TOWARDS ROBUST INTER-ORGANIZATIONAL SYNERGY: PERCEIVED QUALITY KNOWLEDGE TRANSFER IN THE AUTOMOTIVE INDUSTRY

Stenholm, Daniel; Stylidis, Konstantinos; Bergsjö, Dag; Söderberg, Rikard
Chalmers University of Technology, Sweden

Abstract

With the highly competitive market environment, organizations which want to promote innovation are imposed to create strategic alliances. In this situation involved parties have to exchange knowledge at all stages of product development to support the product development process. At the same moment manufacturers have a constant pressure of balancing costs, quality and production cycles shortening. In this paper, authors identified challenges for knowledge exchange in collaboration between competitive organizations. With the example of five European automotive OEMs exchanging knowledge regarding perceived quality. This paper presents a framework for successful knowledge exchange between organizations. It proposes the methodology for the knowledge taxonomy and establishment of the synergistic knowledge network.

Keywords: Knowledge management, Integrated product development, Automotive, Perceived quality, Collaborative design

Contact:
Daniel Stenholm
Chalmers University of Technology
Product and Production Development
Sweden
daniel.stenholm@chalmers.se

Please cite this paper as:
Surnames, Initials: *Title of paper*. In: Proceedings of the 21st International Conference on Engineering Design (ICED17), Vol. 6: Design Information and Knowledge, Vancouver, Canada, 21.-25.08.2017.

1 INTRODUCTION

Customer and market needs enforce fierce competition in high-technology organizations and encourage many organizations to form horizontal strategic alliances (HSAs) for offensive and defensive reasons. The involved parties exchange knowledge at chosen stages of the product development (PD) to support cooperation-based learning: this process is driven by the need for increased output of products to the market, higher quality at a reduced cost, shorter production cycle time, or as a strategic decision to join forces to create a collaborative product. However, knowledge transfer comes with several challenges that are well known by the typical automotive Original Equipment Manufacturer (OEM). To a greater extent than in vertical alliances (e.g. collaboration with constituents of supply chain), cooperative organizations in HSAs are direct or indirect competitors. Thus, the coordination difficulties and risks inherent in alliances are magnified in HSAs, posing a greater challenge for involved partners (Perry *et al.,* 2004).

A significant amount of research has been performed in the field of knowledge transfer, however when it comes to coopetition (cooperation combined with competition) the demand and focus on classified knowledge is even higher, which has not been explored to the same degree. Finding the right balance between transparency and knowledge protection is of interest (Manhart and Thalmann, 2015). Relatively little research has addressed how organizations achieve the desired level of knowledge ambiguity that enables them to prevent unwanted leakage and promote purposeful transfer processes (Van Wijk *et al.,* 2008). Manhart et al. (2015) concluded in their literature survey that a majority of the papers primarily focus on formal and explicit knowledge, whereas unclassified documented knowledge or event tacit knowledge was very underrepresented. They stress the paradox of knowledge visibility. On one hand, organizations should increase the visibility of knowledge to facilitate knowledge flow. On the other hand, greater transparency also enhances the risk of unwanted spillovers, which challenge knowledge protection. In the case of competitive automotive OEMs, this question regarding finding the right balance is crucial. Another challenge is a deficiency of common language, ontology and taxonomy of the knowledge elements that are intended to be shared. After all, such a scarcity of the exchanged information can lead to the limited usage of the strategic alliance potential and as a consequence can impact the quality of the final product.

The existing research gap and organizational need lead us to the following question:

RQ: How can we overcome challenges of knowledge exchange between organizations in a HSA?

To answer the RQ, relevant literature was studied and presented in the next section giving an overview of the theoretical background of knowledge transfer in HSAs and perceived quality (PQ). The theoretical framework is followed by an explanatory case including description of research method. The process is illustrated with the development of a framework for PQ, where we propose a knowledge informational array sequential break down into reproducible technical knowledge characteristics with the subsequent integration into the product development process (PDP). The evidence of the need for such a framework was found from semi-structured and unstructured interviews of design engineers at leading European Automotive OEMs in the premium and luxury segment of the industry. The results together with a proposed method are discussed, and the paper concludes with some key insights such as building a learning alliance with competitors can overcome challenges in the process of evolving on each other's knowledge.

2 ORGANIZATIONAL KNOWLEDGE TRANSFER IN HORIZONTAL STRATEGIC ALLIANCES

The increasing importance of organizational learning for creating competitive advantage has triggered the study of challenges in organizational knowledge transfer at the inter-organizational level. To speed up learning, organizations tend to join into different strategic alliances. The literature has produced an impressive list of reasons for why organizations enter into an alliance including categorizations, such as "learning alliances," where the objective is to symbiotically exchange products, skills, and knowledge (Lei and Slocum, 1992). The term "learning alliances" is similar to the term used by Cricelli and Grimaldi (2010), "learning networks," characterized by a low level of control, a multi-directional knowledge flow to fulfill the main purpose of exchanging, and learning of experiences and tacit knowledge. Regarding the strategic choice of the organization, this is consistent with a choice between exploiting existing resources and capabilities or exploring new opportunities (March 1991; Koza and Lewin, 1998). Exploitation is concerned with the productivity increment and efficiency of employed capital and assets through standardization, systematic cost reductions, and improvement of existing technologies, skills, and capabilities (Koza and Lewin, 1998). Exploration, on the other hand, is associated with discovering new opportunities for wealth creation and above average returns through innovation, invention, building new capabilities, and investment in the organization's absorptive capacity defined as an organization's ability to assimilate new knowledge from external sources (Cohen and Levinthal, 1990). Although conceptually a clear distinction exists between these two extremes, in practice, these two possibilities form endpoints of a continuum of choices, as organizations are likely to seek both exploiting and exploring benefits from their involvement in cooperative alliances. Nielsen (2002) argue that the higher the degree of complementarity in knowledge bases the more likely is the outcome to be exploitation rather than exploration. He developed a framework where different perceptions of complementarity (symmetry vs. asymmetry) in knowledge bases and the networking of these play a significant role and he argued that the difference in intentions behind the alliance formations likely impacted the performance of the network.

HSAs are formed between organizations at the same level in the value chain and constitute a formal collaboration to benefit mutual business interests such as PD. They are defined as cooperation involving two or more organizations within the same industry with the aim to create economies of scope and synergies across multiple businesses (Nielsen, 2002). Increased needs for products with rising customer value fuel many organizations' desire to enter HSAs. However, the coordination problems and risks inherent in this type of alliance are magnified compared to networks between non competitors (Bengtsson and Kock, 2000), so one cannot assume that high levels of commitment or performance will occur naturally.

There exist many approaches to transfer knowledge, however they may for convenience be explained by two categories; social, the interaction between humans, and codified, the transferring of an artefact holding the knowledge. Several studies investigate when a social rather than a codified approach to knowledge transfer is appropriate. Codified knowledge is typically less flexible than knowledge exchanged through personal interactions in which the individuals involved have the opportunity to renegotiate meanings (Wenger, 1998) and to jointly modify the knowledge, e.g. (Carlile, 2004). Therefore, in the case of more secured assets, which are often the case between competitors, organizations find the codified transfer of knowledge less useful.

Cohen and Zotto (2007) investigate inter-organizational knowledge transfer, absorptive capacity, and knowledge management. Referring to their case studies as "learning alliances," they derived eight propositions. (1) Similar knowledge bases and information management systems stimulate inter-organizational learning. That is, the higher the level of companies' absorptive capacity, the more effective the knowledge transfer. (2) Similar knowledge structure between partners increases absorptive capacity. (3) Motivation to foster learning and knowledge transfer within the alliance increases absorptive capacity. (4) Lower cultural distance between the partners increases absorptive capacity. (5) With higher absorptive capacity, more balanced and selective information is requested and offered. This reduces information overload and increases efficiency of the knowledge transfer. (6) Higher satisfaction in a previous alliance increases motivation to further knowledge transfer with new organizations, increasing technology acquisition. (7) Perception of future rewards increases motivation to further knowledge transfer within an alliance. (8) High absorptive capacity in partners increases motivation to further knowledge transfer within an established alliance.

2.1 Moving beyond knowledge compatibility and complementarity

Nielsen (2002) highlights the importance of moving beyond compatibility (skills and resources that match another organization) and complementary knowledge (skills and resources the other partner needs but does not have). He embraces synergies of knowledge between the organizations to foster learning, however, most traditional literature is preoccupied with knowledge compatibility and complementary knowledge. Further on, he breaks with the traditional assumption of complementarity of knowledge bases being a necessity for successful collaboration and proposes a different and more dynamic approach to alliance formation in the pursuit of the dream of collaborative synergy. He proposes two different types of alliances that, depending on the initial motivation and conditions, lead to different outcomes regarding learning and knowledge creation (synergy) for the partners. Complementary Knowledge Networks are motivated by the intent to disseminate pre-determined, project-specific knowledge across well-defined boundaries. This type of alliance involves only certain excerpts of each organization's knowledge driven by complementarity in capabilities, which is likely to lead to the transfer of existing explicit knowledge rather than a creation of new tacit knowledge or synergies of knowledge. Synergistic Knowledge Networks, on the other hand, are motivated by a perception of developing synergies of knowledge through the interaction of most or all of the organizations' knowledge bases. These types of alliances more likely lead to double-loop learning and spin-off innovations or process improvements, especially as more levels of the organizations get involved and project boundaries are relaxed. Argyris' (1976) concept of double-loop learning, involves when changes in the action and governing variables facilitate both knowledge transfer and knowledge creation. Double-loop learning recognizes the inherent gap between stored knowledge and knowledge required to act effectively. Nielsen (2002) argues that Synergistic Knowledge Networks more likely lead to creation of new knowledge related capabilities and eventually, through synergies of knowledge, better performance than Complementary Knowledge Networks. Through challenging the norms and the system themselves and deeper integration of knowledge bases, Synergistic Knowledge Networks increase the stakes and the potential for opportunistic behavior.

2.2 Challenges for knowledge transfer in HSA

Knowledge management literature presents a host of challenges related to transfer of knowledge that applies to the case of knowledge reuse between different teams as well as organizations. New knowledge in the world brings uncertainty, and new knowledge in an organization can display the same characteristics regardless of the existence of prior knowledge in the scientific community (Green *et al.*, 1995). If a team reuses knowledge developed by another team, a more **complete view of the knowledge** needs to be provided, such as design rationale, to ensure a successful outcome. The new team could be within the same department (perhaps including people from previous implementations), a different business unit at the same site, a site in a very different geographical location, or even a different organization.

The preconditions for a recipient of knowledge transfer to learn a new capability are primarily based on two factors: the **characteristics of the knowledge** and the **recipient's learning capacity**. "**Causal ambiguity**" is a characteristic of knowledge that is commonly cited as one of the significant causes of unsuccessful knowledge transfer (Szulanski, 1996; Cummings and Teng, 2003; Van Wijk *et al.*, 2008). Causal ambiguity occurs when it is difficult to identify, express and transfer the knowledge elements necessary for application (Szulanski, 1996; Simonin, 1999). Some define it more narrowly as the possibility to distinguish the knowledge elements (Szulanski, 1996). Others define it as a wider concept of transferability including tacitness, complexity, prior experience of the recipient, cultural gap, etc. (Simonin, 1999). According to Simonin (2004), the ambiguity of knowledge is directly and negatively related to knowledge transfer, and ambiguity is associated more with tacit knowledge than with explicit knowledge. Other characteristics of a dissemination partner's capacity that have been shown to affect the speed of knowledge transfer are **"teachability"** and **"codifiability"** (Zander and Kogut, 1995).

The recipients **absorptive capacity** is an important factor for successful knowledge transfer. This includes the organization's related prior knowledge, usually through proprietary R&D, as well as their **internal and external communication patterns and incentives for learning**. One traditional view is that the acquiring organization needs to possess a closely related domain knowledge base since only **knowledge similarity** allows for an understanding and application of knowledge to the organization's unique circumstances (Cohen and Levinthal, 1990). With **relevant prior knowledge** in a domain, new knowledge can be more readily integrated through shared language, especially from codified knowledge (Simonin 1999). If the prior knowledge gap between the two transferring parties is large, there will be more learning steps for the recipient (Cummings & Teng, 2003).

Nielsen (2002) argues that creating synergies of knowledge does not dictate that knowledge bases need to be similar or matching; if synergy is a goal, complementarity of knowledge bases is a poor criterion for selecting an alliance partner. Szulanski (1996) found that the **intimacy and ease of communication** between the source and recipient have a strong influence the successful transfer of best practices across organizational units. Regardless of the structure of the inter-organizational relationship, research has suggested that **informal, social ties** between members of the same organization (Hansen and Løvås, 2004) or different organizations (Bell and Zaheer, 2007) are superior conduits for knowledge flow between geographically distant locations. Such ties probably also help to address national or organizational **cultural differences, which** require more time for communication and synchronization of design routines and managerial approaches (Simonin 1999). Interestingly, Wijk et al. (2008) illustrate that cultural gaps hamper intra-organization more than inter-organization knowledge transfer, since in the latter case, units within organizations are likely to transfer knowledge in **familiar communication channels. Prior experience of collaboration** between the transferring parties also lowers the cultural gap and builds trust and familiarity with each other's expertise facilitating knowledge transfer (Simonin, 1999). Stock and Tatikonda's (2000) study did not support the direct benefit of prior experience, but acknowledged the possibility of an indirect effect.

Another significant challenge is the perceived loss of knowledge and competitive advantage. The source unit may not be fully willing to share its knowledge and its position as a prominent expert in the area (Simonin, 1999). The disseminator unit often perceives a risk of **unintended transfer** of knowledge that leads to the erosion of its competitive advantage (Norman, 2002). On the other hand, the recipients might worry that the disseminated knowledge will not be useful or of high quality. Thus **source credibility** is considered a relevant factor (Ko *et al.*, 2005), and is associated with inter-organizational trust. **Trust** creates a sense of security that transferred knowledge will not be exploited beyond what is initially intended (Dhanaraj *et al.*, 2004). As a result, knowledge transfer across organizational units requires deep **commitment** from the source even though commitment may not always be part of their main mission (Molas-Gallart, 1997). Without seeing a direct benefit, sources of knowledge can lack of **interest in allocating resources** to the transfer (Markus, 2001). Stock and Tatikonda (2000) showed that the **criticality of a knowledge transfer** project influences its chances of success. Without proper **motivation**, the recipient may directly or indirectly sabotage the transfer through passive behaviour or rejection of outside knowledge as in the **"not-invented-here syndrome"** (Szulanski, 1996).

3 PERCEIVED QUALITY

To describe the context of the paper regarding the perceived quality (PQ) of knowledge exchange in HSAs, we provide a brief overview below regarding historical and current development of PQ.

3.1 Historical evolution of product and perceived quality.

The construct of quality has a multidimensional structure. Traditionally, PQ have been seen as one of the dimensions of the product quality. One of the first descriptions of PQ was given by Shapiro (1970) describing purchase behaviour. At the macro level, the term "product quality" is a key driver of competitiveness (Steenkamp, 1990). At the micro level, product quality is a key driver for manufacturers and consumers. Josef Juran offered the popular definition of product quality as "fitness for use," where "fitness" is defined by the customer. Olson (1972) defined quality perception as a two-stage process. The first stage includes consumer judgment based on available cues and forms, and the second stage includes impressions based on interpretation of those cues and forms. There are both intrinsic and extrinsic cues. Intrinsic cues are a part of the physical product and cannot be changed without changing the product's characteristics e.g. orientation of texture for carbon fiber panels and leather texture. Conversely, extrinsic cues are those attributes that are not a part of the physical product e.g. brand and core values. According to Olson, intrinsic cues are more accurate indicators of quality than extrinsic. Crosby (1980) offers another definition of quality as "conformance to requirements," though requirements may not always fulfil customers' expectations.

One of the most remarkable definitions was performed by the Taguchi (1986) as "the losses of society caused by the product after its delivery" and "uniformity around the target value." PD, according to Taguchi, consists of Product Quality (what consumers desire) and Engineering Quality (what consumers do not want). Furthermore, Kano (1984) presented a model with two dimensions of quality: "must-be quality" and "attractive quality." Kano's model defined customer satisfaction as the result of the company's performance and is widely used across various engineering practices today, particularly in the automotive industry.

Garvin (1984) introduced an inclusive model of quality with the five approaches: transcendent, product-based, user-based, manufacturing-based and value-based. Additionally, Garvin noticed that "marketing people" and "manufacturing people" hold different views on quality. Marketing sees customers as subjective referees of quality, and hence prefer a product-based approach. Manufacturing sees quality as objective "conformance to requirements." To mitigate the clear conflict between these views, Garvin proposed to shift a company's quality approach as a product moves from the early design stage to the production stage. Finally, he defined eight dimensions of quality: performance, features, reliability, conformance, durability, serviceability, aesthetics and PQ. According to Garvin, PQ derives from incomplete information about product attributes and cannot be adequately assessed. However Monroe and Krishnan (1985) define PQ as "perceived ability of a product to provide satisfaction relative to the available alternatives."

There are several "marketing-oriented" definitions of PQ that focus mainly on the consumer. Zeithaml (1988) defined PQ as a subjective customer's judgement regarding overall product superiority. Mitra and Golder (2006) build on this definition to interpret PQ as "perception of the customer" and in opposition to "objective" quality. Aaker (2009) expresses a similar definition, "the customer's perception of the overall quality or superiority of a product or service with respect to its intended purpose, relative to alternatives." Castleberry and McIntyre (2011) integrate several previous definitions and define PQ as "..a belief about the degree of excellence of a goods or service that is derived by examining consciously and/or unconsciously, relevant cues that are appropriate and available, and made within the context of prior experience, relative alternatives, evaluative criteria and/or expectations."

From these definitions, it is clear that the majority of quality models and views on PQ are either driven by the market research or manufacturing side of PD. They lack ideas about elicitation and/or objective assessment methodology regarding product attributes that comprise PQ.

3.2 Perceived quality challenges for the automotive industry

In the luxury segment of the automotive industry, a majority of players subscribe to the idea of "zero-defects" quality. It is perfectly understood by automotive manufacturers that quality perception is at the forefront of customer's attention and highly influences purchasing behaviour. However, identification and mapping attributes that represent PQ is an on-going challenge for researchers and practitioners (Ren *et al.*, 2013; Burnap *et al.*, 2015). This process is arduous due to subjective nature of evaluations and absence of robust methodologies for translating the voice of the customer into technical specifications. Additionally, customers often have difficulties expressing their opinions about a product with a high level of complexity such as a premium vehicle. Given these points, designers and engineers need to strike a balance representing PQ attributes while ensuring that customers to perceive a high-quality product.

Such a fuzzy background often creates a phenomenon of information asymmetry, or a way to understand the behaviour of two parties when they have access to a different amount of information (Connelly *et al.*, 2011). With the application of the PDP, information asymmetry can cause misprioritization of perceptual design attributes between designer and customer. Previous studies (e.g. Stylidis *et al.*, 2016a) showed that information asymmetry is detrimental a product's success on the market and reduction of such asymmetry should increase PQ of the vehicle. In the case of HSAs, information asymmetry can appear due to differing terminology, knowledge, organizational structure, or internal organizational culture used by various OEMs.

4 EXPLANATORY CASE ON COMPLEMENTARY CAPABILITIES ON PERCEIVED QUALITY IN HSA

In a case study, we explore evidence of knowledge transfer challenges followed by a suggested and explanatory approach for overcoming them. We seek to generate successful knowledge transfer of PQ knowledge between organizations involved entirely or partially in a HSA. This section presents preliminary results of the PQ dimensions and attributes found through qualitative analysis.

4.1 Methodology

We implemented a research design in the form of an exploratory pilot case study. We built our statements on findings from data sets on communication strategies of Italian luxury automotive brands (Stylidis *et al.*, 2016b). We applied Grounded Theory methodology in the analysis of received data (Corbin and Strauss, 1990). One of the primary reasons behind the choice of methodology was the fact that automotive OEMs are unlikely to share data with the public and so chances to conduct prior data analysis are very low. The study includes data from two Italian luxury market automotive OEMs, five European and two North-American premium and luxury segment OEMs.

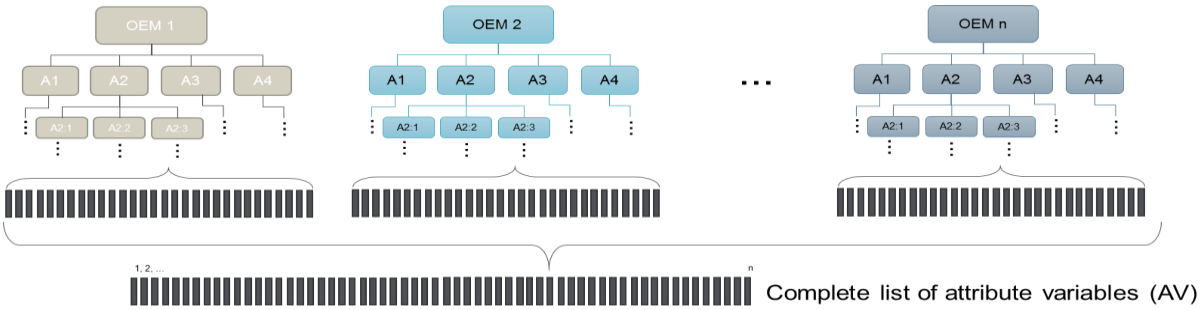

Figure 1 A complete list of "ground" perceived quality attributes was obtained

4.2 Data collection method

The European and North-American OEMs studied develop vehicles across several product types and are all global market players. The primary source of information regarding PQ attributes, decomposition, methods and structure was semi-structured face-to-face interviews with senior designers, managers, and engineers. There are many forms of the interview design, and typically an interview study can be classified as an unstructured interview in the form of informal conversation, a structured interview with scripted prompts, and a semi-structured interview with open-ended and follow-up questions (Yin, 2013). In addition, various types of document attributes, structure descriptions, and working instructions were studied.

4.3 Understanding complementarities in knowledge bases by mapping PQ attributes

The semi-structured interview study involved eighteen high-ranking professionals within the levels of director and vice president. All interviewees had long track records in the global automotive market working within the area of PQ. Such a choice of respondents was grounded by the opportunity to obtain holistic view regarding company's methods and approaches addressing PQ issues. To explore complications regarding communication with customers and other units of the organization, questionnaires were created to reveal (1) the interviewee's opinion on PQ, (2) determination of PQ attributes, (3) subjective importance rating among different PQ attributes and areas, and (4) knowledge sources.

To build the common terminology of PQ the questions in the beginning of the interview were quite open and general. For example: "What is PQ from the designers' point of view?" and "What are the prerequisites for a good PQ?" The following questions narrowed the interest to mapping PQ attributes and addressing customer's requirements definition. For example: "What PQ attributes determine visual quality?" or "What attributes, in your opinion, are important for the vehicle exterior and why?" During the interviews, the authors sometimes had to ask additional questions to explore topics widely and determine PQ attributes clearly. For example: "So how did you get feedback from the customers?".

The average length of each interview was about 60 minutes. Interviews were carried out in English, voice recorded and later transcribed into the text format. Text coding and further analysis were performed with the help of NVivo qualitative data analysis software. We were able to obtain a list of PQ attributes, which is holistically visualized in Figure 1.

5 RESULTS

During the study, we identified a need to speed up the process of understanding complementarities in knowledge bases to foster common learning and gain increased value out of the HSA. Such a demand is also supported in literature e.g. (Nielsen, 2002). We developed a framework based on findings from Nielsen (2002) and Cricelli & Grimaldi (2010) for learning processes in different knowledge networks (Figure 2). Hence, we argue that approaching cooperation from a dynamic, synergistic perspective, shifts the unit of analysis from the organization and its knowledge assets to the cooperation of organizations, focusing on intra-organization capabilities combined with inter-organization dependencies through cooperation.

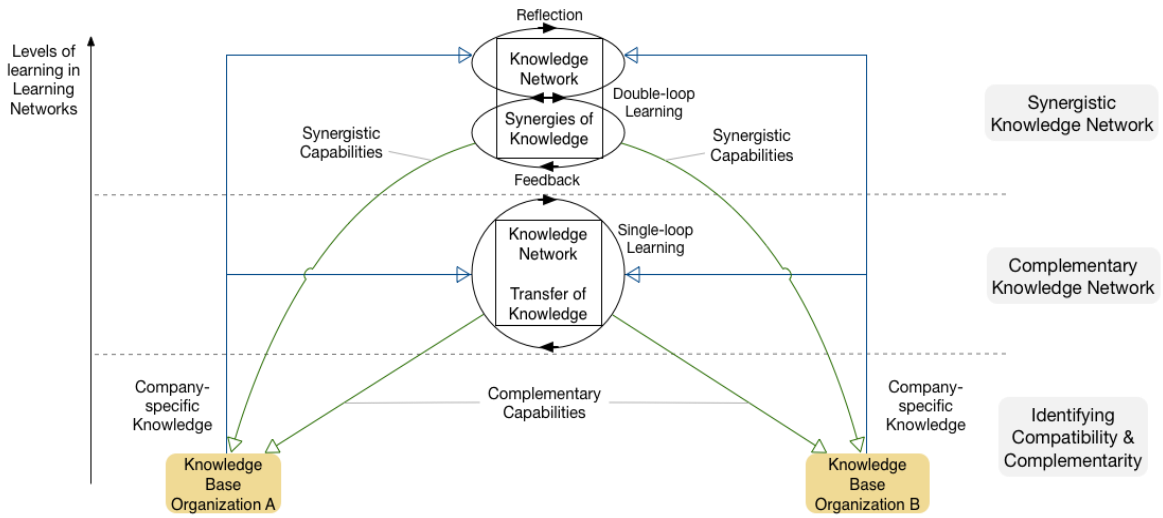

Figure 2 Framework of level of learning in learning networks adapted from Nielsen (2002) and Cricelli & Grimaldi (2010).

By expanding the focus further than inter-organization pooling and transfer of complementary knowledge to development and distribution of synergies of knowledge, we form a more dynamic and flexible understanding of the relationship between motivation and outcome in complex HSAs. This simultaneous focus on internal organization-specific competencies and external cooperation synergies enhances competitive performance by creating new knowledge related capabilities. Though, perspective knowledge is viewed as a complex, dynamic and subjective set of assets, which is inherently indeterminate and continually reconfiguring. Hence, new knowledge can be created among the participants in a strategic aggregate arrangement as a synergy (and not simply the sum) of the knowledge-related capabilities brought into the collaboration by each member. We argue though that to reach the higher level in learning network the lower needs to first be in place and understood.

For the case of PQ it seems that a high motivation exists in collaboration between OEMs involved in the study. This motivation could be explained by the need for increased efficiency at the early design stages to meet customer requirements. Automotive manufacturers are aware of the PQ importance, though few are working with this area in a systematic way. Specifically, in the illustrated case, the organizations run into different challenges regarding the first stage, which is to identify compatibility and complementarity in their knowledge bases. In order to increase the knowledge transfer, and thus learning between organizations in HSAs, Cohen et. al (2007) presents eight arguments that should be embraced where the case focused mainly on number two (“Similar knowledge structure between partners increases absorptive capacity.”) by performing extensive effort regarding identifying and mapping knowledge base similarities.

For the majority of the interviewed OEMs, “engineering perspective” on PQ is a new area of expertise. However, the intention to objectify evaluation process for PQ attributes force OEMs to create PQ expertise areas, platforms or dedicated departments. Therefore, the PQ vocabulary varies from one OEM to another significantly. There is no common or unified terminology, which creates a potential threat to knowledge transfer where terminology is often restricted or classified. The illustrative case, therefore, showed that a supervised group of experts could align their terminology and product attributes’ taxonomy to support mutual understanding. We also identified from the numerous discussions with the industry professionals that the need for common vocabulary and proper taxonomy is evident. From identifying and mapping PQ attributes from discussions with professionals at OEMs, our framework will increase the speed, amount and accuracy of the knowledge shared between the OEMs and bring further knowledge to all involved parties. Much more can potentially be revealed upon further analysis.

6 CONCLUSIONS

Organizations are becoming more aware of the necessity for collaboration to withstand the rapid evolution of customer needs and market changes to still be competitive. However, finding the balance between knowledge transfer and knowledge hoarding is an obstacle not only at the organizational level but also at individual level.

Organizations involved in inter-firm knowledge transfer need to develop capabilities and routines to share across their boundaries. We therefore propose a synergistic methodology to overcome challenges for organizations hoarding their knowledge to stay competitive. It is not only about finding the compatibility and complementarity in the knowledge bases but rather to create a learning alliance that prosper from the complementarity and further develop the common knowledge base. Such an alliance can evolve to strengthen the competition of all the involved organizations.
A similar approach can be applied not only in the case of HSA but also in the relation of OEMs' vertical alliances e.g. supply chain; where the role and importance of the intellectual property (IP) is continuously increasing. For the future research we believe that use of new technologies such as blockchain (Swan, 2015) can improve quality and scale of the collaboration between OEMs.

REFERENCES

Aaker, D.A. (2009) *Managing brand equity*, Simon and Schuster.

Argyris, C. (1976) "Single-loop and double-loop models in research on decision making", *Administrative science quarterly*, 363-375,

Bell, G.G. and Zaheer, A. (2007) "Geography, networks, and knowledge flow", *Organization Science*, 18(6), 955-972,

Bengtsson, M. and Kock, S. (2000) "" Coopetition" in business Networks—to cooperate and compete simultaneously", *Industrial Marketing Management*, 29(5), 411-426,

Burnap, A., Hartley, J., Pan, Y., Gonzalez, R. and Papalambros, P.Y. (2015) "Balancing design freedom and brand recognition in the evolution of automotive brand styling", *ASME 2015 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference*, American Society of Mechanical Engineers, V007T06A047-V007T06A047,

Carlile, P.R. (2004) "Transferring, translating, and transforming: An integrative framework for managing knowledge across boundaries", *Organization Science*, 15(5), 555-568,

Castleberry, S.B. and McIntyre, F.S. (2011) "Consumers quality evaluation process", *Journal of Applied Business Research (JABR)*, 8(3), 74-82,

Cohen, S.S. and Dal Zotto, C. (2007) "Inter-organizational knowledge transfer as a source of innovation: the role of absorptive capacity and information management systems", In: *Managing in the information economy* Springer, 231-258.

Cohen, W.M. and Levinthal, D.A. (1990) "Absorptive capacity: A new perspective on learning and innovation", *Administrative science quarterly*, 128-152,

Connelly, B.L., Certo, S.T., Ireland, R.D. and Reutzel, C.R. (2011) "Signaling theory: A review and assessment", *Journal of Management*, 37(1), 39-67,

Corbin, J.M. and Strauss, A. (1990) "Grounded theory research: Procedures, canons, and evaluative criteria", *Qualitative sociology*, 13(1), 3-21,

Cricelli, L. and Grimaldi, M. (2010) "Knowledge-based inter-organizational collaborations", *Journal of Knowledge Management*, 14(3), 348-358,

Crosby, P.B. (1980) *Quality is free: The art of making quality certain*, Signet.

Cummings, J.L. and Teng, B.-S. (2003) "Transferring R&D knowledge: the key factors affecting knowledge transfer success", *Journal of Engineering and Technology Management*, 20(1), 39-68,

Dhanaraj, C., Lyles, M.A., Steensma, H.K. and Tihanyi, L. (2004) "Managing tacit and explicit knowledge transfer in IJVs: the role of relational embeddedness and the impact on performance", *Journal of international business studies*, 35(5), 428-442,

Easterby-Smith, M., Lyles, M.A. and Tsang, E.W. (2008) "Inter-organizational knowledge transfer: Current themes and future prospects", *Journal of Management Studies*, 45(4), 677-690,

Garvin, D.A. (1984) "What Does "Product Quality" Really Mean?", *Sloan Management Review*, 25,

Green, S.G., Gavin, M.B. and Aiman-Smith, L. (1995) "Assessing a multidimensional measure of radical technological innovation", *IEEE Transactions on Engineering Management*, 42(3), 203-214,

Hansen, M.T. and Løvås, B. (2004) "How do multinational companies leverage technological competencies? Moving from single to interdependent explanations", *Strategic management journal*, 25(8-9), 801-822,

Kano, N., Seraku, N., Takahashi, F. and Tsuji, S. (1984) "Attractive quality and must-be quality", *Journal of the Japanese Society for Quality Control*, 14(2), 147–156,

Ko, D.-G., Kirsch, L.J. and King, W.R. (2005) "Antecedents of knowledge transfer from consultants to clients in enterprise system implementations", *MIS quarterly*, 59-85,

Koza, M.P. and Lewin, A.Y. (1998) "The co-evolution of strategic alliances", *Organization Science*, 9(3), 255-264,

Lei, D. and Slocum, J.W. (1992) "Global strategy, competence-building and strategic alliances", *California Management Review*, 35(1), 81-97,

Manhart, M. and Thalmann, S. (2015) "Protecting organizational knowledge: a structured literature review", *Journal of Knowledge Management*, 19(2), 190-211,
March, J.G. (1991) "Exploration and exploitation in organizational learning", *Organization Science*, 2(1), 71-87,
Markus, M.L. (2001) "Toward a theory of knowledge reuse: Types of knowledge reuse situations and factors in reuse success", *Journal of Management Information Systems*, 18(1), 57-94,
Mitra, D. and Golder, P.N. (2006) "How does objective quality affect perceived quality? Short-term effects, long-term effects, and asymmetries", *Marketing Science*, 25(3), 230-247,
Molas-Gallart, J. (1997) "Which way to go? Defence technology and the diversity of 'dual-use'technology transfer", *Research Policy*, 26(3), 367-385,
Monroe, K.B. and Krishnan, R. (1985) "The effect of price on subjective product evaluations", *Perceived quality*, 1, 209-232,
Nielsen, B.B. (2002) "Synergies in strategic alliances: motivation and outcomes of complementary and synergistic knowledge networks", *Journal of Knowledge Management Practice*, 3(2), 1-15,
Norman, P.M. (2002) "Protecting knowledge in strategic alliances: Resource and relational characteristics", *The Journal of High Technology Management Research*, 13(2), 177-202,
Olson, J.C. and Jacoby, J. (1972) "Cue utilization in the quality perception process", in *SV-proceedings of the third annual conference of the association for consumer research*,
Perry, M.L., Sengupta, S. and Krapfel, R. (2004) "Effectiveness of horizontal strategic alliances in technologically uncertain environments: are trust and commitment enough?", *Journal of Business Research*, 57(9), 951-956,
Ren, Y., Burnap, A. and Papalambros, P. (2013) "Quantification of perceptual design attributes using a crowd", in *DS 75-6: Proceedings of the 19th International Conference on Engineering Design (ICED13), Design for Harmonies, Vol. 6: Design Information and Knowledge, Seoul, Korea, 19-22.08. 2013*,
Shapiro, B.P. (1970) "The effect of price on purchase behavior", *Broadening the concept of marketing*,
Simonin, B.L. (1999) "Ambiguity and the process of knowledge transfer in strategic alliances", *Strategic management journal*, 20(7), 595-623,
Simonin, B.L. (2004) "An empirical investigation of the process of knowledge transfer in international strategic alliances", *Journal of international business studies*, 35(5), 407-427,
Steenkamp, J.-B.E. (1990) "Conceptual model of the quality perception process", *Journal of Business Research*, 21(4), 309-333,
Stock, G.N. and Tatikonda, M.V. (2000) "A typology of project-level technology transfer processes", *Journal of Operations Management*, 18(6), 719-737,
Stylidis, K., Burnap, A., Rossi, M., Wickman, C., Söderberg, R. and Papalambros, P. (2016a) "A preliminiary study of trends in perceived quality design attributes in the automotive luxury market segment", in *DS 84: Proceedings of the DESIGN 2016 14th International Design Conference*,
Stylidis, K., Rossi, M., Wickman, C. and Söderberg, R. (2016b) "The Communication Strategies and Customer's Requirements Definition at the Early Design Stages: An Empirical Study on Italian Luxury Automotive Brands", *Procedia CIRP*, 50, 553-558,
Swan, M. (2015) *Blockchain: Blueprint for a new economy*, O'Reilly Media, Inc.
Szulanski, G. (1996) "Exploring internal stickiness: Impediments to the transfer of best practice within the firm", *Strategic management journal*, 17(S2), 27-43,
Taguchi, G. (1986) *Introduction to quality engineering: designing quality into products and processes*.
Van Wijk, R., Jansen, J.J. and Lyles, M.A. (2008) "Inter-and intra-organizational knowledge transfer: a meta-analytic review and assessment of its antecedents and consequences", *Journal of Management Studies*, 45(4), 830-853,
Wenger, E. (1998) *Communities of practice: Learning, meaning, and identity*, Cambridge university press.
Yin, R.K. (2013) *Case study research: Design and methods*, Sage publications.
Zander, U. and Kogut, B. (1995) "Knowledge and the speed of the transfer and imitation of organizational capabilities: An empirical test", *Organization Science*, 6(1), 76-92,
Zeithaml, V.A. (1988) "Consumer perceptions of price, quality, and value: a means-end model and synthesis of evidence", *The Journal of marketing*, 2-22,

ACKNOWLEDGMENTS

This work was founded by Wingquist Laboratory VINN Excellence Centre within the Area of Advance Production at Chalmers, and supported by the Swedish Governmental Agency for Innovation Systems (VINNOVA). The authors wish to acknowledge their gratitude and appreciation to the rest of the partners for their contributions during the development of various ideas and concepts presented in this paper.