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PRODUCT DEVELOPMENT IN THE FINANCIAL CRISIS

Geir Ringen[1], Halvor Holtskog[1]
(1) Norwegian University of Science and Technology

ABSTRACT
In the automotive industry product development has been a key for competitive advantage. Such projects are done in a value chain setting with many suppliers. The point of departure is a strategic supply model where key indicators for knowledge development and culture of competiveness, before and after the current financial crisis, are analyzed through case studies, in-depth interviews, internal documents, and survey. Researchers have spent two years inside the companies in a pragmatic research project. During this time the financial crisis hit the industry hard. Hence, degree of market turbulence is discussed according to the key indicators together with market and business implications to the product development process. During the initial shock phase the research shows significant changes in learning orientation, innovativeness orientation, entrepreneurial orientation, and knowledge acquisition.

Keywords: Product development, value chain, automotive industry, financial crisis

1 INTRODUCTION
Four companies in the Norwegian automotive industry have received founding for a user-driven innovation project. One of the main goals in the project is 50% reduction of resources and time in product development projects. To improve the product development process we have viewed it from a supply chain perspective, analyzing competiveness and knowledge development in which how the firm interact with other parties in the supply chain to develop new products. Supply chain efficiency, measured in cycle time performance, has a direct link to profit and growth [1], supporting the industrial objectives in this research project. Therefore, the framework chosen for this work is based on Hult et al.'s model [2], shown in Figure 1, because it incorporates culture of competiveness and intentional knowledge development as key factors for positive influence on cycle time performance. Their inspiration for integrating culture of competiveness and intentional knowledge development is mainly drawn from the broader learning theory, for instance Argyris and Schön [3], Hedberg [4], and Nystrom and Starbuck [5].

1.1 Model of improving performance
Many companies use their value chain as a source for competitive advantage and Hult et al. tried to examine if there were some synergies between culture of competitiveness and knowledge development. They found that interaction between culture of competitiveness and knowledge development has a positive association on performance (H3), shown in Figure 1, but their influence was moderated by market turbulence (H4 and H5). To define culture of competitiveness and knowledge development they classified some first-order latent indicators; Learning Orientation, Innovativeness Orientation, Entrepreneurial Orientation, Knowledge Acquisition, Information Distribution, Shared Meaning, and Achieved Memory [6-13].

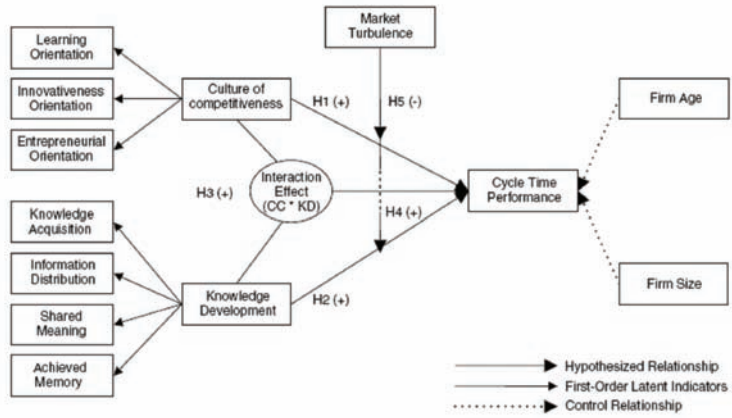

Figure 1. Model by Hult et al. [2]

2 THEORETICAL FOUNDATION AND RESEARCH QUESTION

Reality can be viewed as a social construction. It means that reality is social constructions that "*results in a world of continuous process*" [14]. Generally the methodological approach in the paper is a system approach, where the focus is "*to arrive at new ways of approaching or classifying reality*" [14]. System is defined as "*a set of components and the relations among them*" [14]. Product development project is done in a value chain as an open system, which means that there are important factors in the environment that are beyond the system's control. The system perspective will change during the paper from a structural to a processual perspective. Hult et al.'s model [2] has a focus in a structural perspective where there are stable and dynamic structures and non-regular processes that can mean change of structures. But in light of the financial crisis the paper will shift to a more processual perspective, where the stable structures are not in focus. The shift is done in order to explain changes in the open system.

In a user-driven innovation project the companies have specific goals and focus areas they want the project to address. The research was based on the foundation of pragmatic action research (AR) [15, 16]. Researchers role in the companies have been to create the tools and space for change, believing that the people closest to the problems have often a general idea of the solutions. Insights for the researchers are gained through participation and observation of the change processes.

"*Successful AR … the complexities of the problems addressed require the knowledge and experience" [16].*

Deeper understanding was achieved due to the relation between the researchers and organizations, based on common understanding and cooperation, where the researchers were viewed as a friendly outsider. Detailed findings from the researchers were made available for the organization in a form of situation status and after conformation of the correctness of the situation, researchers and practitioners worked together in order to find a good and effective change process.

2.1 Research question

Hult et al.'s [2] model is related to company level. The interest in this paper is in the function or project level of product development. Based on this fact the research question will then be:

How can Hult et al.'s model[2] explain the efficiency of product development projects done across two or more actors in a value chain in light of the current financial crisis?

This paper has a focus on product development as joint effort between the Original Equipment Manufacturer (OEM) and its suppliers (Tier 1). Several theories have described this cooperation based on the assumption that unique resources exist at the supply chain level [2, 17]. One of the business processes that have most interaction between the OEM and the Tier 1 is the product development department. This is confirmed by the case studies. The reason for a very intense interaction can be explained by the use of "Black Box Parts", where the tier 1 does most of the development work [18, 19] in close partnership with the OEM.

The efficiency measurement in product development project can be argued to be two folded; time and resources, and/or quality. The latter measurement has a strong focus in the industry, rooted in the Total Quality Management theory [20, 21]. In this paper time and resources are in focus due to the project goal of the user-driven innovation project. In addition a turbulent market will have a focus on survival in the phase of a market shake-out phase [22]. Finance muscles will play an essential role in this "survival of the fittest" phase. Or as one of the interviewee said "*this industry is hit by a tsunami*".

3 METHOD

3.1 Quantitative studies vs. qualitative studies

Hult et al.'s model [2] is largely based on quantitative data, but the questions that defines and gives the first-order latent indicators values are asked in a seven-point Likert-type scale. Often it is difficult to know what people mean when they answer according to such scale. This papers qualitative study can explain more of the results.

"*Qualitative methods provide an insight into how people make sense of their experience that cannot be easily provided by other methods*" [2].

The fundamental change in the business environment during the last year is not suited for a quantitative method. People do not know the consequences. Since many talk about a new business system (what that may be), a more explorative approach is chosen.

3.2 Case studies

Case studies can be used to test explanations for why specific events have occurred [23]. It gives the researchers an opportunity to study a phenomenon in real-life context where the boundaries are not evident. Often is knowledge context bounded and therefore can only be studied through a case study method.

"The two main problems social scientists face as empirical researchers are equivocal nature of the theoretical realm and the complexity of the empirical realm. As researchers our primary goal is to link the empirical and the theoretical – to use theory to make sense of evidence and to use evidence to sharpen and refine theory. …. Casing is an essential part of the process of producing theoretically structured descriptions of social life and of using empirical evidence at articulate theories" [24].

Actors in the different cases will always give their reflections over events. Yin [23] argued for participatory observation but not participatory reflection. In the process of data gathering the researchers have spend a lot of time inside each company, and therefore it is difficult separate the reflections discussed on a regular basis with the participants and the reflections only done by the researcher. Perhaps is a separation between the two irrelevant. Because reflections done in close dialog with actors that have 20 years of experience are so valuable, giving insight into different aspects of the studied phenomenon. In a complex world it is important to focus on what can be learned from a case [25]. The reason for two cases was two folded; the practical side was that the project wanted it, and secondly Yin argued that multiple cases can give more solid argument if the perspective/cases conclude the same [26]. All the main respondents and actors have agreed that the facts and interpretations are balanced.

3.3 Data collection

In-depth interviews were used "*to explore the complexity and in-process nature of meanings and interpretations*" [27]. The interviews were focused on specific questions in order to get a deeper understanding of the complexity of the specific question. But other interviews were more of a dialog where the aim was to get a broader picture or to check out specific details.

In order to develop a picture of the product development in the Norwegian automotive suppliers, a survey has been conducted based on the four cornerstones of lean product development by Kennedy [28]. The questionnaire was intended to catch trend lines within the Norwegian automotive supplier industry, and was answered by 120 respondents of 150 asked from in total 19 companies, all working with product development in some way.

All of the internal and external documents in the cases were made available for the researchers. Three large projects were chosen and all the central documents were analyzed for traces of the first-order latent indicators.

3.4 Experiment

The experiment is conducted by investigation the first-order latent indicators in Hult et al.'s model [2], before and after the current financial crisis, to check its validity on a functional level and how it explains degree of market turbulence. For each of the first-order latent indicators Hult et al. outlined a set of features that should be recognized in order to approve the indicator as valid. These set of features were used as guidelines for interviews and concrete questions in the survey described in the previous section. The following section shows results and discussions according to these first-order latent indicators.

4 RESULTS AND DISCUSSIONS

4.1 Market turbulence

The model by Hult et al. [2] has a moderator called "market turbulence", described as the rate of change in customer composition and their preferences. A high degree of market turbulence is assumed to increases the supply chain's knowledge development requirements, but at the same time acts as detrimental to the culture of competiveness. In such, this moderator acts as an explanation factor for market competition discussed by Porter [29]. To explain the first-order latent indicators according to the current global finance crises, it is necessary to extend the moderator by Hult et al. [2]. Figure 2 shows the extended model, describing market turbulence from the two perspectives; stable competition and tsunami (shock initiated by a global fundamental financial crisis). Stable competition is a situation where companies in the value chain compete with a stream of new products, market shares, market segmentation, and performance excellence. The tsunami situation describes a global crisis where fundamental factors impact customers buying power and the financial situation for every actor in the value chain in the industry negatively. This situation is again divided into the two states "out of business" and "survival", where the latter is coupled with opportunities that arise. In a shock state companies tend to be extreme cost saving focused and thereby reluctant to start new product development projects, awaiting for positive market information, financial warranties issued by the government or other incentives. By surviving such a shock an opportunity phase might emerge, described as the ability to see beyond the negative information looking for new markets and segments.

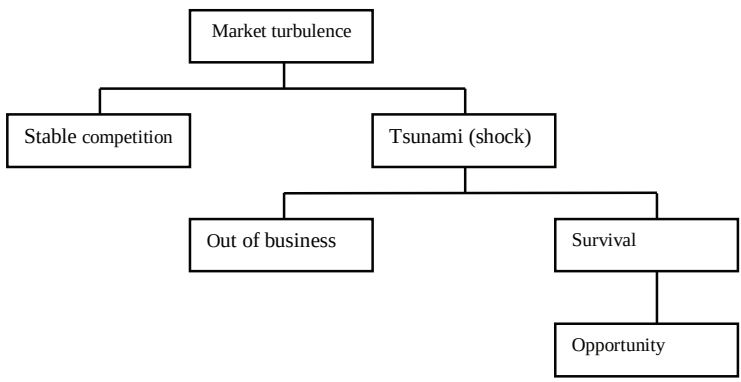

Figure 2. Extended model for market turbulence

At the start of 2009 the case companies are beginning to overcome the first initial shock. The short term cost savings has been initiated and organizational change has been made. New leaders are beginning to speak about opportunities again. But it is too early to place the case companies in the opportunity phase.

4.2 Cycle time

It is a continuous objective to decrease the product development cycle time to increase competiveness. The last three years the case companies has managed to reduce cycle time, measured from official start

of product development process to start of production, by about 20%. The focus on cycle time will be even more emphasized due to the current financial crisis. The customers, OEMs, are facing huge challenges and have to do rapid changes in their product portfolio and the way of doing business. The supplier's ability to meet these new requirements will strongly depend on cycle time efficiency and innovativeness. The assumption behind these two criteria's is that companies are able to look beyond the crisis, overcoming the time where the only focus is how to cut costs. Hult et al. also described involvement from several functional units and actors as a key to improve cycle time performance [2]. Outsourcing of product development activities are found in the cases, but the positive effect of this approach related to cycle time performance is not that evident. Lack of communication and knowledge transfer between actors in the value chain may cause delays when different components are to be assembled. Every actor in the value chain can be innovative and develop outstanding solutions, but without communication and coordination at all levels in the organizations it could lead to sub optimization of the system.

4.3 Firm age and firm size

Empirical data shows that the control variables firm age and -size are not relevant variables due to the effect the current crises have on the industry. As we can observe, they become extremely cost focused.

4.4 First-line latent indicators observed before current crisis

4.4.1Learning orientation

When talking about learning and improvement in a product development environment it has to be distinguished between the product development process and the product which is the result from such a process. After decades with focus on continuous improvement and requirements for improvement in accordance to customer quality standards, there is still a potential to improve [30]. If we look at learning and improvement from the product perspective there is no doubt that the cases show ability to improve. Shortened lifetime cycles for new car models, numerous change orders during development and ever increasing requirements for added functionality, increased strength and reduced weight are all conditions present in the cases. To sustain technological leadership in such a rapidly changing business, one have to be learning oriented. One observation is that learning from incremental product improvement sometimes is confined to the development team. Both case companies dedicate personnel and teams to specific customers as far as possible, and use experienced project managers. This organizational structure ensures continuity and long term relations to specific customers, but may lead to local learning in the teams if only incremental lessons are learned. More fundamental learning situations can be related to step changes. For example, one product development team in case company B was surprised by a new test method from their customer and had to make a considerable concept change late in the project to meet the new specifications. This particular customer was strategically important so the case company offered profit for that product. This was done because a new car model with higher potential profit was scheduled to be developed soon by that OEM. The importance of customer relationship together with the degree of concept change could be said to represent a threshold for how the acquired knowledge was spread to other customer teams in the organization. To overcome this test with the next generation of products, the company developed new and improved simulation models which became a standard for all project teams. This new standard was also a result from research programs initiated together with leading universities and several OEM's. The latter can be seen as an investment for further employee learning across organizations.

4.4.2Innovativeness orientation

If the term technical innovation is used to describe product and process advances that set new standards, which is agreed upon by scientists, it could be found extensively evidence of innovativeness orientation within the studied case companies. Both case companies spend a considerable amount of their income on research and development activities. They are participating in research programs, supported by the national research council, together with acknowledged universities and research partners both nationally and internationally. As described earlier, products from the case companies are categorized as black box concepts - strongly connected to a tailor made philosophy. Such a business philosophy attracts and encourages people who are willing to try new things and test limits. Through research activities expert to expert communication is initiated, and sustained, and technical

innovation is accepted as a way of improving the value chain. Another criterion for innovativeness orientation by Hurley and Hult [9] is how one actively seeks innovative supply management ideas. The customer base for these two companies is mainly western car manufacturers, but both have been in contact with Japanese OEM's as well. Experiences from dealing with both western and Japanese companies are dispersed, but a common feature is that both are demanding. Case company B has been a supplier to Toyota, Nissan and Honda, but states that these customers are very demanding and requires even more follow-up, and willingness to be present at customer sites, than for western companies in order to be rated as a long term supplier. The same is experienced by case company A, which is in process of negotiating with Honda. They say that Honda is demanding in a different way than western OEM's. Honda is preoccupied by learning, in a detailed way, about the material, product, processes and so on. Western companies, instead, like to control the development process by rigid procedures and routines. It is not unusual that a western OEM calls and says that they will show up on short notice to go through all the project documentation. The observations in this study shows clearly that western companies try to control their outsourced activities, whereas the Japanese companies try to learn from their suppliers in order to remain technical competent on their purchased components.
Despite these differences in behavior it is possible to seek innovative ideas in the relationship between the buyer and bidder. For instance, deep business relations with western OEM's have opened up for placing guest engineers from the main suppliers. Guest engineers placed at strategically customers give valuable information about planned car models and a thereby the possibility to impact early concept decisions. On the other side, the Japanese learning focus results in numerous questions which may initiate new and improved solutions that the value chain benefits from.

4.4.3Entrepreneurial orientation

The entrepreneurial orientation by Naman and Slevin [31], like the innovativeness orientation, emphasizes research and development as an important element in addition to technological leadership. Technological leadership could be said to be present in the cases since the chief executive officers have engineering education and technological experience, which is a very common background for leaders in the Norwegian automotive supplier industry. As one interviewee stated it;
"*The industrial cluster as we are a part of is the engineer's Mecca and the economist's nightmare*".
With this statement he kind of related the industry to the entrepreneurial orientation. Another measurement scale for the entrepreneurial orientation is how actions are initiated to which other organizations respond. In this measurement scale both positive and negative actions are allowed, where the latter describes how relations may be strengthening in solving project crises. The ability to show vigor from the supplier side to handle problems and technological challenges is valued and can lead to even stronger ties between experts who work together solving specific problems. Of course, if a crisis remain unsolved and may threaten the critical path of the OEM's main project, the OEM will naturally turn to other suppliers if possible. However, experiences from the two case companies show that OEMs in many cases are willing to stretch their limits to help suppliers within the black box product segment. This willingness can be exemplified by tailoring of test procedures in order to better suit specific products and materials or OEM loan guaranties to secure completion date of a supplier production line. Ties are also strengthening by having residence engineers at OEM's product development sites over time. They have the possibility to be close to the customer's product development process and thereby impact decisions like material choice and product category in order to narrow down the OEM's options.
Other indications of entrepreneurship are proclivity for high-risk projects and exploiting of opportunities. To test the former indication we asked the two first questions in Figure 3, where the results clearly show that people working with product development in the Norwegian automotive supplier industry are both willing to try new technical solutions and to make design decisions which implicitly mean unproven technology. Exploiting for opportunities are to a large degree indicated by the results from the two latter questions in the same figure, where respectively 54% and 62% of the respondents rate extensive concept testing and search for technical concepts by a score equal or higher than four. According to the above results it is clear indications of entrepreneurship, both in the industry and in the case companies.

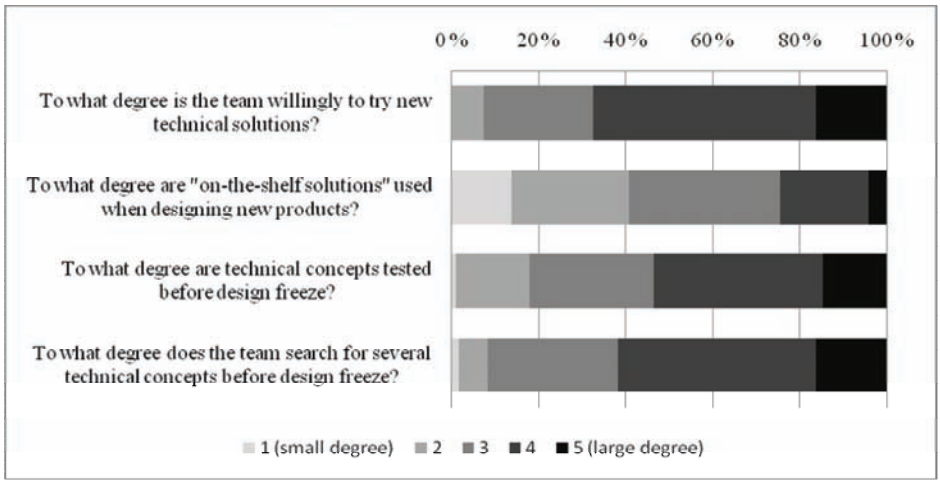

Figure 3. Design and entrepreneurship

4.4.4Knowledge acquisition

The cases in focus combine both in-house research, which is mainly initiated for specific customer projects, and institutional research together with universities and research centers. The ability to combine and see the synergies between these two approaches is highly valued by the actors in the industrial cluster where the case companies. A facilitator for this combination is located within the industrial cluster, emphasizing close bounds to both technical oriented universities and the industry. The main function is to act as a partner with in-depth competence demanded by the industry, and to be a connecting link between industry and academia and between the companies in the cluster. This informal organization of knowledge transfer ensures that the companies receive input on research trend lines and state of the art of product and process technology. Another source for knowledge acquisition for the companies is through their intense communication with their customers. An interesting feature with this interaction is bonding between experts. For example case company B together with leading universities initiated a research program together with a strategically western customer. This could be seen as a Japanese approach, where the OEM and the supplier collaborate extensively to solve problems. Company B emphasizes that an important condition for making strong relations to an OEM is through the technical side and technological solutions, which in turn opens gates to purchasing and market departments. One challenge is to find the right organizational level and the right department at the OEM in order to achieve accessibility. "*Getting accessibility is normally reached only through presentations of technical solutions which can suit specific projects; it is not easy to just invite oneself to an OEM to give a general presentation*". This statement is a good example of the importance to perform long term research activities, both in-house and together with research institutions, in order to achieve new contracts and stay competitive. Another feature of this collaboration and information sharing is the rapidness of detecting shifts in the supply chain, which in turn can impact technology development.

4.4.5Information distribution

In the above chapter the term "intensive communication" was coined. The definition of intensive is shown in Figure 4, where over 71% of the respondents in the survey answered that they communicate with the customer once a week or even more frequent. To go further and examine the value of the communication we asked the question "*How well do you experience that the team communicate with the customer?*", where about 76% rate the communication with the customer as fairly good. Such pattern gives indications for frequent and good communication between experts. The tier 1 and OEM relationship is also characterized by high degree of transparency, where the OEM's require detailed information about the product, production processes, risk, costs and so on during technical reviews. Their degree of information requirements leaves little room for hiding either profit or process parameters.

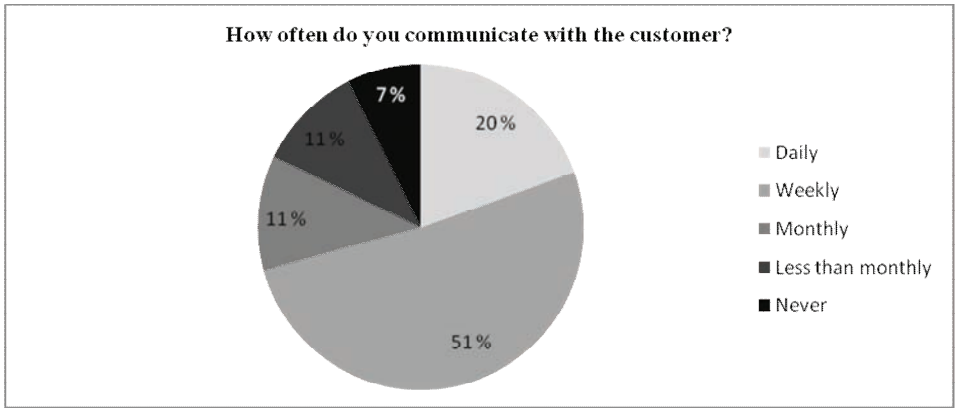

Figure 4. Communication

Alerting the participants in the value chain when something happens is present through extensive testing of suppliers and relationships in the automotive industry. This kind of action is a way of keeping suppliers awake and to check their ability to both improve and adapt to new requirements. In short term such situations create turbulence and many hours of overtime by the supplier, but may lead to increased competiveness by a positive shift in technical capability in the long term. Also frequent technical reviews and crosschecks of project progress according to formalized processes and procedures are typical ways to test suppliers by western OEM's. It is not uncommon that western OEM's arrange events where all their tier 1's are invited and told to reduce their prices by 5% on a generally basis independent of contractual statements and the suppliers economic position. The consequences for many suppliers in such circumstances, to violate a contract, may be to lose a quarter of their yearly sales which they normally cannot afford. These findings is in line with how western OEM's behave in relation with their suppliers on the contractual level, which contradict the Japanese way of focusing on collaboration, common problem solving and long term relations on both the expert level and contractual level [32].

4.4.6Shared meaning and achieved memory

Typical characteristics for the two case companies are their long term relationships with strategically important customers. This continuity is of great importance to understand each other's needs and to reach a point where a shared meaning between the parties is institutionalized. As discussed above transparency due to extensive information sharing is one feature of shared meaning. Another feature in the automotive business is the common language which has been developed through the TQM regime by numerous standards, specifications, routines and procedures. When entering an automotive environment one will quickly be aware of the business language consisting of many acronyms and abbreviations. For instance General Motors has an acronym list which explain over 9 300 acronyms that amounts to over 300 pages if printed. They expect their suppliers to understand this language and what implications it brings along to ignore the meanings and specifications behind the acronyms. The case companies are now establishing production facilities in China, and such expansion requires new and local relations in addition to the existing relations to the global OEM's. Building trust in new markets and cultures is experienced as an extensive process, and requires special trained people in the local culture to be able to understand the underlying mechanisms for building a good relation. For instance, key customer managers in case company B are almost all of the same origin as the customers they interact with, and they are located close to the customer sites in their daily work. The business between western suppliers and OEMs is today characterized by pure business relations, where past performance and knowhow are emphasized. Before, it was not unusual to receive expensive gifts, be invited to dinners and informal events, but with the increased focus on business ethics such activities are almost eliminated. On the other hand, business relations between western suppliers and Asian OEM's are more based on personal relations that require social interaction beyond what is typical in

the western business world. Important elements in achieved memory are knowledge about the supply process together with experience and familiarity with the supply process. Finally, the importance of invested research and development in the supply management process could be said to be the nature of the OEM and supplier relation. Here, potential suppliers have to invest heavily in research and development, and in some cases also tools and prototypes, to achieve a position for contractual discussions and potential serial deliveries of components.

4.5 First-line latent indicators observed during the current crisis

4.5.1Learning orientation

In light of the current crisis, focus on learning at the firm level is reduced – their focus is directed towards daily challenges in order to deliver what is promised to the customer. This means that the time for reflection, courses and participating in research programs is minimized. On the other side, learning orientation is highlighted as one of the possibilities in a governmental anti-crisis package, where further education for dismissed personnel could be financed. In addition, increased funding for existing and new research projects is also evaluated as an alternative to maintain momentum.

4.5.2Innovativeness orientation

The nature of the current crisis and its impact on innovativeness may be twofold. First, the OEMs may have to change their product portfolio in order to survive the crisis, which in turn gives new opportunities for suppliers. Seeking innovative ideas in the value chain then becomes highly important, where close interaction between buyer and bidder is essential for improved cycle time performance. Second, governments could put money into activities that catalyses innovation and industrialization of new products. This strategy could save existing firms and industries and also create new ones. What is obvious is that the crisis stops all internal funded development projects in the cases. This is a serious situation, knowing the importance of technical sales, where presenting a feasible solution is an important criterion for access to an OEM.

4.5.3Entrepreneurial orientation

The willingness to try new technical solutions is evident in a survey intended to measure project performance in the four companies participating in the user-driven innovation project mentioned in the introduction. Here, about half the projects investigated include “new to the world” processes or products. This entrepreneurial attitude in the cases may be valuable during the current crisis in order to move faster to the “opportunity phase” then their competitors. Helping OEMs with entrepreneurial solutions on existing projects, which saves money during this turbulence, may strengthen the relations and the position to win new orders in the future.

4.5.4Knowledge acquisition

After the current financial crisis emerged involvement in long term research programs and internal funded development is minimized. Still, communication between the companies in the industrial cluster and the research center is maintained. The research center has many ongoing programs for initiating innovative products and processes, and by its close contact to the national research council and other government funded organizations that promotes and helps innovation and industrial development, it is in a position to impact and direct anti-crisis packages to the best for the industry. Suggested content in such packages is, of course, issuing of loans to help firm’s liquidity and need for financing ongoing customer projects, but also in some way conserve core competence and acquiring new knowledge for dismissed employees. This is important in order to create new and innovative products, but also in being able to rapidly recover from the crisis when customers prefer to buy new cars again.

4.5.5Information distribution

The information distribution between buyer and bidder does not seem to be affected significant during the current crisis. The frequency of communication is maintained in the projects observed, but the nature of communicating may have changed. For example, an OEM insisted on a telephone meeting as an alternative for “on site evaluation”. In such, the OEM was willing to alter their procedure in the formal quality system for saving some travel expenses. The threshold for making short-cuts is therefore lower when market turbulence is high. Hence, alerting the suppliers by surprising technical

reviews and crosschecks of project progress is also a present approach during the crisis by another OEM.

4.5.6Shared meaning and achieved memory

Knowhow about customer processes and product development information is as well as important in light of the current crises. If the customers turn their product portfolios it is essential to grasp this new information as early as possible to be able to offer feasible solutions. General, the indicators shared meaning and achieved memory are not heavily affected by the crisis yet. Shared meaning and achieved memory are indicators that perhaps will be affected later in the crises, in the opportunity phase. The chief officers in the case companies expect a new way of doing business.

5 CONCLUSION

From the results and discussions evidences of Hult et al.'s [2] first-order latent indicators are present in the product development process in the case companies. By extending the market turbulence moderator to include an existential crisis, observed first-order latent indicators before and during the current crisis are analyzed. Table 1 summarizes these findings.

Table 1. First-order latent indicators before and after the crisis

	Before crises	During current crisis
Learning orientation	-Local team learning for incremental improvements -Organizational learning for major improvements, often as a result of a project crisis -Industry initiated research projects	-At the firm level, learning activities are reduced to a minimum -The government emphasizes learning through anti-crisis packages and increased focus on research projects
Innovativeness Orientation	-Considerable amount of income spent on research and development activities -The black box categorization of products attracts and encourages people to try out new and unproven technology	-Internal funded development projects are stopped -Changed product portfolios by OEMs may lead to new opportunities -Governments can put money into activities that catalyses innovation and industrialization of new and sustainable products
Entrepreneurial Orientation	-Research and development focus -Ability to show vigor to handle problems and crises is valued between the experts from different companies -Proclivity for high-risk projects and exploiting of opportunities	-The entrepreneurial attitude may be valuable in order to move faster to the "opportunity phase" -Saving money on existing projects, for both parties, is more emphasized than ever, and entrepreneurial solutions could strengthen the relationships
Knowledge Acquisition	-Combination of firms in-house research and institutional research -Research trend lines are easily communicated to the industry while industrial requirements in real time are given as feedback to researchers -Bonding between experts in the value chain -Accessibility to OEMs is normally reached only through presentations of technical solutions	-Involvement in long term research programs is minimized -Communication between the companies in the industrial cluster and the local research center is maintained -The research center is in a position to impact and direct anti-crisis packages for the industry -Anti-crisis package may finance conservation of core competence and acquiring new knowledge for dismissed employees
Information Distribution	-Frequent and good communication with customers -High degree of transparency in the	-The information distribution between buyer and bidder did not seem to be significantly affected

	value chain -Frequent technical reviews and crosschecks of project progress	
Shared meaning and Achieved memory	-Common language developed through TQM -Knowhow about business culture -Customer processes are replicated in own quality systems	-Knowhow about customer processes and product development information is as well as important in light of the current crises -These indicators can be affected in a later stage of the crisis

If market turbulence is considered low extensive learning is found according to the first-order latent indicators, indicating increased knowledge development and competiveness with improved cycle time performance as a result. When looking at the same indicators during high degree of market turbulence, learning activities between actors are reduced but degree of communications is sort of maintained. Open information channels are important in the sense of monitoring arising possibilities. A practical implication for the product development process, during high degree of market turbulence, is therefore to, as long as possible, have available resources to support entrepreneurial activities in order to benefit from both customer and government initiatives. The observed state of short terminism, if remained over time, will probably affect cycle time performance negatively.

This work is part of a comprehensive study initiated to investigate learning at the levels of groups, intra-organizations, and inter-organizations related to new product development. Conclusions so far indicate that existing models on knowledge development in inter-organizational contexts explain factors related to culture of competiveness and level of learning. Hence, impact on the product development process caused by macro-factors is less understood. The next step is therefore to develop a more suitable model for the functional unit, which incorporates a more detailed perspective on the product development process. The intensity of communication in the value chain and the changed information the researcher have documented also change the relations between the experts. How the knowledge is generated and maintained is also a missing part in the theory.

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Contact: Geir Ringen
Institution/University: Norwegian University of Science and Technology
Department: Department of Production and Quality Engineering
Street: S.P. Andersens vei. 5, Valgrinda NTNU
Postal Code, City: 7491, Trondheim
Country: Norway
Phone: (+47) 416 79 834
E-mail Address: geir.ringen@sintef.no

Geir Ringen is a PhD student at the Norwegian University of Science and Technology, currently visiting researcher at the University of Michigan, Ann Arbor. Field of interest is improvement of the product development process, viewed from a learning perspective.

Halvor Holtskog is also a PhD student at the Norwegian University of Science and Technology.