

Knowledge-Based Theory of the Firm: Literature Review and KBV Implications for Production

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要 旨

現代経済は知識経済と呼ばれる。その中で企業および国の競争優位を保障する唯一の資源となるのが知識である。本稿の目的は、次の二点である。第一は、知識ベース企業理論の歴史や主要な用語を明らかにしながら、知識がどのように企業理論の基礎になっているのかを見ていくことである。既存研究では生産現場レベルでの知識に関する議論がほとんど存在していない。そこで第二の目的は、生産レベルでの知識創造を促進する要素を識別することである。そのために包括的な文献のレビューを通じて、生産レベルでの知識の定義・知識創造の概念及び知識労働者の概念を提示した。

Keywords: KBV, knowledge, knowledge creation, production worker

Table of Contents

- . Introduction
- . Knowledge-based Economy and Knowledge as the Main Production Factor
- 1. Knowledge, Knowledge Creation and Learning: a Cooperative Review of Definitions
- 2. Review on the Knowledge –based Theory of the Firm
- . Knowledge Creation and Production
- 1. Manufacturing Sector in a Modern Economy: Changing Role
- 2. Concept of Knowledge Worker in Production
- . Conclusion

Endnote

References

. Introduction

In the spirit of this Knowledge Era in which intellectual assets and human capital are becoming

re-appreciated, many thinkers have re-oriented the concept of work around knowledge. Globalization and other rapid changes in markets and technologies increasingly require companies to generate new knowledge in order to remain competitive. Cost pressure mounts as multinationals locate plants in low-wage countries and as global supply-chain organizations increase in prominence. At the same time, customers increasingly demand that producers meet new standards for quality, variety, customization, ease of use, and timeliness - whether in the form of time-to market with innovative products, on-time delivery of ordered materials, or quick replenishment of retailers' inventories (Appelbaum, 2000).

The statement that an organization can seize competitive advantage from the knowledge it possesses and from the efficiency with which it produces and distributes it has been proved in the voluminous literature (Drucker, 1993; Nonaka & Takeuchi, 1995; Takeuchi & Nonaka, 2004). Ample research on knowledge management and knowledge creation may give an impression that a solid theoretical perspective on the issue has been constructed (Davenport & Prusak, 2000; Von Krogh, Ichijo, & Nonaka, 2000; Ichijo, 2004).

However, debate, grounded in the cognitive nature of knowledge, continues on almost every aspect connected to it, thus corroborating that there remains room for further development. In order to innovate successfully, firms must generate knowledge faster than their rivals (Prahalad & Hamel, 1990; Teece & Pisano, 1994). Knowledge lies at the core of the firm, unlike traditional resources such as land, labor and capital. Therefore, factors influencing knowledge generation are crucially important to researchers and managers.

Growing recognition of its importance has spawned an explosion of research about the generation and management of knowledge, representing several distinct research traditions, including organizational learning (Argyris, 1976), management of technology and managerial cognition (Grant, 1996). However, much of this research has treated knowledge as an object and has focused on its definition, on distinguishing it from other dimensions, whether explicit or tacit, individual or collective (Polanyi, 1966; Faulkner, 1994), or on distinguishing the object of knowledge from the object of information (Davenport & Prusak, 2000). Apart from the works of Nonaka and his progenies (Nonaka & Takeuchi, 1995; Nonaka, Toyama, Konno, 2004) little research has been focused on the process by which knowledge in an organization is generated and the factors that can facilitate this generation. Furthermore, there is a lack of insight into the factors that enable the productivity of knowledge processes in these organizations.

From the present study's point of view, a problem with authors such as Davenport et al. (2000) is that they formulate no plan for extending the benefits of the new knowledge-intensity of work to production workers.

With a few exceptions, like Leonard-Barton (1995), who clearly demonstrates that the physical representation of manufacturing knowledge through processes and machinery is an important source of learning, few researchers believe the reality that workers and their machines *are* valid components of a manufacturer's knowledge management systems and that human operators are still the most adaptable part of a system.

Overall, there appears to be a pervasive assumption that competitive manufacturing knowledge can only come from academically advanced personnel. Much of current organizational learning thinking has been devoted to workers traditionally thought of as "professionals." Kelloway & Barling (2000) recognize this "creeping elitism" in conceptualizations of knowledge work, and Collins (1998) also decries the elite nature of the theoretical development on knowledge work and knowledge workers. Even discussions of advanced manufacturing concepts, such as agile/flexible manufacturing (Appelbaum, Bailey, Berg, & Kalleberg, 2000) and mass customization (Pine, Peppers & Rogers, 1995), tend to focus primarily on the prowess of the production knowledge in design and development area.

This paper moves counter to these trends by honoring those who, through their daily efforts, sculpt and produce our material world - production workers. The manufacture of goods has long been a mainstay of strong economies and continues to be a prime driver of export success of Japan. It is said that in the information age and the knowledge economy the manufacturing function appears to decline in value, with services increasingly providing more of the value-added to manufactured goods. But the significant, economic linkages between numerous service industries and manufacturing indicate that manufacturing still matters and still warrants the kind of critical analysis presented here.

Undoubtedly, knowledge creation happens in a research laboratory, but the intrigue of today is that it can be equally powerful and important in manufacturing. For instance, better understanding of key process, such as bottlenecks in manufacturing, can allow for substantial cost reduction or product development (von Krogh, Nonaka, Aben, 2001; Matusik & Hill, 1998) Hence, application of knowledge creation notion to the production level will be developed in the following research being guided by the knowledge-based perspective of the firm.

In the present paper this goal is facilitated by defining and analyzing the role of production in today's economy and role of workers and their knowledge in constructing competitive advantages.

I conducted a review of the literature on knowledge management and related topics such as organizational learning, individual learning, innovation management, R&D management, technology management, information systems, human resource management and strategic management. Based on an extensive

literature overview and a review of articles published in leading management journals over the last 15 years, I tried to identify potential facilitating factors for knowledge creation in manufacturing sector. These factors will be put in base of my future research. Conducted parallel with the development of the hypotheses from the theory base, in-depth interviews with executives and engineers in several knowledge-intensive manufacturing organizations were a starting point for the development of the research.

This paper is organized as follows. Defining knowledge, knowledge creation and learning opens the study. Discussion on the knowledge-based economy and its main features follows. Then, overview of attempts to create a theory of the firm based on knowledge is given. After the changing place of production in today's knowledge economy is discussed, an alternative concept of knowledge worker applied to the production is developed.

. Knowledge-based Economy and Knowledge as the Main Production Factor

There is consensus among entrepreneurs, managers, academics, and consultants that we are about to embark on a new economic order: a knowledge –based economy. In recent years we have seen an increasing interest in firm knowledge and innovation as the source of competitive advantage, which can be traced back to the emergence of the resource-based perspective of the firm (Barney,1991), the growing literature on innovation (Christensen, 1997), organizational learning (Argyris, 1993), and most explicitly in the recent development of a knowledge –based perspective of strategy (Von Krogh et al, 2000; Grant, 1996 ; Nonaka &Takeuchi, 1995).

However, there are many problems with this line of analysis .What do the terms “resource”, “knowledge”, “knowledge-creation” and “organizational learning” mean? In the following sections I review how the concept of knowledge may be made the basis for a theory of the firm. I sketch a system of ideas about organizational knowledge and its relationship to the entities which create it and apply it in the pursuit of economic rents. But the first task is to develop a view of knowledge that makes meaningful discussion about its creation, storage and application possible. The second task is to relate this epistemology to the firm.

1. Knowledge, Knowledge Creation and Learning: a Cooperative Review of Definitions

It has been widely accepted that knowledge is critical to firm success, particularly for firms operating in knowledge-intensive industries. The unique approach to knowledge management by high-profile Japanese

companies, such as Honda, Canon, Matsushita, NEC, and Kao is generally acclaimed as the secret to their success over western competitors (Nonaka & Takeuchi, 1995).

But what is knowledge? This question has intrigued some of the world's greatest thinkers from Plato to Popper, but no clear consensus has emerged. In order to understand the fallacy of these attempts one must understand first that knowledge is a social process. It is perfectly reasonable to think that the knowledge creation process is potentially open-ended. This process can conceivably go on forever. Where it may lead is dependent only on the socially multideterminant process or act of knowledge creation (Takeuchi & Nonaka, 2004).

However, if we dig deeper into the problem we can see that there are essentially two types of knowledge to be considered. The first might be termed imaginary or fantastic knowledge. Yet this knowledge has no direct relationship to material reality (although there may be, obviously, an allegorical or metaphorical connection). The utility of such knowledge is determined by a set of social and cultural criteria and processes the categorization of which are not relevant to the analysis presented here. In the crudest market sense, such knowledge is valid insofar as it has value (i.e., it can be bought and sold in the marketplace).

The second type of knowledge can be termed practical knowledge. Drucker (1993) makes a similar distinction between knowledge as self-enlightenment and, from the Greek, *techne*, as technology. This type of knowledge has a direct reference to the actually existing material world. It is this type of knowledge that is applied to production and which infuses the technical essence of most commodities. However, the point here is not to draw a false distinction between useful, value producing, knowledge and imaginary knowledge which does not produce value. Both of these forms of knowledge produce value. Present research is interested in defining of knowledge within the organizational context and as a factor of economic development.

In connection to above problem, Peter Drucker seems to be a pioneer in citing knowledge as an economic resource and notion of its critical role in economic development. Back in 1968, in *The Age of Discontinuity* he emphasized that "knowledge is the foundation and measurement of economic potential and economic power. Knowledge has become the economy's central resource. Knowledge rather than science has become the foundation of the modern economy". In his later books Drucker has further developed that point of view and detailed the main characteristics of the "new economy".

In *Post-Capitalist Society*, Drucker underlines that the real, controlling resource and absolutely decisive factor of production is now neither capital nor land nor labor. The basic economic resource is and will continue to be knowledge. The traditional factors of production - land, labor and capital - have not disappeared, but they have become secondary. They can be obtained and obtained easily, provided there is

knowledge. And knowledge in this new sense means knowledge as a unity, knowledge as the means to obtain social and economic results. That knowledge has become the resource, rather than a resource. Knowledge is what makes our society "post-capitalist". It creates new social and economic dynamics. It creates new politics. The only long-term policy which promises success is to convert manufacturing from being labor based into being knowledge based. What makes the market economy superior is precisely that it organizes economic activity around information. Value is now created by "productivity" and "innovation", both application of knowledge to work. The economic challenge of the post-capitalist society will therefore be the productivity of knowledge work and the knowledge worker. Drucker (1993) later elucidated that knowledge has two incarnations: knowledge applied to existing processes, services, and products is productivity; knowledge applied to the new is innovation.

Drucker, then, continues that the organization of the post-capitalist society is a destabilizer. Because its function is to put knowledge to work - on tools, processes, and products; on work; and on knowledge itself - it must be organized for constant change. It must be organized for innovation, where innovation is "creative destruction."

Alvin Toffler in his *The Third Wave* (1980) is another prominent advocate of the role of knowledge as a factor of production: "While land, labor and capital were the main factors of production in the Second Wave economy of the past, knowledge - broadly defined here to include data, information, images, symbols, culture, ideology, and values - is the central resource of the Third Wave economy. Intangible assets like information have become the key resources. Information increasingly substitutes for bulk raw materials, labor, and other resources. Given the appropriate data, information, and/or knowledge, it is possible to reduce all the other inputs used to create wealth. The right knowledge inputs can reduce labor requirements, cut inventory, save energy, save raw materials, and reduce the time, space, and money needed for production. Knowledge is the ultimate substitute for other resources".

In general, the current explosion of writing about organizational knowledge has two somewhat distinct roots. The first, epitomized in the work of Drucker and Toffler, and admirably summarized in Nonaka and Takeuchi (1995), distinguishes knowledge from the traditional factors of production, labor, land and capital. Since knowledge has become the 'strategic' factor of production, managers must now focus on its production, acquisition, movement, retention and application. There is a considerable literature in this tradition both from those considering the economics of knowledge and its production, and from those considering the management of innovation and the organizational design and behavioral consequences of

this historical shift¹.

The second discourse has less to do with differentiating knowledge from the other factors of production. Rather it deals with differentiating between alternative types of knowledge and definable relationship between the types of knowledge.

According to Spender(1996), to be the basis of a theory of the firm, knowledge must be defined precisely enough to let us see which firm has the more significant knowledge and explain how that leads to competitive advantage. Therefore, let us review the most famous definitions.

The distinction between explicit and implicit knowledge made by Polanyi (1966) frames the multitype epistemology which, according to Spender, has had most impact on the knowledge management field starting from Penrose. Polanyi's explicit/tacit distinction was introduced into knowledge literature by Nelson and Winter (1982) in their evolutionary theory of the firm. For Nelson and Winter (1982: 166, 400) "the firm is a production function made up of decision rules, a set of production rules in the sense that this term is used by expert systems designers". The boundary between the explicit and tacit types of knowledge is both porous and flexible, so there is traffic between the domains. Nelson and Winter move towards a theory of the firm by assuming that the firm provides that special context in which the explicit and implicit bodies of knowledge are both selected by interaction with the external economic reality and then stored in the routines available to future generations of employees. Over time the quality of the interaction of the explicit and evolving implicit types of knowledge may lead to further improvements and, thence, to superior firm performance.

Nonaka and Takeuchi (1995) make the interaction of the explicit and the tacit modes of knowing central to their theory of organizational knowledge creation. Like Polanyi they see the origin of all knowledge in individual intuition. Their theory is precisely focused on the transformation and communication of what is already known tacitly by employees, i.e., on the way other employees learn what an individual has discovered, rather than on Nelson and Winter's notion of the firm itself learning by acquiring better routines. For Nonaka and Takeuchi (1995:62, 239), organizational knowledge is the knowledge shared by individuals, albeit transformed and amplified, and the four dimensions of knowledge conversion are the means of communicating the two modes of knowing around the firm.

The key difference between Nonaka and Takeuchi's treatment, and that of Nelson and Winter, lies in the latter presuming the firm has an ability to know independently of its employees, or at least independently of their conscious reasoning. Nelson and Winter rely more on the employees' pre- or subconscious modes of

knowing, though they are less clear about what it is about the firm that facilitates the generation and subsequent application of such explorational knowledge and learning.

Adding to the organizational knowledge debate, Spender (1994) have argued (a) that the different types of knowledge lend to different types of economic rents, and that firms' strategies, as the pursuit of these economic rents, will also differ. While an individual's knowledge is inherently transferable, moving with the person, giving rise to Pareto rents and the resultant agency problems, the social types of knowledge are either publicly available or collective and embedded in the firm's routines, norms and culture. Since the latter are generated internally and remain 'of the firm,' they give rise to the economic rents associated with effective collective practice which Spender labeled "Penrose rents". Different strategies are required for these rents maximization. Finally, he has argued (b) that the firm's knowledge mix or profile may change over time, being dominated by one type of knowledge at one time and by another type at another time (Spender, 1994).

Team-oriented production, widely seen in modern world and discussed later in the paper, produces organizational knowledge as one of its best outcomes (Nonaka et al, 2004). If, as Spender has suggested, collective knowledge is the most secure and strategically significant kind of organizational knowledge, then we should seek an explanation of what it is about firms that enables collective learning to take place, and collective knowledge to be retained and applied better at team production than under other institutional arrangements. Responding to this agenda Nonaka and Takeuchi focus on the way individual creativity contributes to the growth of collective knowledge, while Nelson and Winter focus on the extra rational learning processes that lead the collective to develop routines and so learn.

High-technology firms and their production methods (team-oriented in particular) are backing up the research, so here we are interested in technological knowledge, that is, knowledge generated in response to major technological shifts. So in this study, *knowledge is understood as information that has been validated by experience that has entered human belief systems as rules for guiding actions, and, in the case of business, that has proved beneficial to firm performance.*

Knowledge alone, however, is static. To achieve lasting competitive advantage, practitioners should not simply use knowledge in an instrumental fashion; they must continuously *create new knowledge* (Nonaka & Takeuchi, 1995), pertaining to current and future technology needs.

Learning

For highly theoretical purposes, knowledge can also be viewed as "a stock of expectations or dispositions to

act in particular ways conditional on the receipt external information” (Boisot, 2002:70).

From the above perspective, what amounts to a change of levels in stocks of knowledge is learning. Learning and knowledge creation processes can not be split in time and space- one is a constituent of the other. When learning adds to the range of contingencies over which one can entertain expectations (i.e., we learn to pay attention to events that we had hitherto ignored), the knowledge level goes up. When learning reduce the range (we decide that certain things can be safely be ignored) the knowledge level goes down. Learning can thus involve acquiring new knowledge or dropping old knowledge. When those two activities go on simultaneously, they serve to refine our stock of knowledge and adapt it to our changing needs (Boisot, 2002).

The way that different agents internalize incoming information through adjustments to their existing stocks of knowledge, and the different meaning and interpretations that they attach to it, constitutes a source of further opportunities for generating new knowledge or discarding old knowledge. In general that means opportunities for learning. As Huber (1991) points it, for production worker, who is in the centre of the paper, knowledge is the potential to do work, and learning increases one’s capacity to take affective actions.

The discussion below examines the process through which learning opportunities emerge and how they contribute to the generation of new knowledge.

Knowledge is bound to a smaller group of professional experts. For example, in manufacturing the calibration of equipment, the layout of a production process, the reduction of downtime etc are all ultimately linked to work experience of professionals operating locally (von Krogh et al, 2001:423). If speaking of entities identifying what is termed “knowledge gaps”, typically they are the knowledge workshops and the community of practice (CP). They work as follows: technical or marketing problems might have been identified, but the knowledge on how to solve the problem is not available. In such cases participants are charged with the task of collecting data, information, and creating knowledge around how to solve the problem based on their existing work practice. This increases the depth of knowledge in the domain. Sometimes, when people from other groups invited, they bring new work experience, explicit procedures, information and data. This enlarges the scope of knowledge in the domain (Nonaka et al, 2004).

One of the biggest problems in knowledge management is its evaluation. Here the value of new knowledge is assessed locally by its ability to solve the problem at hand, as well as generally by its ability to enhance the organizational capabilities in the long run (Choo,2002: 86) The outcome of knowledge creating are new capabilities and innovations that lead to generating new products or services and expand the pool of viable organizational responses.

Spotting an opportunity or a threat involves seeing potentially fruitful patterns in the data of experience. Extracting novel patterns from data is a creative activity of seeing what is tentative and possible as well as what is probable and obvious(Choo, 2002). New insights often reside in the gap between these two poles. Once a possible new pattern has been identified, it needs to be stabilized and tested for robustness if it is to yield useful information, which leads to knowledge generation.

As seen from above, what amounts to the process of pattern elaboration is *problem-solving activity*, which due to its particular importance to the present and following research on knowledge creation, becomes a topic at attention. It involves teasing out whatever latent structures and forms that reside in the pattern and testing them against competing alternatives. In this process emerging patterns compete and many of them are rejected. Clearly, then, the process of generating new knowledge involves forgetting as well as learning. Thus, although we frame the process as one of knowledge creation, it should be clear, following previous discussion, that knowledge destruction is a constituent part of the picture².

Thus we can say that opportunities for identifying new patterns, or problem –solving, create a base for generating new knowledge (Boisot, 2002; Choo, 2002).

To sum up, society has now come to recognize that knowledge itself is a factor of production. The production process is itself becoming knowledge intensive. It is clear that a new economy is being put in place - an economy that produces and consumes intangibles. It is said that the new economy is being constructed in a global context. It is said that whereas Adam Smith `s Wealth of Nations depended on specialization and a division of labor within nations, the new wealth of nations depends on information, communication technology, and in-depth knowledge - on a global basis. Knowledge can be in the mind of a worker, embodied in software or in the working of the computer. Brought to the production process, it adds value. The nature of capital is changing. Once it referred to money used for investment; later it identified the range of products, including machine tools (tools used to make new tools), that were used to make new products. More and more, capital included human capital: the level and breadth of knowledge held by the population in general and workers in particular. Increasingly today one hears about the rise of the knowledge workers - people who bring to the production process complex blocks of knowledge. Thus, concept of knowledge worker will be discussed precisely in sections to follow.

2. Review on the Knowledge - based Theory of the Firm

Notwithstanding the recognition of ultimate role of knowledge in economy, scholars argue that we do not

fully understand how knowledge behaves as a resource. As Drucker (1993) states it, we need an economic theory that puts knowledge into the center of the wealth-producing process and can explain innovation but we have not enough experience to formulate such a theory and to test it.

As it was mentioned above, echoing Drucker, Grant and Spender argue that there is not a theory of the firm based on knowledge in any formal sense. Rather, the emerging “knowledge-based view of the firm”(KVB) presents us more a set of ideas about the existence and nature of the firm that emphasize the role of knowledge. However, the knowledge –based view of the firm ,more then others, offer us the insight into aspects of the firm and its management that we have failed to understand properly because of our failure to consider the nature and characteristics of knowledge (Grant, 2002). Going further, Nonaka completely aligns the KBV and his theory of organizational knowledge creation (Nonaka et al, 2004)

KBV originates from the resource –based view of the firm, which teaches us that valuable, rare, hard to imitate, non-substitutable resources are a source of competitive advantage for a firm(Barney, 1991) and elaborates the nature of resources focusing on the role of knowledge in obtaining this advantage (Kogut & Zander,1992; Conner & Prahalad, 2002) . Knowledge may involve judgment, autonomy and discretion (Conner & Prahalad, 2002). The better management of knowledge as a competitive resource has been argued to influence firm’s performance (Matusik & Hill, 1998). Thus KBV is put in the base of the present study.

Summarizing ideas which are at KBV foundation, let us give a number of assumptions and observations concerning the nature of knowledge and its part in production:

1. Knowledge is the overwhelmingly important productive resource in terms of market value and the primary source of rents (Grant, 1996).
2. Different types of knowledge vary in their transferability. Explicit knowledge can be articulated and easily communicated between individuals and organizations. Tacit knowledge (skills, know-how, and contextual knowledge) is manifest only in its application; transferring it from one individual to another is costly and slow (Kogut & Zander, 1992, Nonaka & Takeuchi, 1995).
3. Knowledge is subject to economies of scale and scope. A characteristic of all knowledge is that its initial creation is more costly than its subsequent replication. As Grant argues, economies of scale in knowledge together with the complementarity of different types of knowledge imply increasing returns in knowledge-intensive industries, which is a fundamental feature of the "new economy". To the extent that knowledge is not specific to the production of a specific good, economies of scale translate into economies of scope. The extent of economies of scale and scope vary considerably among different types of knowledge.

They are especially great for explicit knowledge, information in particular, which is costly to produce, but cheap to reproduce. Tacit knowledge tends to be costly to replicate, but these costs are lower than those incurred in its original creation (Grant, 2002).

4. Knowledge is created by human beings, and to be efficient in knowledge creation and storage, individuals need to specialize (Spender,1996).

5. Producing a good or service typically requires the application of many types of knowledge (Kogut & Zander, 1992).

An important implication of these assumptions is the dichotomy between two types of knowledge-based activity in the economy. There are those activities that are concerned with increasing the stock of knowledge-what March (1991) refers to as "exploration", Bierly &Daly (2002) –as "knowledge generation". And those activities concerned with deploying knowledge in order to produce goods and services-what March (1991) refers to as "exploitation" and Grant (1996) calls "knowledge application." Reconciling the dichotomy between knowledge creating and knowledge applying activities represents a key challenge for economic organization (Bierly &Daly, 2002): knowledge creation requires specialization (points 3 and 4 above), while knowledge application requires diversity of knowledge (number 5). Given the limited transferability of knowledge (item 2), this presents considerable difficulty for the institutions of production. The solution lies in some process of knowledge integration³ that permits individuals to apply their specialized knowledge to the production of goods and services while preserving the efficiencies of specialization in knowledge acquisition (Grant, 2002). And one of the main knowledge integration processes is, again, *problem- solving activity*, which adds to our assuming of problem solving as a main facilitator of organizational knowledge creation.

Narrowing the context to production, March (1991)stated that in the struggle of an organizational learning system between exploring new knowledge versus exploiting existing competencies and capabilities, manufacturing organizations tend to be biased towards exploitation. The relentless push for reducing cycle times, increasing throughput, and improving quality means that production commonly proceeds under pressure for immediate results, leaving little time for exploration. As a result, manufacturers tend to designate specialized design and development functions largely to technical professionals external to operational sources of knowledge(or workers), creating divisions between design and production. However, a good learning cycle should contain a positive feedback loop where new knowledge leads to new products and vice versa (Argyris, 1976). Thus, investments in both processes can reinforce each other by bi-directionally conducting knowledge between design and operations.

The concept of organizational capabilities will be called for when looking for other potential facilitating factors of organizational knowledge creation. Going back to the knowledge-based approach, let us speculate on organizational structure and design problems, which are supposed to help in distinguishing such factors. Two most relevant to the present study topics are the design of hierarchical structures and the distribution of the decision making in the organization. As it was mentioned above, evolution of different organizational forms in the business sector can be seen widely. Knowledge-based view offers an insight in analysis of some of them. Manufacturing and service companies increasingly emulate the team-based structure of project-based organizations such as consulting, engineering, and construction firms. Consideration of the characteristics and role of knowledge may assist the analysis and design of such team-based organizations.

Potential contributions of knowledge-based thinking to the design of teams and team-based organizations include, first, principles of modularity and second, the role of knowledge integration among team members. The essence of the team-based organization is recognition that coordination is best achieved through the direct involvement of individual specialists. It is also a point that specialist coordinators (managers) cannot effectively coordinate if they cannot access the requisite specialists knowledge. The spread of team-based organizations throughout production activities recognizes that critical know-how is located among individual operatives-specialists (Grant, 1996).

From a knowledge-based perspective, the most intense interdependencies are likely to involve the integration of tacit knowledge in team-based activities that require organizational routines and /or joint problem-solving. If no one outside the team has access to the knowledge within the team or, by extension, to the design of the integration mechanisms within the team, then the implication is that effective knowledge integration within the teams is likely to require a significant level of self-management.

Directly from the above discussion of hierarchical structures in integrating knowledge follow implications for the allocation of decision-making authority of the firm. The conventional base for the analysis of decision making is delegation (Lawler, 1988). Knowledge-based view offers two principal implications for the distribution of decision-making. The first issue concerns the linkage between decision rights and ownership (simply speaking, if the primary resource of the firm is knowledge, and if it resides in individual employees, then it is employees who own the bulk of the firm resources). The second issue concerns co-location of decision-making and knowledge (i.e., the quality of decision depends upon their being based upon relevant knowledge).

If, as Grant (1996) has established, the quality of decision making depends critically upon the co-location of decision-making rights with the knowledge relevant to that decision, then we can specify two approaches:

decision making can be devolved to where the knowledge resides, or knowledge can be transferred to the decision-making authority.

The critical issue here is the mobility of knowledge. This depends upon whether the relevant knowledge can be codified. Where knowledge is fully codifiable (e.g., information on the inventories of different products), the knowledge not only can be transferred at low cost, but it can also be aggregated at a single location. Given economies of scale in decision making, it is desirable to centralize such decisions (Grant, 2002). Hence, in most companies, treasury functions, including cash management and foreign exchange hedging, are centralized in a single corporate treasury. Similarly with the purchasing of standardized items by different departments within an organization: these activities, too, are easy to centralize. Conversely, highly tacit knowledge cannot be codified and is extremely difficult to transfer and to aggregate (Nonaka & Takeuchi, 1995). Hence, where the relevant knowledge is tacit, then decision-making power must be distributed to where the tacit knowledge is located.

Notion of employee empowerment, which has become extremely popular in recent management literature, also gets new insights. Usually moves toward empowerment have been justified primarily in terms of motivation and philosophies of individualism and self-determination (Lawler, 1988). Knowledge-based view provides an efficiency-based argument for empowerment decisions: when knowledge is tacit, or is not readily codifiable, decision-making speed and quality is enhanced where authority is delegated to those who possess relevant knowledge.

However, one should admit that thinking of, say nothing of treating, rank and file employees as a contributors to the knowledge creation, or a decision-making authority, was impossible under the mass production or conventional manufacturing paradigm (Isa & Tsuru, 2002). As discussed above, team-based organizational structure lets us develop such approach. According to Grant, two of the most important contributions to management practices during the last century were scientific management and the TQM-total quality management. Difference between the two, which appears in decision making and role of the managers, can be traced to their different assumptions concerning the characteristics of knowledge within the firm.

In contrast with Taylor's assumption that managers can access the knowledge of their subordinates and fully use for decision making, TQM recognizes that knowledge is not easily transferable. Given that good decisions require the application of the knowledge relevant to those decisions, TQM favors the transfer of decision making concerning each employee's production tasks to the employees who are undertaking the task. This outcome also rests upon a second assumption: that workers are intelligent and capable of constant learning. Hence, the

continuous training of workers in process control and problem solving is a central feature of TQM.

Introduction of production system having TQM in its bases, namely cell production, as seen especially in the Japanese electronics industry, proved that putting people in the centre of production process can finally lead to improving operational performance or plant performance, i.e. productivity, quality, and lead-time, and furthermore financial performance, i.e. cash flow, capital turnover, and bottom line (Sakikawa, 2004). Cell production, its outcomes, and definition is beyond the present research scope. However, and particularly appealing in terms of the present research, initial proposition based on literature overview and further field work showed that at the companies adopting cell production people are emphasized as the best resource and attention is put on developing high-quality employees and tapping maximum skills and knowledge from them. Thus study on the human-centric, innovative cell production method, seems imperative to understanding of how knowledge is being created and utilized in manufacturing industry.

The displacement of scientific management by different forms of participative, employee-empowering management approaches partly reflects the motivational benefits of these systems, but if viewed from KBV, is also a result of the greater efficiency of these systems in accessing and integrating the relevant knowledge. A nonhierarchical, team-based organizing technology- TQM - permits an organization to utilize individuals' knowledge located at low levels of the organization.

. Knowledge Creation and Production

1. Manufacturing Sector in a Modern Economy: Changing Role

For a number of decades, the importance of the manufacturing sectors has been at the forefront of national economic debates. However, with a shifting focus towards the knowledge economy and what some have termed the 'post-industrial economy', interest in the debate has dimmed. It is however, once again back on the agenda, but it may stall if a new angle is not taken on the debate. Production, and a production capability, has operational and strategic implications for firms, and therefore regions and countries. These implications are discussed in the various bodies of knowledge, including innovation and technology management researches (Subramaniam & Youndt, 2005).

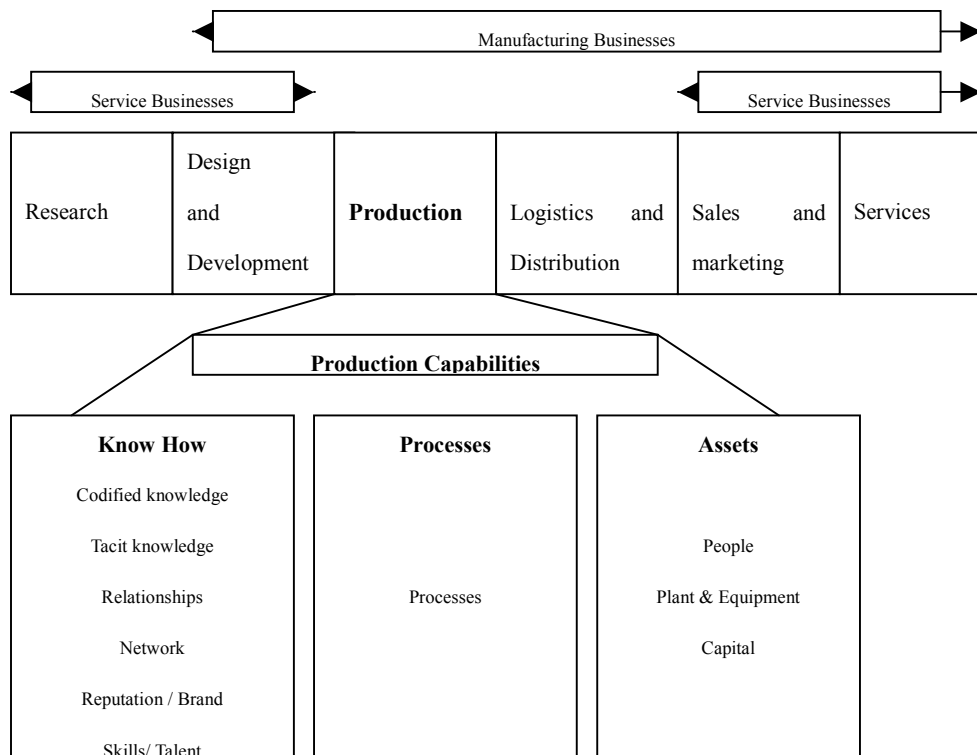
Production has often been viewed in the economics literature through the neoclassical lens which makes numerous simplifying assumptions and which misses much of the real-world operational and strategic issues surrounding production. This has left production concept separated from knowledge. However, much

progress in the field is being made through the incorporation of innovation, knowledge, learning and technology in economics. In particular, capabilities perspective, drawn from the strategic management literature is called for the present research purposes.

The concept of ‘production capability’ will be called for help in the present research. Production is only one part of the manufacturing activity. Manufacturing in this definition includes R&D, production, logistics and management of the production network, whilst production specifically refers to the physical creation of the product (Figure 1).

Successful companies select the appropriate mix of production and service activities to serve their markets and exploit their capabilities. Production capability is, essentially, one level higher than production itself, bringing together the knowledge of the process, and the physical assets that allow a company to deliver its product and market strategy. The diagram below shows production in the context of manufacturing.

Figure 1. Production in the Manufacturing Cycle



Source: made by author, based on Rejal S. (2004)

Services can be associated with any stage in the manufacturing cycle, from research services to branding services, so service providers are shown throughout the manufacturing cycle.

Aiming at overcoming hampering of the manufacturing sector importance through definitional problems, the distinction between production and manufacturing is given.

Production as a source of innovation

According to the Rejal(2004) empirical research results, companies with short product lifecycles, and in markets with high levels of innovation, have found that separating production from idea generation and design and development has had a negative impact on their ability to innovate quickly. Thus the speed of a company's innovation process is partly determined by the ability to test ideas in production quickly, and by the interaction of designers and production engineers.

Not only the linkages between production, design and development mean that having them in different locations may weaken the innovation process within the company. Production, itself, can also be an important source of ideas to improve existing products and production processes. This feedback loop between the production of products and their design and development becomes increasingly difficult as production and other functions are significantly separated. Although information and communication technologies have helped to coordinate company actions over great distances, they are not always able to provide the intimate link that is required if production and innovation are to act together.

In the case of radical innovation, co-location of production and design and development can be vital. A series of iterations between production and design is often required as part of the new product development process to stabilize such innovations. Companies with weak production capability may find radical innovation problematic.

Production as a source of distinctiveness and sustainable competitive advantage

It is production capability, particularly its embedded know-how, which can create and maintain distinctiveness which is hard to copy, offering protectable competitive advantage.

Surprisingly, those companies, enjoying a high level of tacit knowledge embedded in factories, however, may even not need to patent to protect their production processes. As it can be seen at Japanese manufacturers this knowledge is embedded in the specialist equipment, skills and know-how of the company employees, sustaining their competitive advantage (Nonaka et al, 2004). For example, design and production together are used to deliver competitive advantage in the Japanese automotive and electronics industry through innovative

platform strategies and high levels of delivered quality and delivery time.

Production capability is critical to achieving *flexibility*. It seems, quality and service are no longer always enough to provide competitive differentiation. Companies are seeking to offer their customers products and services that meet their unique needs. For example, 70% of note PCs produced by NEC are produced in less than 10 units' batches and a customer can enjoy having the PC delivered in 3-7 days after placing an individual order.

Delivery of such customized products at mass production economies of scale - so called mass-customization - requires a sophisticated approach to both design and production⁴.

However, as the simultaneous trend, companies are increasingly selling services based on their products, and production capability can enhance such services through accurate cost estimation and detailed production knowledge. Manufacturers are increasingly offering to manage risks on behalf of their customers through total care packages to support a product throughout its life, which enables customers to focus on their core business, while reducing overall cost of ownership and increasing revenues for the traditional manufacturer. It is because of the detailed understanding of product behavior and maintenance they retain, manufacturers can do this.

Companies may observe that production capability enhances service business performance in the following major areas. Firstly, know-how from the production process gives an entry advantage in estimating the costs of through-life services. Secondly, the manufacturer has a unique opportunity to design for maintenance based on experience in the field when building systems. This intricate link enables the company to offer new products that provide best value over the whole of the product's life.

Debating on production importance one can't but mention a general trend in today's world economy - relocation of production facilities. Japan is not exclusion; its production is being moved to the low-cost areas, for example, China extensively. Surely, companies in some industries have little choice but to move production to low cost areas if they are to remain competitive. For example, Canon has to move its production facilities to China following its suppliers.

Despite the obvious cost benefits belying the process of facilities relocation, there is a hidden risk, however, of undermining the country's competitiveness if seen from the long run. I think under-investment and loss of production knowledge at home, after production relocation, might make reversing location decisions difficult later on. The following barriers to the return of production seem to be the main:

- During the time production has been located overseas, there will have been little local investment and

substantial re-investment in physical plant which may be required would be an immediate barrier to returning production.

- Which is in the centre of the present research, the loss of local skills and knowledge – particularly tacit knowledge – may make return of production problematic.

In these highly challenging circumstances retention of production capability requires the ability to control global production networks, including knowledge of production processes, the ability to influence production performance and the means to prevent leakage of production knowledge and capacity to competitors on the one hand and constant development of knowledge base on the other (Rejal, 2004).

Judging from the latest examples, (Sony example) production may be more important to the national economy and individual company success than previously thought. There is a strong linkage between production and other manufacturing functions in some industries, most apparent of which is the linkage between production and design and development. Close interaction between these functions can be an essential component of a successful innovation process and anchor other high value added activities development. That is why despite the opportunities offered by modern information and communication technology many companies still prefer the co-location of these functions. There is also interdependence between production and other functions such as marketing, distribution and after sales services.

As seen from above, a company's ability to compete in its chosen part of the manufacturing cycle may be reduced by relocating production, since the migration of production may be followed by a migration of design and development, therefore threatening the long-term strategy of moving up the value chain (Rejal, 2004).

To sum up, the continuing movement of production out of the industrialized nations has raised questions about the strategic importance of production to companies and even countries. If the strength and depth of linkages between production and the other functions of a manufacturing company is fully understood, companies, as well as developing their production base, are beginning to develop sophisticated design and development capabilities. For example, many Japanese manufacturers are said to become "mother-plants" (Sakikawa, 2004).

Surely, there are activities which have become commoditized and which should move if labor costs are dominant. However, more complex production activities, particularly at the early stages of product life cycles, should not move if a company or even country is to stay competitive. Indeed, I believe that only in-house production capability may provide companies with a significant advantage in markets that continue to demand faster cycle times and higher degrees of customization.

In these circumstances, further research in knowledge aspects in production will definitely add to the understanding of the vital question: how should a company and thinking broader, a country, survive in the long term.

2. Concept of Knowledge Worker in Production

Transformation to the "new economy" has created new systems of production and distribution organization which require a more knowledgeable worker in some parts of the system. In the society based on knowledge, says Drucker, the "knowledge worker" is the single greatest asset. Included in his definition of a knowledge worker is a knowledge executive who knows how to allocate knowledge to productive use, just as capitalist knew how to allocate capital to productive use (Drucker, 1993).

Since then, ample research demonstrates several advantages of knowledge development for production workers: workers can organize their own work better, less reliance on engineers for handling production contingencies, and increased capability of the entire production system (Cusimano, 1995; Vidal, 2004). Most importantly, these authors note that the resulting egalitarianism in the organization enhances the innovating of production workers and the overall flexibility and responsiveness of the organization (Nilsson, 1995). These observations are evident in a host of modern manufacturers that have instituted such concepts - examples include Chaparral Steel (Leonard-Barton, 1995), Honda and Kao (Nonaka&Takeuchi, 1995), NUMMI and companies included in my on-going field research.

Additionally, it is said that if production workers do not participate in the knowledge exploration process, their strong bias towards exploitation of existing knowledge will make them increasingly resistant to the innovative changes ordered by the management. They need to have control over their own learning needs and think through and even plan these needs when possible (Cusimano, 1995).

To the certain extend this perception might seem idealistic, but as a researcher I found it very challenging to trace a line of "knowledge worker" perception to front-line employees. Indeed, the value of any one person's contribution in the knowledge-creating organization should be determined less by his or her position in the organizational hierarchy than by the importance of the information he or she provides to the entire knowledge-creating system. Since rank and file workers act almost as "walking archives" (Nonaka & Takeuchi, 1995), on a day-to-day basis, I assume that they are competent actors of knowledge creation process and hence, shop floor – a place, where knowledge creation occurs as intensively as in the R&D or marketing department.

I am not completely happy with the term “knowledge worker” as it does not convey clear meaning by itself. Many people mean very different types of workers when they talk about “knowledge workers” and different types of work when they say “knowledge work”. There is no such thing as a knowledge worker in the sense that we have agricultural or factory workers and this term comes from the person who performs a knowledge work. However, due to the cognitive nature of knowledge, discussed above, it is almost impossible to find a clear definition of the phenomena. Knowledge work is discretionary and invisible, thus difficult to identify and difficult to control. That is why majority of studies tend to look at what is visible- physical work and its production (Kelloway & Barling , 2000).

Going back to the “knowledge worker” term’s history some thirty years ago, Drucker (1968) described someone who adds value by processing existing information to create new information which could be used to define and solve problems. Davenport (1999) stated that knowledge workers use their intellect to convert their ideas into products, services or process.

All knowledge work is first and foremost a management task. Of course, strictly speaking, management is a type of work. However, in knowledge work, everyone is a manager to one degree or another. Right now, one may not in fact be managing people. He is, however, managing his time, managing content, and perhaps managing other resources. And decision-making activity discussed above is a major indicator of managerial character of knowledge work.

So what is a knowledge worker? Knowledge workers are best described as investors (Davenport, 1999; Kelloway et al., 2000): they make choices of when and how much of their knowledge and energy to invest in a company that doesn't have much direct control over these investments. Taking this standpoint leads to defining knowledge work as discretionary behavior, as a system of activities that knowledge workers opt to do, and managing knowledge work as establishing conditions that increase the likelihood of making the “right” choices.

As such knowledge work is understood to comprise the creation of knowledge, the application of knowledge, the transmission of knowledge and the acquisition of knowledge. Each of the activities is seen as discretionary behavior. Employees are likely to engage in knowledge work to the extent that they have the (a) ability, (b) motivation, and (c) opportunity to do so. The task of managing knowledge work is focused on establishing these conditions. Organizational characteristics such as transformational leadership, job design, social interaction and organizational culture are identified as potential predictors of ability, motivation and opportunity (Kelloway et al., 2000).

Modern literature on human resource management claims that fewer and fewer people in the organization are subordinates - even in low-level jobs. Increasingly they are associates and are knowledge workers. The very definition of a knowledge worker here is one who knows more about his or her job than anyone else in the organization. It is said, what motivates workers - especially knowledge workers - is what motivates volunteers. Volunteers, we know, have to get more satisfaction from their work than paid employees precisely because they do not get a pay check. They need, above all, challenge. They need to know the organization's mission and to believe in it. They need continuous training. They need to see results. Implicit in this is that employees have to be managed as intrinsically motivated associates, partners-and not in name only.

Knowledge workers are believed to produce more when empowered to make the most of their deepest skills; they know how to allocate their time; and they can multiply the results of their efforts through soft factors such as emotional intelligence and trust. Organizations designed around the knowledge worker (instead of just machine capital) are thought to integrate the best of hierarchy, self-organization and networking rather than the worst.

A weakness of majority of discussions given above from the present paper` point of view, is that they always focus only on workers who are not in operative processes (Nilsson, 1995). It is explained by the assumption that knowledge workers` job is "different every day" - they don't have tasks that are the same every day. They innovate their own work and usually work on innovating other people's work too. They need to cope with complexity. It is often said that even though "plumbers and carpenters" are skilled specialists requiring specific knowledge at what they do, they are not knowledge workers, since they apply an established body of knowledge to mainly well known problems.

However, what I have seen during the field work at plants employing cell production method, made me surmise that knowledge work by the certain extent is something that everyone naturally does, some more than others, and some more easily than others.

Going back to the discussions on importance of production, it seems, Japanese manufacturers realize it and consequently, try to keep production facilities within the country. And flexible cell production method is widely used as a suitable tool.

To give a short outline, there are several reasons for abandoning mass production or automated belt conveyor lines and introducing cell production. To make it clear- it has been a question of survival. Managers of the field-researched plants claimed that it had been done in order to keep operating in Japan and

manufacture a small-lot high-variety of products and deliver them to Japanese customers very quickly. It is a particularly challenging task since many Japanese manufactures have been transferring production facilities to overseas, for example, to China, where they can find a cheap labor and keep large-lot, low-diversity manufacturing and ship products globally, using cost advantage.

Judging from the interviews with plant managers, the biggest challenges in today's situation on the way to a flexible, small-lot high –diversity production strategy are:

- productivity increase
- quality increase
- lead time and changeover time shortening
- cost reduction
- inventory reduction
- better customer satisfaction etc.

Success in all of them directly depends on rank and file employees' abilities and will or commitment, which make it vital to create conditions enabling employees to invest their will and strength in the organizational performance (Isa & Tsuru, 2002).

In other words, manufacturers aiming at keeping production in Japan face a problem of eliminating any non-value adding activities or "wastes" in major areas, namely, in overproduction, inventory, defects, processing, transportation, waiting, motion and people. At the same time, they need to foster maximum abilities from their employees since employees are the only inexhaustible source of creativity and flexibility once their eagerness and will for work is secured (Isa & Tsuru, 2002).

In the present paper I assume that since cell production would have all the principal characteristics discussed through this paper (namely, team activities, self-managing teams, autonomy, skills, knowledge, commitment, etc (Sakikawa, 2004)), cell operators should be understood as the ultimate source of the named above desired behavior and attitudes, skills and knowledge.

According to Nonaka and Takeuchi, to create new knowledge means quite literary to re-create the company and everyone in it in a nonstop process of personal and organizational self-renewal. In the knowledge-creating company, inventing knowledge is not a specialized activity - the province of the R&D department or marketing or strategic planning. Knowledge creation "is a way of behavior, a way of being; in which everyone is a knowledge worker" (Nonaka & Takeuchi, 1995).

They contend, that the centerpiece of the Japanese approach to creating new knowledge depends on tapping

the tacit and often highly subjective insights, intuitions, and hunches of individual employees and making those insights available for testing and use by the company as a whole. The scholars call front-line employees and line managers “knowledge practitioners”, whose basic role is the embodiment of knowledge⁵.

“Knowledge operators” or “knowledge practitioners” - front-line employees, including skilled workers and supervisors on production lines, skilled crafts persons and line managers - accumulate, generate and update both rich tacit and explicit knowledge in the form of experience-based embodied skills(Nonaka &Takeuchi, 1995). Hence, front-line employees, immersed in the day-to-day details of particular technologies, products, or markets, must be given well-deserved credits for their contribution in the organizational knowledge creation.

I think that workers, day-to-day, float between process and knowledge work. Reminding of main characteristics of the knowledge worker, and imposing them on the portrait of the cell production operator, I dare to state that intrinsically motivated, empowered and highly responsible operator, often taking a direct part in production planning and problem solving, has much in common with knowledge worker. Manufacturing employees contributions, I believe, mean that actually they are knowledge workers, albeit not naturally bookish ones.

In accordance with Kawakita’s (1998) report on Japanese Production Workers in Small Companies, the desire for production workers to earn qualifications and acquire official additional skills is generally strong regardless of age. The percentage of those wanting to acquire qualifications and skills which are trans-corporate useful is high in such fields as maintenance, quality control and production planning(46.2%), design and engineering(36.2%) and supervision and training (35.9%). The percentage of those who are learning skills useful for their jobs at their own expenses is high in product design and engineering (25.9%) as well as in supervision and training (21.9%).

More often than not, it is said that work requiring special knowledge and manual production work are differentiated but many male skilled workers consider their jobs strongly intellectual. 59.3 percent said they can improve on their own jobs; 56.6 percent noted they can see the results and achievement of their work and 49.9 percent remarked they constantly need to use judgment to perform their work adequately. Furthermore, 24.5 percent said their work involves much change and the same percent said they can improve their ability through their job.

Japanese small- and mid-size companies have a low unionization rate. Only 5.8 percent said they can express their views and opinions through the labor union, but this does not mean that without the labor union

skilled workers cannot voice their views to management. A majority large number, or 51.1 percent, of the surveyed said their suggestions were heard by management. Twenty-one percent participate in quality control circles and self-management committees. Team activities are widespread also in smaller-scale enterprises. These facts give us additional motivation to stretch knowledge worker concept onto shop-floor level.

Speculations on manufacturing knowledge make me thinking that it may be more useful to consider knowledge work not as well-known creating-learning-sharing-applying knowledge cycle, but as system of activities in the following interrelated areas:

- Idea zone (managing ideas): creating, capturing, organizing and applying ideas
- Personal zone (managing yourself): constant learning
- People zone (managing relations): establishing, maintaining and activating connections with others.

Such broad diversification would help us to include production workers into the knowledge workers scope and develop this concept in the future.

IV. Conclusion

The heated debate concerning the knowledge phenomena in the modern economy is to be continued. A large amount of the definitions and approaches produced in association with it prove it very well. Moving forward, it is necessary to set up a framework for the further research according to my own view on the achievements of the previous researchers.

Knowledge in the present paper is defined within the organizational context and as a factor of economic development.

Two distinct roots of writing about organizational knowledge have been identified. The first distinguishes knowledge from the traditional factors of production, labor, land and capital. Knowledge there is taken as the most important or 'strategic' factor of production. The second discourse has to do with differentiating between alternative types of knowledge and definable relationship between the types of knowledge. The distinction between explicit and implicit knowledge is put in the centre of this approach and Nonaka and Takeuchi (1995) make the interaction of the explicit and the tacit modes of knowing central to their theory of organizational knowledge creation.

Adding to the organizational knowledge debate, Spender (1994) have argued (a) that the different types of

knowledge lead to different types of economic rents, and that firms' strategies, as the pursuit of these economic rents, will also differ. While an individual's knowledge is inherently transferable, moving with the person, giving rise to Pareto rents and the resultant agency problems, the social types of knowledge are either publicly available or collective and embedded in the firm's routines, norms and culture.

High-technology firms and their production methods (team-oriented in particular) are backing up the research, so here we are interested in technological knowledge, that is, knowledge generated in response to major technological shifts. So in this study, knowledge is understood as information that has been validated by experience that has entered human belief systems as rules for guiding actions, and, in the case of business, that has proved beneficial to firm performance.

Thus, the research focuses on extracting potential facilitating factors for knowledge generation, the enlargement of the knowledge of individuals, and especially the organization-wide generation of new knowledge pertaining to current and future technology needs.

Learning amounts to a change of levels in stocks of knowledge; learning and knowledge creation processes can not be split in time and space- one is a constituent of the other. For production worker, who is in the centre of the paper, knowledge is the potential to do work, and learning increases one's capacity to take affective actions. Knowledge is bound to a smaller group of professional experts. For example, in manufacturing the calibration of equipment, the layout of a production process, the reduction of downtime etc are all ultimately linked to work experience of professionals operating locally.

Differently organized groups of experts identify "knowledge gaps". When technical or marketing problems have been identified, but the knowledge on how to solve the problem is not available, participants are charged with the task of collecting data, information, and creating knowledge around how to solve the problem based on their existing work practice. Thus, problem-solving activity - the process of pattern elaboration and testing them against competing alternatives- create a base for generating new knowledge. Following this logic, one of the biggest problems in knowledge management - its evaluation- is solved. Here the value of new knowledge is assessed locally by its ability to solve the problem at hand, as well as generally by its ability to enhance the organizational capabilities in the long run. Problem-solving activity is also the solution of various problems originated in the cognitive and complex nature of knowledge. It happens through the process of knowledge integration that permits individuals to apply their specialized knowledge to the production of goods and services while preserving the efficiencies of specialization in knowledge acquisition.

The better management of knowledge as a competitive resource has been argued to influence firm's

performance. Thus, following Nonaka's debate, KBV is put in the base of the present study.

The spread of team-based organizations throughout production activities recognizes that critical know-how is located among individual operatives-specialists or production workers. From a knowledge-based perspective, the most intense interdependencies are likely to involve the integration of tacit knowledge in team-based activities that require organizational routines and /or joint problem-solving.

Narrowing the organizational context to production, it is stated that in the struggle of an organizational learning system between exploring new knowledge versus exploiting existing competencies and capabilities, manufacturing organizations tend to be biased towards exploitation. The relentless push for reducing cycle times, increasing throughput, and improving quality means that production commonly proceeds under pressure for immediate results, leaving little time for exploration.

Based on above I assume problem solving as the main facilitator of organizational knowledge creation viewed from the lower levels of organization – shop-floor.

The displacement of scientific management by different forms of participative, employee-empowering management approaches, if viewed from KBV, is a result of the greater efficiency of these systems in accessing and integrating the relevant knowledge, since they permit an organization to utilize individuals' knowledge located at low levels of the organization.

Production capability - bringing together the knowledge of the process, and the physical assets that allow a company to deliver its product and market strategy - is assumed to be extremely important for a company if it is to stay competitive. Indeed, I believe that only in-house production capability may provide companies with a significant advantage in markets that continue to demand faster cycle times and higher degrees of customization. Companies with weak production capability may find radical innovation problematic. Production capability is also critical to achieving flexibility.

Surely, there are activities which have become commoditized and which should move abroad if labor costs are dominant. However, more complex production activities, particularly at the early stages of product life cycles, should stay in house. In these circumstances, further research in knowledge aspects in production will definitely add to the understanding of the vital question: how should a company and thinking broader, a country, survive in the long term.

Thus study on the human-centric, innovative cell production method (especially, as seen in Japan), seems imperative to understanding of how knowledge is being created and utilized in manufacturing industry.

Opportunity to participate in decision making is assumed to be the next facilitator of knowledge creation.

Knowledge-based view offers two principal implications for the distribution of decision-making. The first states that if the primary resource of the firm is knowledge, and if it resides in individual employees, then it is employees who own the bulk of the firm resources. The second issue states that the quality of decision depends upon their being based upon relevant knowledge. Hence, where the relevant knowledge is tacit, then decision-making power must be distributed to where the tacit knowledge is located- to the forefront production workers. This outcome also rests upon an assumption that workers are intelligent and capable of constant learning. It is widely known that the continuous training of workers in process control and problem solving is a central feature of TQM-based cell production.

Ample research demonstrates several advantages of knowledge development for production workers: workers can organize their own work better, less reliance on engineers for handling production contingencies, and increased capability of the entire production system. Most importantly, the resulting egalitarianism in the organization enhances the innovating of production workers and the overall flexibility and responsiveness of the organization. Additionally, it is said that if production workers do not participate in the knowledge exploration process, their strong bias towards exploitation of existing knowledge will make them increasingly resistant to the innovative changes ordered by the management. They need to have control over their own learning needs and think through and even plan these needs when possible.

Based on above debate, I assume that production workers are competent actors of knowledge creation process and hence, shop floor – a place, where knowledge creation occurs as intensively as in the R&D or marketing department. Through this assumption I try to overcome weakness of majority of discussions on knowledge work and knowledge worker given in management literature, namely, the fact that they always focus only on workers who are not in operative processes.

If knowledge worker is someone who adds value by processing exiting information to create new information which could be used to define and solve problems, and use his/her intellect to convert ideas into products, services or process, than production worker can be called a knowledge worker in team-based organizational context. Knowledge work is understood to comprise the creation of knowledge, the application of knowledge, the transmission of knowledge and the acquisition of knowledge. Each of the activities is seen as discretionary behavior. Employees are likely to engage in knowledge work to the extent that they have the (a) ability, (b) motivation, and (c) opportunity to do so.

Hence, empirical research on production workers opportunity and scale of participation in problem-solving activity and decision-making in real organizational context will be put in the centre of my future study aimed

at testing the assumptions given above.

Endnote

- 1 Though, it is not easy to make this distinction between knowledge. Some theories differentiate knowledge by using the notion of "public good." While land, labor and capital are private goods, knowledge is often said to be a 'public good', meaning that it is infinitely extensible and its use by one person does not deprive others of its use. But this is scarcely adequate so long as the knowledge relevant to the firm is conceptualized as either labor skills or intellectual capital, thus turning it into a private good which can be accommodated in the conventional analysis (Spender, 1996).
- 2 It should be mentioned though, that forgetting is always partly, and although discarded ideas do not form part of any formal and public body of knowledge, they are unconsciously retained in personal and subjective expectations and dispositions (Boisot, M. 2002:71).
- 3 Problems of organizing the integration process fall into two categories: the problems of cooperation and the problems of coordination. The cooperation problem results from the fact that different organizational members have different goals. The coordination problem is the technical problem of how to integrate the separate efforts of multiple individuals. These topics lay directly in the area of strategic human resource management, which is above the scope of the present study due to its size constraints. However we should point out that human resources (labor) and knowledge (information) share the principal roles in application of KBV to the production. Knowledge and human resources are seen as separate distinct factors of production, but it is human resources that generate, refine and add value to knowledge (Grant, 2002).
- 4 Mass customization is not a new idea, although it is a growing trend (Pine et al, 1995). Central to the manufacturing philosophy of mass customization is the requirement for very short cycle times. This needs to be synchronized with agile logistics. To make a long story short, the target is that the customer can specify unique requirements and expect delivery as quickly as standard product but at a premium price.
- 5 All individuals, involved in knowledge creation process in the company are called "a knowledge-creating crew" (Nonaka & Takeuchi, 1995:151-153).

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