacturing, exploring their internal resources (SCHROEDER et al, 2002; ROSENZWEIG and ROTH, 2004), others extend this framework to study groups of inter-related firms, like supply chains (HULT et al, 2004; 2007).

Some studies relate competitiveness to intangible, hard to identify assets. They link operations to topics typically from the human resources areas, such as learning (e.g. HULT et al, 2003), employee behavior (e.g. UZUNERI and NEMBHARD, 1998), organizational culture (e.g. WEST and BURNS, 2000), and knowledge (e.g. PAIVA et al, 2008). These cross-area, multidimensional researches usually have part of their theoretical background in the knowledge-based view (KBV) of the firm. We intend to contribute to the 'KBV x Operations' framework expanding the work of Hult et al (2007), reframing if from a supply chain to a strategic business unit (SBU) perspective.

Hult et al (2007) focus on explaining order fulfillment cycle time in their search for superior supply chain performance. Cycle time as a uni-dimensional dependent variable is appropriate as 'the length of time between taking an order and delivery of the needed product to the customer' is paramount for the success of a supply chain, as is illustrated in anecdotal cases such as Dell, Zara, and Toyota. However, if we focus on the strategic business unit (SBU), there is a lot more to see and evaluate as performance measures. To achieve a competitive cycle time even may not be hard; to do so with low costs, high quality, superior dependability, fast delivery, and great flexibility is a more challenging (sometimes impossible) task. Thus we return the focus to the original 'Hult et al. studies', perceiving new ways of why some firms (and not supply chains) outperform others. Our paper build upon a series of previous articles and correspondent scales, remarkably on:

- Hult et al's (2002) 'culture of competitiveness' concept, a reflection of innovativeness, entrepreneurial, and learning orientations. We recall the scales as they were tested, adding elements to the 'learning orientation' construct.
- Huber's (1991) 'knowledge development' concept, a reflection of knowledge acquisition, information distribution, shared meaning, and achieved memory. We recall the original scales proposed by: Kholi et al (1993), adapting them from marketing to manufacturing; Hult et al (2004), adapting them from supply chain to single business units; and Moorman and Miner (1997), adapting them from R&D to manufacturing.

- Skinner's (1969) 'manufacturing performance' concept, a reflection of cost, quality, dependability, delivery, flexibility. We recall scales proposed by authors ranging from Ferdows and DeMeyer (1990) to Choo et al (2007), and especially upon recent research developed in our university (HASHIBA, 2009; MIGUEL, 2009; SANTOS, 2009).

We propose a deeper examination of the knowledge development process in the context of superior manufacturing performance. Taking previous studies we build on the resource-based view (WERNERFELT, 1984), the knowledge-based view (KOGUT and ZANDER, 1992), the theory of organizational learning (ARGYRIS, 1976; HUBER, 1991) and information-processing (DAFT and WEICK, 1984) literatures, to reinforce Hult et al's (2007) proposition that 'neither a culture of competitiveness nor knowledge development by itself is sufficient to superior performance, these phenomena operate in tandem to achieve desired outcomes'.

This paper presents the theoretical foundation justifying the proposed model, the hypotheses, and scales adapted and developed. Data collection and analysis will take place during 2009.

We intend to use data from Brazilian firms located in two industrial centers in Sao Paulo and Amazonas states. A survey will be delivered to about 600 industrial firms through two class associations: CIESP and SUFRAMA. Desired respondents will be HR and operations directors, who will be asked about their perception on competitive culture (CC), knowledge development (KD), and manufacturing performance. Data will be subjected to structural equation modeling (SEM), testing for fit to our adapted model (Figure 1). Our contribution to operations strategy literature will be twofold: to measure manufacturing performance as a dependent variable, reflected in its cost, quality, dependability, delivery, and flexibility elements; and to review Hult et al (2007) scales on their CC and KD independent variables.

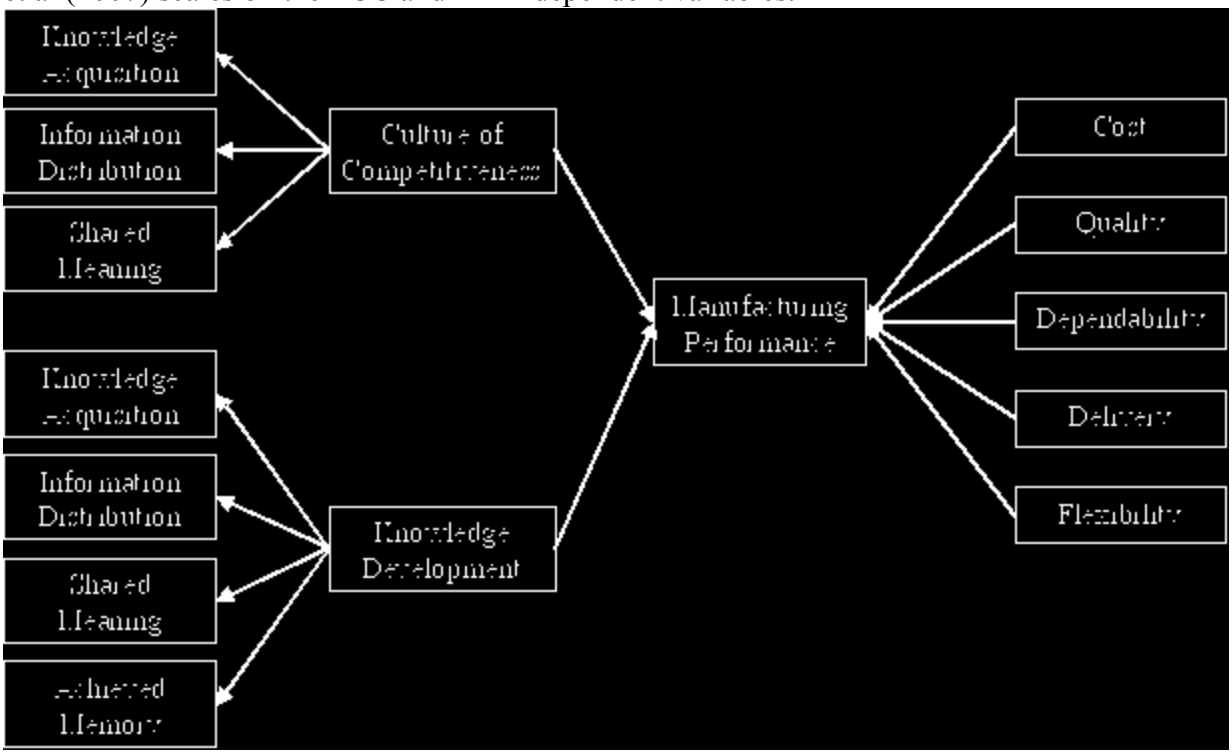

Figure 1: Adapted from Hult et al's (2007) model of culture of competitiveness, knowledge development, and performance

THEORETICAL FOUNDATION

Recent research by Schroeder et al (2002), Paiva et al (2007), and Menor et al (2007) highlight the importance of examining resources in a firm's operations management process, connecting intangible variables such as learning and knowledge to effective results such as manufacturing performance and financial returns. In this stream Huber et al (2007) propose their model of Culture of Competitiveness (CC) and Knowledge Development (KD), which influence in cycle time – the framework upon which we work on. Our conceptual model maintain the two higher-order factors of CC and KD, reviewing the scales for the first-order indicators: CC is reflected by the innovativeness, entrepeneurial, and learning orientations; KD is reflected by knowledge acquisition, information distribution, shared meaning, and achieve memory. Notwithstanding we expand the cycle time dependent variable to the more comprehensive concept of manufacturing performance, a higher-order factor composed of the following first-order indicators: cost, quality, dependability, delivery, and flexibility.

Culture of Competitiveness (CC) definition is adjusted from Hult et al (2002) as the 'degree to which firms are predisposed to detect and fill gaps between what the market desires and what is currently offered by production'. We support the authors' view that learning is a critical element, thus we conduct a deeper revision of this indicator. Knowledge Development (KD) is adjusted from Huber (1991) as the 'development of a set of varied interpretations, which can change the range of potential behaviors and develop various possible interpretations'. We extensively review Hult et al (2007) definitions and scales for all indicators. Manufacturing performance is adjusted from Slack et al (2004) definition as the 'conciliation of market desires and the production capabilities of a firm'. The broader operations strategy literature is the basis to operationalize this dependent variable.

CULTURE OF COMPETITIVENESS

Building on the knowledge-based view we support Hult et al (2002, 2007) proposition of Culture of Competitiveness (CC) as 'an intangible strategic resource', rephrasing it to the strategic

business unit (SBU) context. CC provides members of a SBU with ‘a pattern of shared values and beliefs’. It is a part of the more comprehensive phenomenon organizational culture, narrowed into what the authors call the entrepreneurship, innovativeness and learning orientations – which lead the firm to meet customers’ desires. We adjust these concepts as follows: entrepeneurial orientation as pursuit of opportunities and renewal of activities in manufacturing; innovativeness orientation as openness to new ideas in production; learning orientation as generation of insights that have the potential to shape manufacturing.

> *Each of these orientations is necessary, but individually insufficient for the emergence of the higher order intangible strategic resource of culture of competitiveness. Most importantly, rooted in the resource-based view, CC appears to be a valuable, rare, and inimitable strategic resource in supply chains that can provide a sustainable competitive advantage and enhanced performance’ (HULT et al, 2007).*

Revisiting the authors operationalization of CC we search for their original sources, and discard items not validated by their research. Thus, the questions supporting the first two orientations are rewritten (questions 1 to 8 in the Apendix).

Learning Orientation

To Easterby-Smith (1997, p. 1086) the creation of a comprehensive learning theory is an unrealistic aspiration, so researchers must select some indicators and omit others, focusing on discipline-specific frameworks. We follow this to better understand learning in the operations strategy context. There, if excellence in an activity is critical to competitive advantage, and if improvement over time is a key aspect, then learning must play a central role to firms (PISANO, 1994). Nowadays manufacturers are challenged to deliver much larger quantities of timely, factual information, that workers must learn at maximum rate, and avoid the mistakes and confusion that rapid change too often creates (UZUMERI and NEMBHARD, 1998; HULT et al, 2007). These ideas support questions 9 and 10 (Appendix).

Learning is inherently backward-looking, and depends upon engaging in practice, developing along with others a common outlook on, and understanding of, the work and how it fits into the world (GAVETTI and LEVINTHAL, 2000; BROWN and DUGUID, 2001). Human beings create, store, and retrieve designs that advise them how to act, and if practice with a particular problem is discontinued before it is learned, little transfer occurs to the next series, and considerable time and effort is spent when the activity is accessed once again (COHEN and LEVINTHAL, 1990; ARGYRIS, 1995). There is no best way to learn, and different approaches may be required in different environments, depending on the depth of knowledge to be attained: where it is less articulated and structured, trial and error (learning-by-doing) are necessary; where underlying factors are better understood, more deductive approaches can be undertaken (learning-before-doing) (PISANO, 1994; TEECE et al, 1997).

A classic learning process is Argyris’ (1976) single and double-looping approaches. Single-loop occurs when errors are corrected without altering the underlying governing values, in a way that

skills are refined through the enhancement of existing routines, without questioning. The governing values follow the "Model I theory-in-use", which are unilateral control, win and not lose, suppress negative feelings, and act rationally (things get done the way they should). Double-loop occurs when errors are corrected by changing the governing values and then, actions. Why things are done in a certain way is accessed. The governing values follow the "Model II theory-in-use", which are valid information, choice, and vigilant monitoring of implementation to detect and correct error, are put to practice. Many different ways to how things may get done are considered. The premises and inferences are explicit, and conclusions are tested by logic (ARGYRIS, 2002).

Learning also occurs in firms, and as SBUs gain experience their knowledge becomes deeper. Also, there is a consensus in the literature that: there is an empirical link between cumulative production experience and manufacturing performance; and organizational learning is a problem-solving process, triggered by gaps between actual and potential performance (PISANO, 1994). Learning is often a process of trial, feedback, and evaluation, where parameters are changed, experiments are conducted, cause-effect relationships are sought, and cognitive structures are formed, where simplicity, repetition, experience, and homogeneity breed competence (SKINNER, 1974). Organizational learning is path dependent, for what a firm has done in the past tends to predict what it can do in the future. Learning builds on past knowledge and experience, with a self-reinforcing nature (STATA, 1989; ROSENZWEIG and ROTH, 2004; HUBER et al, 2007). These ideas support question 11 (Appendix).

In many articles learning includes the training of multifunctional employees and incorporating employee suggestions (SCHROEDER et al, 2002; HULT, 2007) into process and product development. It is a multifunctional experience, as employees with varied experiences bring to the table new ideas about how to make improvements or new ways to understand problems. Learning includes self-appraisal activities, which gather information on problems and needed changes, involving members in choosing, planning, and implementing actions (HUBER, 1991; ROSENZWEIG and ROTH, 2004). These ideas support questions 12 to 14 (Appendix).

Hult et al (2003) broadly define learning as the values and beliefs associated with the development of new knowledge. This topic of Knowledge Development is now accessed.

KNOWLEDGE DEVELOPMENT

It is not uncommon to hear knowledge heralded as one of the 'newest ideas in management'. With markets liberalization and expansion the shift to assets that are valuable, hard to get, imitate and substitute, is compelling for competitive advantage (BARNEY, 1986). Knowledge management seems to fit well to these: while many inputs are available to all firms everywhere at similar prices knowledge, which is about context and understanding, is an asset that cannot readily be bought and sold, and thus must be built 'in house' (TEECE, 2001). Knowing how to select, interpret and integrate information into a useable body of knowledge is valuable skill. Its creation and utilization is a key resource managers need to achieve sustainable competence, as it stimulates individual and organizational learning and accelerates performance improvement

(LUCIER and TORSILIERI, 2001). However, there is little understanding on how firms create and manage knowledge, with few effective systems or tools for evaluating and managing knowledge assets (NONAKA et al, 2001). Going back to Penrose (1959, p. 67-87), knowledge is a latent resource waiting for a wake-up call, offering the firm productive services when activated.

Its study is not simple. An unpublished report from McKinsey and Darmstadt University of Technology (TAKEUSHI, 2001) stress that knowledge: means different things to different people; can become outdate instantaneously; is more valuable if shared; and cannot be planned *ex ante*. Knowledge is not one-dimensional either. Authors propose different approaches to its operationalization. Special issues of the *Strategic Management Journal* (*Knowledge and the Firm*, 1996), *Management Science* (*Managing Knowledge*, 2003) and *Organization Studies* (*Knowledge and Professional Organizations*, 2003; *Organizational Memory*, 2006) presents a series of different theoretical and empirical approaches to the study of knowledge management. These, among other articles, contribute to the so-called *Knowledge-Based View* (KBV) of the firm.

One influential article on knowledge management is Huber (1991), which divides knowledge management into four processes: **knowledge acquisition** (how knowledge is obtained); **information distribution** (how information is shared, leading to new understandings); **information interpretation** (how distributed information receives meaning); and **organizational memory** (how firms store knowledge for future use). This framework is used by other authors (e.g. SZULANSKI, 1996; SCHROEDER et al, 2002; HULT et al, 2007), and will guide our definition of knowledge.

Knowledge Acquisition

It is important to understand how firms access and utilize knowledge, i.e. their ability to assimilate information from the environment (COHEN and LEVINTHAL, 1990; GRANT, 1996B). Organizations find and move knowledge in an internalization process. *Finding* involves searches, in areas that do not form a coherent whole from which the best parts can be selected. *Moving* involves practice, and has more to do with aligning different ways of doing things (BROWN and DUGUID, 2001). Acquisition, then, may occur through the arrival of new knowledge blended to that presently possessed (CONNER and PRAHALAD, 1996). New knowledge may come from external activities such as customer surveys, research and development, performance reviews, and analyses of competitor's products (HUBER, 1991). It also occurs through comparison of performances from different firms. These ideas support questions 15 to 18 (Appendix).

Acquisition also comes from internal activities such as cross-functional teams, employee suggestions, and task experience (HUBER, 1991; SZULANSKI, 1996; SCHROEDER et al, 2002). Knowledge is obtained through interaction of individuals that continuously analyze procedures, conventions, and norms (GRANT, 1996B). Each employee possesses diverse and different knowledge structures, all of which, once combined, allow the firm to make novel linkages (COHEN and LEVINTHAL, 1990). These ideas support question 19 (Appendix).

Acquisition is not always available to be distributed, as it is subject to casual ambiguity. Too often the context is poorly appreciated, and sometimes it is so complex that the firm itself does not understand it (TEECE, 1976; LIPPMAN and RUMELT, 1982). Due to cognitive limits knowledge is acquired in a highly specialized form, and the organization is responsible to aggregate its 'chunks' and integrate them to develop further knowledge (GRANT, 1996A, 1996B). Firms with potentially synergistic knowledge are often not aware of where such information could serve, and so do not route it to these destinations. Also, those which might be able to use the knowledge often do not know of its existence or whereabouts (HUBER, 1991). These ideas support question 20 (Appendix).

Knowledge acquisition, thus, may not be 'taken for granted', and while many organizations can develop skills, few are successful in applying the acquired knowledge to their activities (GARVIN, 1993). Information distribution, then, is the next step.

Information Distribution

We use the terms *information distribution* and *knowledge transfer* as interchangeable, both relating to the process by which information is shared (HUBER, 1991). To Teece (2001) the large size of enterprises, their global reach, the importance of knowledge to competitiveness, the distributed nature of competence within the firm, and the availability of tools to assist transfer sharpened the importance of accomplishing knowledge transfer inside the firm. The central dimension of organizations is to create and transfer knowledge efficiently within their context (KOGUT and ZANDER, 1992). Transfers avoid duplicity efforts, capturing benefits of pockets of excellence and great ideas (the replication of what works better) (SZULANSKI, 1996). Information to be distributed can reside in design, production, installation, sales, distribution, operation, maintenance, management, and so on (ZANDER and KOGUT, 1995). These ideas support questions 21 to 23 (Appendix).

Also the more easily knowledge can be understood, the shorter is the time to transfer. Grant (1996B) emphasizes that most knowledge is tacit and transfer is difficult. To ease this firms establish modes of interaction that minimizes time and barriers, standardizing information through systems such as directives, plans, schedules, forecasts, and policies. Also they create routines, simple sequences that support complex patterns of interaction. Information, then, is distributed through rules, procedures, and practices that ensure the experiences of individuals are passed on, converting collective knowing into improved performance (ARROW, 1974; LEVINTHAL and MARCH, 1993). These ideas support question 24 (Appendix).

To Huber (1982) knowledge transfer is subjected to some conditions to be effective. The probability that *Unit A* will rout information to *Unit B* is related to: their views of the information's relevance; their current workload; their power and status; the costs of routing the information; the rewards and penalties expected; the frequency of their information exchange in the recent past. Group problem solving and decision making, specially when applied to complex and uncertain tasks, provide more communication-intensive integration and facilitates information distribution (GRANT, 1996B).

Teams are unable to access the full range of knowledge in a firm, as coordination restrict their size. But this can be partially addressed if membership is fluid, so that expertise can be tapped among different groups when needed. Effective information distribution requires that individuals occupy multiple roles in many teams (GRANT, 1996B). But as observed by Kogut and Zander (1992), this is not an option free of challenges: the identification with a professional orientation may conflict with the need to integrate, e.g. engineers may have problems communicating with salesmen. This problem is attenuated when the transfer is horizontal, i.e. within the same function. The development of a broad and active network strengthens individual's knowledge, and by shared coding schemes information is distributed effectively within groups. These ideas support question 25 (Appendix).

Knowledge transfer, however, is not an entirely rational process. Shared narratives, myths and metaphors provide powerful means for exchanging and preserving knowledge (NAHAPIET and GOSHAL, 1998). Stories full of details facilitate (or compromise) the exchanging of experience, enabling (or impeding) the development of improved practice. Associated with knowledge transfer are concepts such as culture, motivation, learning, routines, and leadership (CONNER and PRAHALAD, 1996). These ideas support question 26 (Appendix).

People have different knowledge sets, which exert a powerful inertia against the distribution of information (NAHAPIET and GOSHAL, 1998). The harder it is to codify, to the point where it can only be acquired through practice, the more slow, costly, and uncertain the transfer is (KOGUT and ZANDER, 1992). If explaining to each other the reasons behind one's position is costly, the better a firm endows information interpretation, the more it may benefit from knowledge transfer.

Information Interpretation

We use the terms *information interpretation* and *shared meaning* as interchangeable, both relating to the process by which information is given one or more commonly understood interpretations (HUBER, 1991). Interpretation is 'giving meaning', a process through which people translate events and develop shared understandings – the more knowledge is gained the more varied interpretations are developed (DAFT and WEICK, 1984: p. 294). Shared meaning is socially constructed, and is affected by the uniformity of prior information and by the way it is communicated. It does not mean that members agree completely on a subject, but that coordinated action is achieved through the distribution and use of the information (HULT et al, 2007). It is not necessary for all employees to share the same interpretations, what is needed is joint action based on a set of directives and or goals (DONNELLON et al, 1986: p. 43). These ideas support questions 27 to 29 (Appendix).

It is important to notice that interpretation is less effective if information exceeds the subject's processing capacity. When presented with a too complex stimulus the subject perceives in it what he or she is ready to 'believe'. The more complex the stimulus, the more perception will be determined by what is already in the subject's mind (BRUNER, 1957: p. 132). This is related to Simon's (1991) concept of bounded rationality, i.e. how much information a person may posses

and access in order to make a decision. Different interpretations may easily emerge, and have to be dealt with in order to make knowledge useful and efficient.

Due to irreducible differences in the knowledge possessed by individuals common interpretation is hardly automatic, and objections may not be transposed despite all efforts. As an example, parties may have different expectations about future gains, even after each does its best to explain their reasoning to the others and to understand the alternative positions. Irreducible differences in the individuals' knowledge can lead them to expect different outcomes (CONNER and PRAHALAD, 1996). Different skills and backgrounds of diverse groups also result in each knowing different things, or knowing them in different ways (BROWN and DUGUID, 2001). This information is stored in the firm's memory (see next item), and by developing capacity in an area a firm may more readily accumulate additional information it needs to exploit available new knowledge (DONNELLON et al, 1986). These ideas support questions 30 and 31 (Appendix).

To combine information gained through social exchange different parties in a firm must have some overlap in knowledge. Group-specific communication codes are valuable assets, acting as a 'grease' that increases information exchange (NAHAPIET and GHOSHAL, 1998). This is specially important when firms aggregate knowledge through cross-functional working teams, or through high internal job-rotation, as employees must have a commonality that helps them integrate what is known. The following ideas, proposed by Grant (1996B), support question 32 (Appendix):

- Language: mean by which employees discuss and exchange information. It filters events and activities, providing a common conceptual apparatus for evaluating the benefits of exchange and combination (NAHAPIET and GHOSHAL, 1998).
- Symbols: literacy and familiarity with the same symbols (e.g. software) enhance the efficiency and intensity of communication.
- Specialization: workers must not have entirely separated knowledge, or else they won't be able to integrate beyond the most primitive level.
- Shared meaning: cognitive frameworks, metaphor and analogies, stories as vehicles that mold and reconcile individual experiences and understandings.
- Recognition of domains: effective knowledge integration requires that each individual is aware of everyone else's knowledge repertoire.

Knowledge interpretation, then, depends upon a value system that evaluates, justifies and determines the quality of knowledge a group creates. To Nonaka et al (2001) this shared meaning dictates which ideas are needed, created and retained in a firm. Organizations are subject to inertia, so it is difficult for them to diverge from a course set by previous successful experiences. Past interpretations often prevail, and are connected to the achieved memory.

Achieved Memory

We use the terms *achieved memory* and *knowledge base* as interchangeable, both relating to the prior accumulated knowledge that enables recognition of the value of information, its assimilation, and application (COHEN and LEVINTHAL, 1990; HUBER, 1991). What a firm

knows is not easy to specify, stock, or measure, and it is often difficult for a organization to know exactly what it knows (NONAKA et al, 2001). It is hard to realize inventories of knowledge, specially where situations are numerous and shifting, and a firm must continually increase its knowledge base: by the time knowledge is needed, it is too late to gain; before it is needed, it is hard to specify what might be required (LEVINTHAL and MARCH, 1993). As an example, the failure to introduce new technologies may be a consequence of a mismatch between the current achieved memory and new products requirements (TEECE et al, 1997). These ideas support questions 33 and 34 (Appendix).

The key to efficiency in achieved memory is creating mechanisms that avoid costs of repeated learning, transferring knowledge into rules, directives, tasks, routines, and joint problem solving (HUBER, 1991; GRANT, 1996A). These ideas support question 35 (Appendix). Also the partition of a firm's knowledge into 'chunks' of expertise is speeds the coordination of diverse capabilities, and is especially important when these are highly complex and involve broad-scope integration (ZANDER and KOGUT, 1995; GRANT, 1996A). This expertise is obtained: directly, via experimental learning-by-doing, based on repetition and incremental development of expertise; and indirectly, via managerial action, based on process transformation and change in technology, equipment or human capital (ADLER and CLARK, 1991). These ideas support questions 36 and 37 (Appendix).

MANUFACTURING PERFORMANCE

Operations research often investigates the adoption of manufacturing practices and their relationship to performance, usually with focus on cost savings (SCHROEDER et al, 2002). Many measures have been proposed since Skinner's (1969) seminal article, in a range that encompass cost, flexibility, reliability, time, quality, innovation, entrepreneurship, among others. There is evidence that manufacturing plays an important role in how firms compete, being an important part of strategy (HAYES, 1985; HAYES and PISANO, 1996; HAYES and UPTON, 1998). Manufacturing embodies critical choices on an important set of capabilities which require huge investments, playing a proactive role in supporting and even formulating business strategy (CORBETT and WASSENHOVE, 1993; WARD 1996).

Manufacturing competence is paramount to many firms (VICKERY et al, 1994). Business performance may be strongly related to operations strategy, as decisions such as capacity, technology, and quality systems must be matched with the firm's competitive priorities (WARD et al, 1995; BOYER and LEWIS, 2002). Although manufacturing competence may not be a sufficient condition for competitiveness, its lack compromises competitive advantage in the long run (CORBETT and WASSENHOVE, 1993).

Thus measuring manufacturing performance should be indispensable for most firms, and it would be expected that studies in the area might use a consensual set of comparable scales (such as finance's ROE, ROA, EBITDA). However, the operations field has not yet developed an articulated set of manufacturing performance measures to test its theories, commonly using business-level proxies such as profitability, market share, or growth (KIM and ARNOLD, 1992).

To Flyn and Flyn (2004), without common definitions in measures, and clarity in explaining the interrelationships among constructs, different conclusions are reached without advancing theory.

If standardized constructs have not emerged, there is some consensus in the dimensions upon which manufacturing performance might be measured. Cost, quality, dependability, delivery, and flexibility galvanize current scales, being important factors in empirical studies that focus on how these elements are acquired and related to one another, and how they contribute to profitability (SWINK and WAY 1995; BOYER and LEWIS, 2002; ROSENZWEIG and ROTH, 2004). Different authors refer to these factors under diverse theoretical perspectives, such as competitive priorities, manufacturing capabilities, or performance objectives. Often these concepts are interchangeable, having the same purpose despite different terminology, leading to confusion in generalizing between studies (FLYNN and FLYNN, 2004).

Developing a consensual tool to capture these manufacturing performance elements is an important step to practical studies in operations strategy, however there are few researches attempting to establish uniform definitions. A serious problem in the area's literature is the lack of generally accepted constructs for performance elements (KIM and ARNOLD, 1992; CORBETT and WASSENHOVE, 1993).

Manufacturing Performance Elements

Despite differences in terminology, there is broad agreement that manufacturing performance can be expressed by five dimensions: cost, quality, dependability, delivery, and flexibility (Table 1). These are stocks of strategic assets, accumulated through investments flows over time, a pattern that cannot be easily imitated, acquired or substituted. Such elements are complex, multidimensional, and dynamic, so capturing them require multiple items scales (CORBETT and WASSENHOVE, 1993; WARD et al, 1995). However they are typically operationalized in a single dimension, so that the gross level of distinction usually leads to confusion in interpretation (FLYNN and FLYNN, 2004). The possibilities are so broad that a firm can "choose its own combination", and no "one right way" emerges to combine the indicators (FERDOWS and DEMEYER, 1990; NOBLE, 1995).

Table 1 – Some Manufacturing Performance Measurement Approaches

Skinner, 1969	?		?				
Skinner, 1974	?		?	?	?	?	?
Wheelwright, 1984		?	?		?		?

Leong et al, 1990	?		?	?		?	?
Kim and Arnold, 1992		?	?	?			?
Vickery et al, 1994	?		?	?	?		?
Ward et al, 1996	?		?	?			?
Schroeder et al, 2002	?		?	?			?
Flynn and Flynn, 2004	?		?	?			?
Rosenzweig and Roth, 2004	?		?	?			?

While a more complete framework exists (Table 2), a synthesis is necessary. Thus, based on a comprehensive set of authors (SKINNER, 1969; SKINNER, 1974; WHEELWRIGHT, 1984; LEONG ET AL, 1990; KIM and ARNOLD, 1992; CORBETT and WASSENHOVE, 1993; VICKERY et al, 1994; WARD et al, 1995; NOBLE, 1995 ; SKINNER, 1996; WARD et al, 1996 ; WARD et al, 1998 ; BOYER and LEWIS, 2002; SCHROEDER et al 2002; ROSENZWEIG and ROTH, 2004; FLYNN and FLYNN, 2004) the performance manufacturing construct is defined as resulting from the following cost, quality, dependability, delivery, and flexibility elements.

Cost is 'producing more spending less'. The cost structure of firms can vary greatly, and the other performance elements all contribute to reducing (or increasing) cost. To measure manufacturing performance this study defines cost in terms of: productivity (production / employee), labor costs (employees), input costs (raw materials, energy), fixed costs (facilities, capacity, equipment), and stock turnover.

Quality is 'conformance', i.e. a product corresponds to its specifications. The external effect of good quality is that customers have less (or nothing) to complain about, being happy and more likely to consume again. Inside operations quality means processes and activities conducted with few mistakes. This generally means that cost is saved, dependability increases and speed of response increases. To measure manufacturing performance this study defines quality in terms of: clients complains, product conformity to specifications, defective products, rework, production losses (waste), and restitutions (guarantee).

Dependability is 'on time delivery'. It means customers receive their products on time, and involves the time between product request and delivery. Using cycle time definition, it starts with reception of raw material and finishes with customer receipt. Highly dependable systems usually increase speed. To measure manufacturing performance this study defines dependability in terms of: on time production delivery, production reliability, programming reliability, and orders reliability.

Delivery is speed, velocity. It means how fast things happen in production, and may relate to product introduction, customization, and production *per see*. Great speed usually contributes to flexibility, guarantee reliability, and allows quality issues to be readily assessed. To measure manufacturing performance this study defines delivery in terms of: cycle time, delivery speed, lead time, and time to change production.

Flexibility is 'being able to change the operation in some way', reducing time and effort involved in 'setting up' for a different product. It allows manufacturing to be for ever changing customers needs, such as variety, incorporation of new ideas, adjustment to output levels, or altering schedules. To measure manufacturing performance this study defines flexibility in terms of: programming change, production volume, process change, new product introduction, and product customization.

Table 2 - Elements of Manufacturing Performance Measurement

KIM and ARNOLD, 1992	Competitive price	Defect rates Performance Durability Reliability	On-time delivery	Speed	Design New product Volume Product mix Product
CORBETT and WASSENHOVE, 1993	Developing Producing Delivering Disposing	Conformance		Lead time	Lead-time
VICKERY et al, 1994	Production	Conformance Durability Reliability	On-time delivery	Lead time Speed	Volume Process Product
NOBLE, 1995	Inventory Work-in-process Overhead Labor productivity	Rework % Quality assurance Material yields Waste	Material handling and logistics Product flow Maintenance	Frequency of expediting orders Speed	Product mix Customization Volume Process

	Machine time Material substitution	Preventive maintenance	PPCP On-time delivery		

Table 2 - Elements of Manufacturing Performance Measurement (cont.)

WARD et al, 1995	Unit costs Materials Overhead Inventory	Defective % Performance Reliability Vendor's QCC ISO 9000	Reliability Pre-sales service Technical support After sales service	Speed	Lead time New product introduction Setup time
WARD et al, 1996	Capital Overhead Labor productivity Materials	Performance Features Reliability Conformance Durability Aesthetics Perception Inspection, scrap, rework	On-time delivery	Speed	Product mix Volume Changeover
WARD et al, 1998	Production Labor productivity Capacity utilization Inventory Productivity	Performance Durability Reliability Service Customer complaints Conformance	On-time delivery	Lead time Cycle time	Product mix New product introduction Volume Design changes
BOYER and LEWIS, 2002	Inventory Capacity utilization Production Labor productivity	Conformance Performance Reliability	Delivery promise	Speed Lead time	Design changes Volume Features Product Product mix
SCHROEDER et al, 2002	% of sales	Conformance	On-time delivery	Cycle time	Process

ROSENZWEIG and ROTH, 2004	Production	Product conformance	On-time delivery		Volume
FLYNN and FLYNN, 2004	Production	Scrap and rework Product returns Process quality Market-based quality	On-time delivery	Speed Cycle time Lead time	New product introduction Production schedule Volume

METHOD

We briefly present our hypothesis and how we intend to collect data. Our research being a work in progress, changes may occur during field experimentation. However, we believe only minor changes will be needed, thus what is presented next shall remain valid to the end.

Hypothesis

Hult et al (2007) give a major contribution to operations strategy literature testing empirically how a culture of competitiveness (CC) and knowledge development (KD) interact with cycle time performance in supply chains, working on difficult-to-measure multi-dimensional concepts. Their research supports the effect of a CC and of the CC-KD interaction with cycle time, but not the direct effect of KD on cycle time. In their words:

> *Our results suggest that such firms might benefit by building a culture of competitiveness first, and then emphasizing knowledge development once the cultural elements are established.*

The model and its conclusions are by no means exhaustive, and opportunities for further development emerge from some gaps. One point is the operationalization of the CC and KD constructs. CC is slightly reviewed, in our aim to cope with more distinct and varied questions specially in the *Learning Orientation* part. KD is extensively reviewed, under comprehensive *KBV* tenets that resulted in a wider and more complete scale. Also we expand the dependent cycle time variable to encompass a proposed manufacturing performance multi-dimensional construct, based upon cost, quality, reliability, delivery, and flexibility elements. Hult et al (2007) also develop the market turbulence concept with a moderating role. We do not access this variable, in our belief that in the present time respondents would show an overshot perception in this matter due to the aggravation of international crisis. One could say that turbulence is in a high pick, far from what could be called ‘normal levels’ for most firms. Studying the influence of turbulence in such conditions would be, in our belief, misleading.

Finally, Hult et al (2007) present firm age and size as control variables, aspects that we will also consider in our research. Thus reexamining their hypothesis we propose that:

> ***Hypothesis 1:*** *Culture of competitiveness (CC) has a positive association with manufacturing performance.*
> ***Hypothesis 2:*** *Knowledge development (KD) has a positive association with manufacturing performance.*
> ***Hypothesis 3:*** *The interaction between CC and KD has a positive association with manufacturing performance.*

Although it will be tested, Hypothesis 3 is not represented in Figure's 1 model, for reasons of parsimony and simplicity at this stage of our study.

Data Collection

We plan to conduct a survey that is both: confirmatory, re-testing some of Hult et al (2007) propositions; and exploratory, inserting new questions and constructs mainly to find new ways of measuring knowledge. We will follow the theory-testing survey research process of Forza (2002), Dilman (2007), and Lee and Lings (2008). Data collection issues are still being assessed, as definitions and constrains to sample size and quality are considered, and a best approach is sought. The unit of analysis, i.e. the strategic business unit (SBU), is defined. It represents the 'smaller part' of a firma where operations is fully applied, from portfolio strategy design to complete production (MENOR et al, 2007).

We will use data from Brazilian firms located in two important industrial centers: Sao Paulo (Paraiba Valley) and Amazonas (Manaus), encompassing a potential number of about 600 respondent firms. Two class associations, SUFRAMA and CIESP, have been contacted and arrangements for mutual collaboration are under way. The respondents will be human resource and manufacturing related directors, who will be asked about their perception on competitive culture, knowledge development, and manufacturing performance. We will target senior manufacturing executives to gather data, supported by the elite informants perspective that these professionals are likely to be more reliable sources of information. This proposition has been presented in studies such as Miller and Roth (1994) and Menor et al (2007). To obtain adequate response rates we will telephone respondents to request their participation. This will be encouraged through a web-portal designed to support all phases of research, which can be reached through the link www.fgv-pesquisa.com. Unfortunately so far all information is available in Portuguese only.

Our multidimensional constructs are operationalized through multiple items scales. Their measurement involves perceptual five-point Likert answers, so we will have to deal with common method and respondent bias. Data will be collected through on-line questionnaires, using the Zoomerang internet tool. The up to date questionnaire was subjected to four academic fellows and five operations management professionals, so a great number of corrections and clarifications have already been done. Translation issues (English to Portuguese and vice-versa)

have been exhaustively assessed, and are still subject of attention. A pilot test is under way, and complementary data collection, analysis and report will follow.

We intend to test the model using structural equation modeling (SEM), obtaining at least 200 respondents. Issues such as reliability and validity will be dealt with following the last developments in the field (e.g. SCHROEDER et al, 2002; PAIVA et al, 2007; MENOR et al, 2008). A series of analysis will be made, such as:

- Missing data treatment.
- Comparisons between first and later respondents in search for bias.
- Split-sample analysis to evaluate internal consistency of the data collected.
- Confirmatory factor analysis (CFA) to evaluate construct operationalization.
- Test unidimensionality of the latent constructs.
- Sample control of size (number of employees, gross revenue), market share (main product position), firm sector and nationality (MNC or not).
- Assess content, convergent, discriminant and criterion-related validity.

As carefully conducted as the empirical data collection may be, it will be subjected to a series of limitation *ex ante*. Some problems identified by Forza (2002) in survey data collections may happen, such as: need for greater clarity of the concepts; lack a common terminology regarding the respondents; and sample selection and description. As observed by the author "each data collection method has merits as well shortcomings. Decisions on which method is best cannot be made in the abstract; rather, they must be based on the needs of the specific survey as well as time, cost and resource constraints".

DISCUSSION

Once data is obtained and statistically treated, we will be able to discuss the implications of the results. The first point to be assessed is about construct convergence and validity, i.e. if the presented scales are strong and robust components of our indicators.

Analyzing higher order latent factor of Culture of Competitiveness (CC), we expect the measurement of the first-order indicators of entrepreneurial and innovativeness orientations to go smoothly, as they are similar to Hult et al's (2007) original scale. The questions designed to reflect the indicators will likely show sufficient co-variation, which will credit them as good second-order indicators. Discriminant validity, based on theoretical grounds, may suffice to justify each item as an independent component. The learning orientation indicator may be more difficult to assess, as its components were reviewed in a sensible way. Although we maintain the core of Hult et al's scale, we add many items. The risk is that, expanding the indicator to grasp greater parts of the learning concept, we loose connection among questions due to the learning's multidimensionality, maybe ending with no connections at all. In this case we will have to draw back from our proposal of enriching the learning orientation concept, thus reverting our items to Hult et al's original scale.

This line of thought apply strongly to the Knowledge Development (KD) higher order latent factor. Here we build sensibly on Huber (1991) concepts, modifying and adding various questions to Hult et al's original scale. Again we risk a too broad expansion, with a greater

problem: immersing the original article into KBV tenets is one of the main objectives of our study. Instead of reverting to the previous questions, we would have to review our analysis of knowledge's theoretical foundations, striving to build a more adequate tool to measure KD in firms. This would lead us a great deal back in our efforts, but with two mitigating factors: the conceptual background would remain valid, as we did a comprehensive study on KBV authors; and the choices made would guide us to prevent pitfalls, helping us to build a safer way to a more complex knowledge construct.

This preoccupation is also valid to the manufacturing performance dependent variable, as the suggestion of a measurement tool to this multidimensional concept is another main objective of our study. However in this issue we are on safer grounds, as our propositions are supported not only on theoretical backgrounds and on analyzing researches from previous authors. Our school has recently conducted three survey field researches (HASHIBA, 2009; MIGUEL, 2009; SANTOS, 2009) accessing operationalizations of the manufacturing performance construct. Our present study is an amalgam of these findings, subjected to a number of alterations and refinements, but we build on previous data that was directly available to us. In this way our contribution will be much more a confirmatory than an exploratory one.

A side chapter on the manufacturing performance construct is about the trade-off versus operations capabilities discussion. Although the theoretical backgrounds of this dispute are not presented here, we have assessed a number of views on the matter if cost, quality, dependability, delivery, and flexibility work in tandem, work against each other, or work as independent elements (ADLER et al, 1999; BOYER and LEWIS, 2002; CORBETT and WASSENHOVE, 1993; FERDOWS and DeMEYER, 1990; FLYNN and FLYNN, 2004; HAYES and PISANO, 1996; KIM and ARNOLD, 1992; NOBLE, 1995; ROTH and MILLER, 1990; SCHMENNER and SWINK, 1998; SKINNER, 1974, 1969, 1996; WARD et al 1996). Again our previous research indicates the existence of a manufacturing performance construct, built on the five first-order indicators we present, which have a positive co-variance with each other, supporting the operations capabilities view. This is what we expect. If in our present field research find a negative covariance among items we will have to rethink our approach to the dependent variable, as there will be support to the trade-off model. If we find little or no correlation at all, we will have to deconstruct manufacturing performance as a higher order latent factor, and analyze the effects of CC and KD on each element.

Retrieving the culture of competitiveness and the knowledge development factors, we will test our three hypothesis (Table 3), including the CC * KD interaction of Hult et al (2007). The implications are sustained. If no interactions are found between CC and KD we may conclude that they are independent in this context, and that: CC only, KD only , both of them (separately) or none of them at all contribute to the manufacturing performance construct. We expect, however, that there will be an interaction, and that CC and KD influence manufacturing performance both directly and in tandem. Conceptually this means that, as a culture of competitiveness and knowledge development are built in a firm, they support each other in a symbiotic manner, to synergistically contribute to manufacturing performance.

Table 3 - Hypothesis testing and expected relations

VARIABLES	Culture of Competitiveness	Knowledge Development	Manufacturing Performance
Culture of Competitiveness	-		
Knowledge Development	Hypothesis 3	-	
Manufacturing Performance	Hypothesis 1	Hypothesis 2	-

Finally there is a broad list of further considerations our research will have to deal with. We will work with control variables such as size and industry. We will have to deal with data collection limitations. We will have to carefully conduct statistical procedures, and analyze them both in the light of the theory and through the perception we build on the firms we assess. We may possibly find connections that make no sense, and at the same time find no evidence for issues largely supported by previous work. Thus we will have to deal with all these (and many other) preoccupations, in our objective to better understand the effects of a culture of competitiveness and knowledge development in manufacturing performance, giving our contribution to both academic and management areas.

CONCLUSION

Designing tools to measure manufacturing performance in an aggregated form would bring a major contribution to operations strategy. Also a better understanding on how knowledge and culture interact with a firm to influence its performance would help guiding managers in their day-to-day decisions of where and why invest in initiatives such as employee training and teams evaluation surveys. Drawing on multiple theories, our study will contribute to these points, proposing new ideas to compose the resource and the knowledge-based views of the firm. Reduce these gaps, with a better understanding of manufacturing performance under a culture of competitiveness and knowledge development backgrounds, is our main objective.

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APENDIX – MEASUREMENT SCALES

Respondents will be asked to answer comparing their firms with competitors. 'We' refer to the strategic business unit, and 'Products' refer to tangible, physical goods. Five-point Likert-type scales will be used for all items ranging from 'strongly disagree' to 'strongly agree.'

Entrepeneurial Orientation

1. We initiate actions to which other organizations respond.
2. We are fast to introduce new administrative techniques and operating technologies.
3. We have a strong proclivity for high-risk projects.
4. We are bold in our efforts to maximize exploiting opportunities.

All questions come from the Hult et al (2007) scale, based on Naman and Slevin (1993).

Innovativeness Orientation

5. We actively seek innovative manufacturing ideas.
6. Innovation is readily accepted in the manufacturing process.
7. People are not penalized for new ideas that do not work.
8. Innovation in our manufacturing process is encouraged.

All questions come from the Hult et al (2007) scale, based on Hurley and Hult (1998).

Learning Orientation

9. Our ability to learn is the key to improvement in the manufacturing process.
10. Once we quit learning in the manufacturing process we endanger our future.
11. The sense around here is that employee learning is an investment not an expense.
12. We have a good capacity to value, assimilate, and apply knowledge in manufacturing.
13. When obtaining knowledge employees quickly recognize where it is potentially useful.
14. Governing values and actions are easily changed in order to generate new insights.

Questions 9 to 11 come the from Hult et al (2007) scale, based on Hult (1998). Questions 12 to 14 are new, based on Huber (1991), Argyris (2002) and Rosenzweig and Roth (2004).

Knowledge Acquisition

15. We meet regularly to find out what products we need in the future.
16. We are fast to detect changes in our customers' product preferences.

17. We are fast to detect fundamental shifts in our industry (competition, technology, etc).
18. We compare our performance to the market through benchmarking and best practices.
19. We do a lot of in-house manufacturing research.
20. We continually strive to obtain and absorb new knowledge generated by others.

Questions 15 to 17 and 19 come from the Hult et al (2007) scale, based on Kholi et al (1993). Questions 18 and 20 are new, based on Levinthal and March (1993) and Szulanski (1996).

Information Distribution

21. We spend time discussing manufacturing future needs with other functional departments.
22. We immediately know when something important happens in the manufacturing process.
23. When we find out something important about competitors, we are fast to alert other areas.
24. We transfer knowledge using rules, procedures and other standardized practices.
25. We engage in cross-functional teams and job rotation programs.
26. We have shared narratives, myths and metaphors that exchange and preserve knowledge.

Questions 21 to 23 come from the Hult et al (2007) scale, based on Kohli et al (1993). Questions 24 to 26 are new, based on Levinthal and March (1993) and Nahapiet and Goshal (1998).

Shared Meaning

27. We share information effectively between the manufacturing participants.
28. We develop a shared understanding of the available manufacturing information.
29. We debate the most relevant events in groups in order to develop a shared meaning.
30. We do all efforts to transpose objections despite differences in knowledge possession.
31. We have an uniform knowledge framing for most manufacturing issues.
32. We have a language, symbols, shared meanings, and common contexts that help all areas to exchange knowledge.

Questions 27 and 28 come from the Hult et al (2007) scale, based on Hult et al (2004). Questions 29 to 32 are new, based on Daft and Weick (1984), Donnellon et al (1986), Conner and Prahalad (1996), and Grant (1996B).

Achieved Memory:

33. Our prior knowledge permit us to better understand the potential of advances.
34. Different areas have a knowledge overlap that allow us to better combine information.
35. We spare time to store how we do things in operating procedures and scripts.
36. We have a great deal of knowledge about the manufacturing process.
37. We have a great deal of experience with the manufacturing process.

Questions 33 to 35 are new, based on Cohen and Levinthal (1990), Huber (1991), and Nahapiet and Gochal (1998). Questions 36 and 37 come from the Hult et al (2007) scale, based on Moorman and Miner (1997).