



Aligning Market Needs with Technological Innovations: The Strategic Role of Knowledge Management

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ABSTRACT

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In today's rapidly evolving and competitive business landscape, innovation is an important driving force for organizational success. As companies strive to create competitive advantage, the role of knowledge management (KM) in catalyzing innovation becomes increasingly critical. This thesis explores the integral role of knowledge management in supporting technological innovation management, particularly within the context of aligning market needs with technological capabilities in an organization. Through an in-depth literature review and a case study of VIM, this research explains how KM practices, especially those facilitating the flow of customer and market insights to R&D teams, are critical in developing products that align with market needs. This study identifies best practices top innovators use to bridge the gap between commercial insights and technical expertise, underscoring the importance of systematic knowledge capture to organize the fuzzy front end of innovation, and for aligning innovations with business objectives. The result of the literature review is reported as a conceptual framework to guide organizations looking to align technological innovation efforts with customers and market needs. This framework was used in a real business context of Vaisala's Industrial Measurements (VIM) to evaluate the current flow of customer and market knowledge to R&D teams and to provide recommendations for improvements. Findings revealed that systematic knowledge capture and sharing, underpinned by a culture of open communication and collaboration, are fundamental to transforming individual insights into organizational knowledge that drives innovation. The study highlights the necessity of a KM strategy that integrates customer insights with technological capabilities, ensuring that innovation efforts are closely aligned with market demands.

Key words: innovation management, knowledge management, customer knowledge, technological innovation.

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ABBREVIATIONS AND TERMS

CKM	Customer Knowledge Management
CRM	Customer Relation Management
IM	Innovation Management
KPI	Key Performance Indicator
KM	Knowledge Management
RBV	Resource Based View
TIM	Technological Innovation Management
TM	Technology Management
VIM	Vaisala's Industrial Measurements

1 INTRODUCTION

Innovation is a critical factor for organizations to succeed in today's rapidly changing and competitive business environment. A central part of successful innovations is the seamless exchange of knowledge and ideas between the business and technology dimensions in an organization. This continuous and dynamic collaboration connects problems with solutions, fostering the creation of ideas which can be then transformed into tangible products or services that truly resonate with the market.

In this context, knowledge plays a crucial role as a foundation for generating new ideas, solutions, and breakthroughs. Specifically, knowledge from customers serve as a force for innovation, leading to the development of products or services that not only meet but also anticipate market needs, driving businesses ahead in their industries.

Many scholars argue that the current business landscape is characterized by a knowledge economy. In a knowledge economy, the generation, dissemination, and application of knowledge are the primary drivers of growth and competitiveness in organizations. Therefore, Knowledge Management (KM) activities are becoming more than operational tools, and they can be considered a strategic resource that can revolutionize the performance of organizations.

Knowledge management is a crucial supporting activity of Innovation Management (IM) because it facilitates the effective acquisition, organization, and dissemination of knowledge within an organization, including customer knowledge. The management of knowledge resources enhances decision-making, promotes collaboration, and ultimately contributes to the successful identification, development, and implementation of breakthrough innovations. KM practices foster innovation by facilitating the exchange of ideas, enabling cross-functional collaboration, and ensuring timely access to relevant knowledge for individuals across the organization.

This thesis delved into the study and enhancement of KM practices as a supporting activity to IM within the context of Vaisala's Industrial Measurements

(VIM), a global leader in measurement instruments. The research aimed at understanding the relationship between technological innovation and knowledge management activities, with a specific focus on KM's role as a dynamic and real-time mechanism for bridging customer insights with the company's technological capabilities to fuel innovation.

The thesis aimed to investigate how KM can be leveraged to align market demands with innovations. This involves continuously generating and disseminating insights from market and customer needs to Vaisala's Industrial Measurements (VIM) R&D team. The overall goal is to ensure knowledge flows across departments to facilitate cross-functional ideation and enhance the creation of innovations that align with market needs, thereby driving the organization towards success and competitiveness.

1.1 Background and business context

Vaisala is a Finnish company providing environmental and industrial measurement products and solutions. It specializes in areas such as weather forecasting, environmental monitoring, and industrial measurement solutions for humidity, temperature, and other parameters. Its two business units Weather and Environment, and Industrial Measurements, have a global presence and work with a variety of industries including aviation, renewable energy, and life sciences (Vaisala, n.d.).

Vaisala Industrial Measurements (VIM) business unit provides measurement instruments for monitoring, control and optimization of processes in different industries. The business unit consists in turn of 4 product areas: liquid measurement products, industrial measurement products, power and transformers and continuous monitoring products for the life sciences industry. Each product area is responsible for driving the business of their product lines including product development project portfolio, which is carried out by Vaisala's VIM R&D.

In 2023, a new department was established with a focus on technology strategy and innovation. The objective of this new function is to create strategies that ensure the company's competitive advantage and its positioning as innovator. Vaisala aims at product leadership and in developing products that align with the market present and future needs. The work of technology strategy does not only involves scouting for new technologies and opportunities, but also involves developing capabilities and the culture that encourage continuous innovation.

The work has many challenges to address, including the enrichment of an organizational culture and structure that fosters innovation. At the moment, R&D and other main functions work as siloed departments. Departments and functions are isolated one from another which results in poor information sharing, thus hindering collaboration and successful innovation.

The aim of this thesis project is to generate concrete recommendations that can be implemented in VIM's innovation framework. This framework incorporates internal practices designed to bridge the commercial-technological gap and foster innovation within the organization. Internal practices are needed that promote cross-functional collaboration and ensure seamless knowledge flow between business functions and R&D department. The main goal is to ensure not only continuous opportunity identification and idea generation, but also alignment of innovations to market needs right from the outset from the development process.

1.2 The research questions and objectives of the project

The development of a technology strategy in VIM has created the need to evaluate that the company's culture, structure and capabilities are suitable to foster innovation. One element is the way knowledge flows within the organization and applied to achieve the company's strategic goal.

The aim of this research project is to investigate the role of knowledge management practices in fostering innovation in the context of Vaisala's VIM organization. The specific research questions that guide this thesis have been formulated as follows:

1. *What practices and mechanisms are adopted in top innovator organizations to improve knowledge flow, and bridge the gap between commercial insights and technical expertise to foster idea generation and innovation?*

Question 1 highlights the need for strategies and processes that effectively combine the market-oriented knowledge from the business teams with the technical expertise of R&D. The question focuses on understanding practices and mechanisms that can be put in place within an organization to enhance the flow of knowledge. The ultimate goal is to facilitate idea generation and innovation.

2. *What are the key challenges and opportunities associated with knowledge sharing among business and technology teams in the context of VIM, and how can these challenges be effectively addressed to foster innovation?*

Question 2 focuses on identifying strengths and weaknesses related to the sharing of knowledge and integration of efforts between business and R&D teams within the context of technology innovation management in the case organization, VIM. It also seeks to propose how these challenges can be effectively overcome to promote innovation.

The findings from this research will provide insights into how knowledge sharing can be leveraged to drive idea generation in the context of technological innovation management and will contribute to the development of practical recommendations for the company to enhance its innovation framework. Therefore, the following objectives of this research can be drawn:

1. *To understand the nexus between knowledge management and innovation.*

This objective will help to elucidate how knowledge management practices, specifically emphasizing knowledge sharing, play a pivotal role in driving idea generation for enhancing innovation within organizations. This includes examining the key factors and best practices employed by

top innovators that ensure the alignment of technologies with market demands.

2. *To evaluate current knowledge flow practices between business and technology levels in VIM organization.*

This objective focuses on examining how knowledge flows across departments in the VIM organization. The assessment will help to understand the current balance between market-driven knowledge flow (market pull) and technology-driven knowledge flow (technology push) within the organization. The objective is to gain an understanding of how the current state of knowledge sharing impacts the generation of ideas and innovation in Vaisala, and to identify areas where improvements can be made.

3. *To propose recommendations to enhance knowledge sharing and idea generation from knowledge from customers to drive market-aligned innovations.*

This objective aims to provide concrete recommendations for enhancing internal practices and processes related to knowledge management. These recommendations will be tailored to foster a more innovative environment within the organization. The focus is on practices that bridge the gap between the business and technology levels, facilitating effective collaboration and innovation.

1.3 Justification of the research

Knowledge management in organizations is not a new topic. Over the past few decades, authors such as Hirotaka Takeuchi and Ikujiro Nonaka, have extensively studied knowledge management in organizations, and have proposed various theories and frameworks to provide a better understanding and manage knowledge within organizations.

According to Brooking (1999) knowledge can be defined as information in context with understanding to applying that knowledge. Knowledge has become an important resource for competitive advantage in organization and it is considered as a production factor and a determinant of innovation (Hidalgo et. al., 2008). Knowledge plays a critical role in driving innovation and technological progress, and in this sense, it is an active force that drives economic growth and development.

Already in the early 90s Nonaka (1991) introduced the concept of knowledge-creating companies as the defining success factor of Japanese's enterprises' innovation. Through the SECI model, Nonaka et al. (1995) explain how individuals' tacit and explicit knowledge is converted into organizational knowledge that can be leveraged by the organization for continuous innovation.

Tacit knowledge is defined as personal knowledge an individual has gained through studies or experiences. Explicit knowledge is born only when individuals are capable to articulate their tacit knowledge. Therefore, explicit knowledge is more formal and systematic and can be managed and shared within the organization. According to Nonaka et at. (1995) tacit knowledge can be converted into explicit knowledge by the four steps: Socialization, Externalization, Combination and Internalization (SECI).

Other authors also have explained how knowledge management has important implications on innovation. Rahimi et. al. (2017) explain that innovation is closely linked to knowledge management as it implies the generation, acceptance and implementation of new ideas. Therefore, knowledge management is about supporting innovation, the generation of new ideas and the exploitation of the organization's thinking power.

Paterson (2013) emphasizes the importance of effective knowledge application for achieving successful organizational innovation, which includes faster development of products and services, optimized R&D investment, alignment with market needs, successful product introductions, anticipation of customer needs and competitor differentiation. While Abraham (2008) highlights the primary goal of knowledge management is innovation.

It is clear that knowledge management plays a crucial role in fostering innovation within organizations. To achieve this, organizations must establish effective channels for sharing and distributing knowledge among employees (Akram et al., 2011). Knowledge management activities, such as gathering, managing, sharing, learning, reuse, and retrieval, are essential in promoting innovation. Through knowledge management, organizations can identify the sources of knowledge and manage them appropriately. When the right knowledge to the right person at the right time is available it can result in faster product development, closer alignment with market needs, and better anticipation of customer needs, which are all crucial for organizational innovation.

Top innovators in the world recognize that knowledge is a valuable asset that should be actively shared and utilized by all employees. Organizations should put emphasis to knowledge management if they are to succeed in innovation. Organizations must cultivate a culture of knowledge sharing, facilitate cross-functional collaboration, and implement effective knowledge management practices to break silos and leverage the collective expertise and insights.

1.4 Outline of the thesis

This thesis consists of six chapters. The introductory chapter 1 provides essential background information on the case study organization and outlines the research questions, objectives, and main goals. This chapter establishes the context and rationale for the study.

Chapter 2 focus on literature review to explore key concepts related to technology, innovation, and knowledge management. This chapter aims to understand the role of knowledge management in innovation and identify best practices utilized by top innovators to bridge the gap between market insights and technological expertise.

In Chapter 3, the methodology utilized in the study is explained, as well as it defines the scope of the research and the data collection methods utilized to

assess the case organization. This chapter provides insight into the research design and approach. It aims to offer transparency regarding the methods used to gather and analyze data.

Chapter 4 presents the results of the data collection process, providing a descriptive analysis of the findings. This chapter emphasizes on relevant results that align with the research objectives and identified best practices.

Chapter 5 interprets the research findings and discusses their managerial implications. This chapter serves as a reflection on the implications of the research findings for both theory and practice in the context of knowledge flow for bridging the gap between market and technology teams and for innovation.

Finally, chapter 6 offers recommendations tailored to VIM based on the identified best practices before presenting the conclusions in chapter 7. These recommendations are designed to help the organization enhance its knowledge management practices and foster innovation.

2 LITERATURE REVIEW

2.1 Technology management (TM)

Technology, in the business context, involves not only tools and equipment, but also the knowledge, skills, and processes required to design, create, manufacture, and deliver products, services, and solutions. It represents a distinct form of knowledge that goes beyond theoretical understanding, emphasizing practical application and the capacity to achieve specific tasks or goals. Technology is integral to a company's ability to respond to market demands, stay competitive, and create value for customers. It serves as a catalyst for innovation and differentiation, enabling organizations to meet customer needs more effectively than their competitors. Effective technology utilization is not just a matter of employing tools, but rather a strategic means of achieving a competitive advantage (Phaal et al., 2000).

In this sense, Technology Management (TM) plays a pivotal role in establishing a sustainable competitive advantage. This is based on the understanding that achieving and maintaining competitive advantage means more than just operational streamlining and cost reduction. Especially for high-tech firms, the ability to remain competitive is closely linked to the management of technological capabilities (Ünsal et al., 2015).

The management of technology has gained increased significance as today's business environment is dynamic and rapidly evolving. Organizations recognize that technology is not just a means to an end; it is a crucial resource that underpins their operations, growth, and profitability. Properly managed technology can lead to improved operational efficiency, streamlined processes, enhanced product development, and increased market share. It enables organizations to respond swiftly to market changes, capitalize on emerging opportunities, and outpace competitors.

TM is vital to bridge the gap between the company's technological resources and market requirements (Phaal et al., 2000). TM entails a systematic approach to

planning, directing, controlling, and coordinating the development and implementation of technological capabilities. Its core objective is to align technological resources with strategic and operational goals, ensuring that technology is harnessed to achieve tangible business outcomes (Cetindamar et al., 2009).

2.1.1 Technology management framework

Technology management theory offers very few widely adopted methods for the practical application of TM principles, and few universally accepted conceptual models or frameworks to underpin them (Cetindamar et al. 2009).

One prominent framework used in literature of TM is the one proposed by Phaal and colleagues (2004). The framework presented in Figure 1 illustrates how technological and commercial knowledge come together to drive strategic, innovative, and operational activities within an organization, encompassing both its internal dynamics and external surroundings. This model highlights the importance of seamless knowledge flows that must happen between the levels of business and technology within a company. This flow is knowledge exchanged that can be categorized into “push” (the firm’s technological capabilities) and “pull” (the market demands and requirements) mechanisms, which ensure equilibrium and effective alignment of the technology and business levels (Phaal et al., 2000). This means that there need to be good ways for information and ideas to move between different parts of the organization.

In this context, TM relies on leveraging knowledge management principles, including organizational learning, as well as the distinctions between explicit and implicit knowledge, along with various dimensions of knowledge such as “know-why”, “know-what”, “know-how”, “know-who”, “know-where”, and “know-when” (Phaal et al., 2000). These principles and dimensions are seamlessly integrated into the framework.

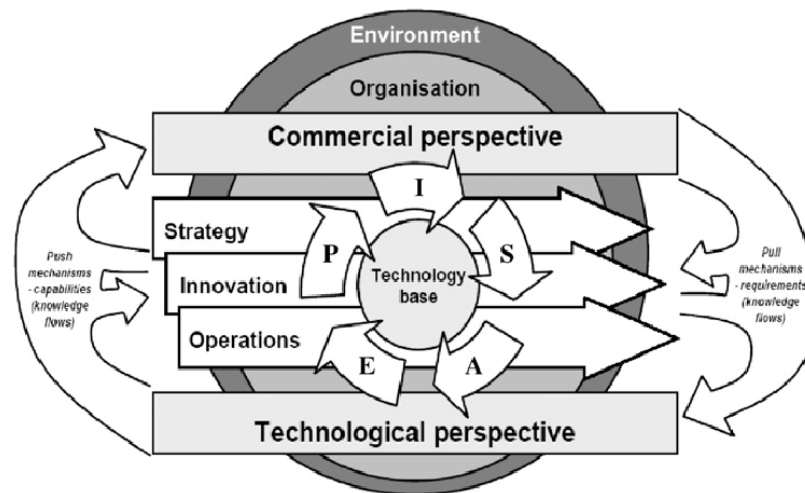


FIGURE 1. Technology management framework by Phaal et al. (2004).

2.1.2 Core activities for technology management

At the core of the framework depicted in Figure 1 lies the technology base and the essential activities for both managing technology and developing technological capabilities. The five activities required for the generation and exploitation of a firm's technology base are identification, selection, acquisition, exploitation, and protection (Phaal et al., 2004).

The first activity, identification of technologies, involves recognizing and evaluating technologies that hold strategic importance to the organization. This process involves searching, auditing, data collection, and intelligence gathering to identify potential avenues for technological advancement.

Selection involves assessing technologies in alignment with the organization's objectives and priorities and making informed decisions about which technologies to support based on strategic considerations.

Next step is the acquisition of the selected technologies which consists in determining whether to develop the selected technologies internally, collaborate with external partners, or acquire technologies from other sources.

Exploitation involves translating technological potential into tangible benefits (i.e. products and services) as well as leveraging technologies to generate value, whether through commercialization, operational implementation, or incremental development.

The final activity consists in the protection of the knowledge and expertise embedded in the firm's technologies. This includes strategies like patenting and retaining specialized staff to preserve intellectual property and skills.

2.1.3 Supporting activities in technology management

The management of technology in an organization cannot happen without close collaboration of other functions. TM will need to draw at times skills and knowledge from other principles to perform its core activities (section 2.1.2) and successfully delivering technology-driven solutions to the market.

These activities include Knowledge Management (KM), Innovation Management (IM), and Project Management (PM) and are crucial to optimize technological capabilities and transforming ideas into tangible products and services (Figure 2) (Centidamar et al., 2009). For example, in practice each core activities in the TM framework can turn into separate projects, requiring skills and knowledge from the project management field to manage them.

The primary task of managing technology is to utilize technological knowledge (Trauffler et al., 2007). In this context, Knowledge Management (KM) principles which help organizations manage knowledge (including technological knowledge) ensures that knowledge is not only acquired and stored, but also strategically utilized to drive innovation and propel the development of cutting-edge solutions in the market. KM accomplishes this through activities like documenting and safeguarding technological knowledge, as well as facilitating the timely dissemination of knowledge to the right individuals.

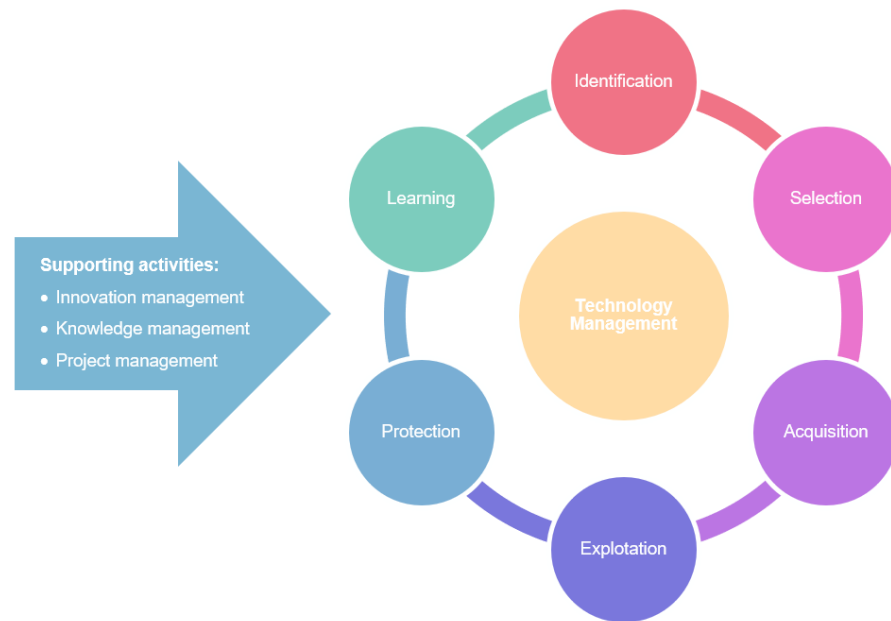


FIGURE 2. Technology management activities and supporting activities. Adapted from Cetindamar et al., 2009.

Ünsal et al. (2015) explain KM has a crucial role in in TM and its impact on competitiveness. They emphasize the need for including KM routines in TM recognizing the challenges technology managers face in effectively harnessing knowledge, including the management of researchers and the establishment of comprehensive knowledge databases. Moreover, the authors emphasize that managing technology is not just about technical development, but also about understanding and meeting customer needs.

This viewpoint aligns with Levin et al.'s (2008) argument that any TM framework should not include only activities aimed at developing technological capabilities, but also for the determination of customer requirements. KM plays a critical role in ensuring that customer insights and requirements are efficiently captured, shared, and seamlessly integrated into technology development and management processes.

Innovation Management (IM) involves different types of innovations including organizational, financial and technological; it naturally overlaps with TM (Centidamar et al., 2009). IM connects technological knowledge and practical applications, continuing the work initiated by TM and ensuring that insights acquired lead to innovative marketable solutions (Jorna, 2017). It provides a

structured framework for turning this knowledge into innovative solutions, aligns technological development with market needs, fosters a culture of creativity, and ensures that TM efforts lead to meaningful outcomes, enhancing the organization's competitive position.

In essence, the interaction between TM and its supporting activities establishes a foundation for dynamic successful technological innovation development. KM ensures the effective use of knowledge, from acquisition to practical application. Similarly, IM carries forward technological insights, guiding them towards market-oriented solutions. This research explores various aspects of these disciplines, so it's important to understand their clear boundaries and implications. These intersections are focus points, as they shape the landscape for effective knowledge flow, idea generation, and successful innovation within an organization.

2.2 Innovation management (IM)

Innovation is crucial for organizations to stay competitive in today's rapid evolving markets, as well as for driving sustainable growth and profitability. Therefore, the topic has gained significant importance in literature across diverse fields, marking a growing trend in discussions and research.

Innovation can be viewed from different perspectives and thought of as a multi-faceted concept. As a result, different authors offer distinct definitions, contributing to a comprehensive understanding of its diverse nature.

The Oxford English Dictionary defines "innovation" as the action or process of innovating (Oxford University Press., n.d.); the introduction of new things, ideas, or ways of doing something. Trauffer et al. (2007) defines innovation as a first successful commercial use of something new by an enterprise. Nonaka (1994) argues that innovation is a form of knowledge creation and can be described as a process in which the organization creates and defines problems and then actively develops new knowledge to solve them. Trott (2011) defines innovation as a management process stating that innovation is the management of all the

activities involved in the process of idea generation, technology development, manufacturing and marketing of a new (or improved) product or manufacturing process or equipment. While Cetindamar et al. (2009) explain that in essence, innovation can be defined as the act of introducing something novel, whether it be a new product, process, or service.

The diverse understanding of innovation is rooted in the fact that the concept of innovation can be interpreted and applied in various ways depending on the context, industry, and perspective of the individuals or organizations involved. Goffin et al. (2016) explain that different definitions of innovation always describe what is changed, resulting in the interpretation of the many types or dimensions of innovation.

In the manufacturing sector, for instance, the dimension of innovation can be described as product (the improvement of product and their features), process (enhancement on the manufacturing of a product), service (the creation of additional services to differentiate a product), business process (the optimization or streamlining of internal and external processes), and business model innovation (the creation of value to the customers in new and revolutionary ways). Therefore, innovations can manifest in various forms, including technological or organizational innovations, and can originate from diverse sources, such as innovations in marketing or finance.

Innovations can be classified depending on their newness or degree of novelty, which is defined by the difference of the innovation compared to the previous state (Trauffler et al., 2007). The term “radical innovation” is commonly used to describe innovations with high degree of novelty, that is when the innovation provides a completely new technological performance. The term “incremental innovation” is used to describe innovations with a low degree of novelty, or innovations that consist of only improvements or modifications of the current performance.

Trott (2011) explains the process from which innovations are born consists of three distinct stages: theoretical conception, technical invention, and commercial exploitation (Figure 3). It begins with the theoretical conception of new ideas,

which serves as the initial spark for innovation. However, it's important to note that the novel idea itself is not yet an innovation; it remains a conceptual thought or a collection of thoughts. The subsequent step in the process is the technical invention phase. This entails the transformation of intellectual concepts into tangible, real-world objects, typically in the form of a new product or process. Science and technology often play a pivotal role in this stage. Nevertheless, inventions alone are not sufficient for true innovation. To achieve this, a collective effort involving the diligent work of numerous individuals is required to transform these inventions into products that enhance overall company performance. This final phase, encompassing both invention and exploitation, collectively constitutes the complete process of innovation.

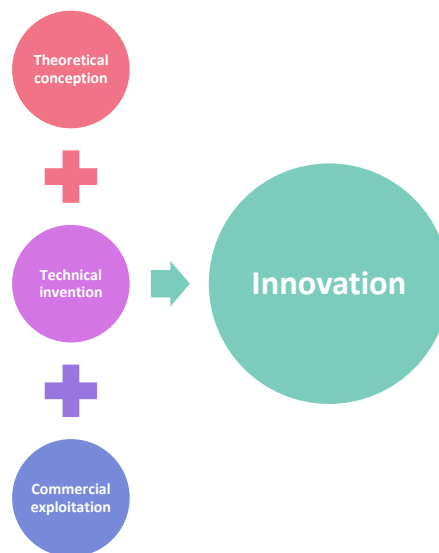


FIGURE 3. The complete process that draws innovation. Adapted from Trott (2011).

In this context, innovation is a process concerning different stages that need to be managed to be successful. Innovation management (IM) therefore is concerned with the management of the innovation process. IM can be seen as a range of tools, techniques and methodologies that help companies to adapt to circumstances and meet market challenges in a systematic way (Hidalgo et al., 2008). IM is also concerned with cultivating an organizational culture that thrives on creativity, experimentation, and the exploration of novel pathways. It includes the systematic identification, evaluation, and implementation of innovative

concepts, whether they manifest as technological, organizational, or market-oriented innovations.

2.2.1 Innovation management framework

IM as explained above involves overseeing all the necessary phases for successfully introducing products and services to the market. There are various models that have been proposed to guide this process, typically following a basic framework of idea generation, selection, and implementation. The IM framework is often represented as a funnel, which symbolizes the gradual progression as well as refinement of ideas through the different stages of development (Figure 4).

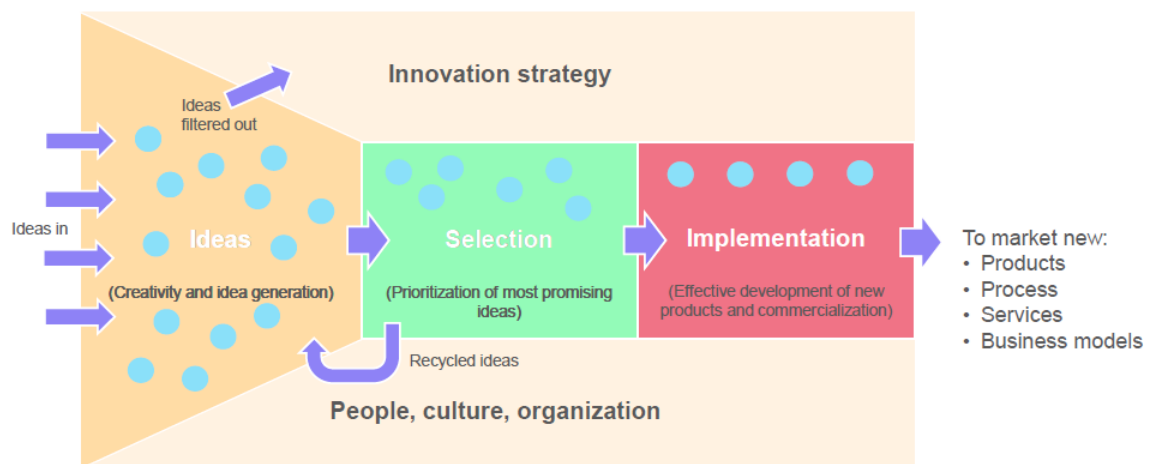


FIGURE 4. The development funnel of innovation, adapted from Goffin et al. (2016).

The innovation funnel concept is enhanced by Goffin et al. (2016) with the inclusion of innovation strategy and people and organization to link the firm's strategic purpose and innovation culture to the innovation purpose. This framework presented in Figure 4 is known as "the Innovation Pentathlon Framework".

The initial phase of the Pentathlon's funnel involves ideation. The creation of ideas from recognizing and solving problems that greatly benefit customers. This

also involves creating an environment that supports creativity, both individually and in teams. During this stage, some ideas are promptly filtered out, while others progress through the funnel through the selection phase. This consists of evaluating by an effective process the best ideas for development into products, services, or business concepts. Since the resources are limited, this phase helps to allocate them wisely across the most promising projects. In the final step of implementation is where the selected ideas are developed. This phase should focus in developing quickly and efficiently new products, services, or processes. Faster development can be achieved for example through effective teamwork, prototyping, and testing. The last part of implementation is commercialization which focuses on successfully introducing these innovations to the market (Goffin et al., 2016).

Professor Mitchell (R&D Today, 2018), co-creator of the Pentathlon framework, says the last two elements in the model (strategy and people, culture, and organization) are crucial. He explains the importance of having in place an innovation strategy, which sets the right direction and guides the effort and how the work is done in the funnel. The strategy helps in recognizing opportunities, addressing potential threats, acquiring the needed expertise, and aligning resources with the chosen strategic direction. Moreover, it is vital to have the right people culture and organization to allow to be playful and experimental to end up with a sellable product in the real world. Creating a culture where employees are motivated to be innovative is fundamental.

It is important to note the analogy of the pentathlon, which comes from the Olympic discipline and its implication to management. This analogy emphasize that organizations can only achieve innovation and long-term competitiveness if they pay attention and excel in all of the five elements of the framework.

2.2.2 Management of idea generation and the front end of innovation

“Innovation starts with ideas and therefore idea generation is regarded as a very important variable of the innovative capacity of firms” (Koc et al., 2007).

Innovations start with ideas, which come from the creative thinking of various individuals or groups both within and outside the organization (Boeddrich, 2004). Without ideas there cannot be innovation.

This idea generation phase is often referred to as the "Front End of Innovation" (FEI). The term "fuzzy" is also sometimes used in this context because in this stage ideas are uncertain, unclear, and there's a lot of unpredictability.

The FEI involves identifying, collecting, and developing potential concepts that have the potential to address market needs or improve existing products and services. This phase parallels idea generation but places a stronger emphasis on opportunity identification and analysis. The front-end is also important because it ensures at early-stage alignment of new products and services with business goals by linking the innovation process with strategic objectives (Peykani et al., 2022). The FEI is a critical, but often weak, area in the innovation process, which influences greatly the later innovation success.

Brem et al. (2009) state the FEI lays the foundation for the entire innovation process, therefore, effectively managing the front end can provide a sustainable competitive advantage in innovation. They suggest that the FEI should be clearly structured as a phase of idea collection and creation supported by the level of creativity and innovation culture of the organization. A crucial aspect is their emphasis in their proposal for input of market and technology expertise during idea generation stage. In fact, they propose this expertise should be included the whole innovation process to guarantee the success of the innovation.

Boeddrich (2004) agrees that a structured and systematic process is needed at the FEI. It leads to better utilization of problem-solving knowledge and resources, maximizes the use of human capital and core competencies, and fosters a positive organizational climate. Moreover, innovations are most successful on the market when the concept identification phase consists of a structured and systematic idea management process. Boeddrich (2004) outlines a process-oriented strategy that includes defining specific idea categories aligned with strategic goals, establishing clear evaluation and selection criteria, assigning

ownership of the idea management process, cross-functionality in decision-making and empowering innovation drivers within the organization (Figure 5).

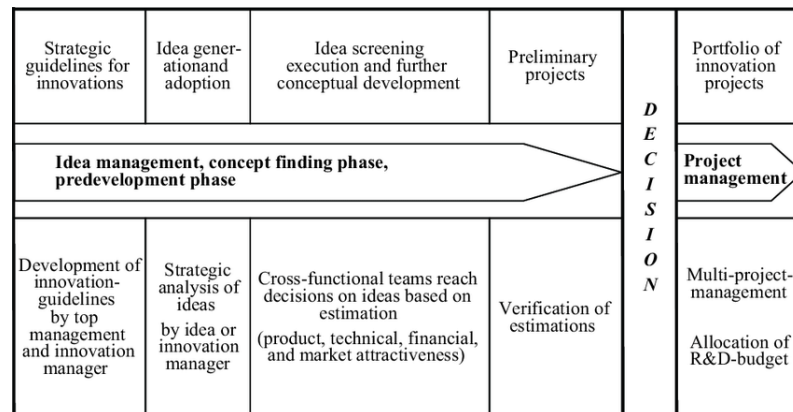


FIGURE 5. A proposal for organizing the front end of innovation (Boeddrich, 2004).

The literature strongly supports the idea that a systematic approach to the fuzzy front end and concept development phases leads to a more productive outcome. However, quite often companies do not pay attention to the steps before R&D projects begin. The collection and flow of ideas are not regulated, decision criteria are not specified, and authorizations are unclear, leading to the true definition of a fuzzy front end.

A structured approach results in a greater number of ideas, which significantly enhances a company's future prospects. A robust pool of ideas not only taps into problem-solving knowledge effectively but also optimizes human capital and core competencies, creating a positive organizational environment. It empowers managers to make more informed decisions regarding the allocation of R&D budgets, ensuring resources are channeled into initiatives with the highest potential for success.

In the 2018 Global Innovation 1000 study, organizations emphasized the significance of the front end of the innovation process. According to the survey, 31 percent of respondents considered the phase of idea generation as the second most crucial stage, closely following project selection with 35 percent. Moreover, companies reporting fast growth said they were most competent at the ideation

and project selection stages. This FEI is vital as it determines a significant portion (up to 70 percent) of the long-term costs. It highlights the importance of making sound decisions during ideation and project selection, as even outstanding operational capabilities and management cannot compensate for poor choices regarding which ideas to develop and produce (Jaruzelski et al., 2018).

In the context of this research, the innovation funnel model provides a critical foundation to highlight the importance of effectively coordinating activities in the initial phase of innovation. As discussed above, the fuzzy front end and idea generation lays the groundwork not only for identifying viable opportunities but also for making informed decisions regarding which concepts should progress to implementation. It sets the stage for subsequent phases in the innovation process, ultimately increasing the likelihood of successful innovation outcomes. Effective and constant knowledge flow between commercial and technical departments is identified as a cornerstone for fostering successful innovation within the organization.

2.3 The link between technology and innovation management

In high-tech firms, technology is the key for driving innovation and enhancing market competitiveness. In this context, the interaction between Technology Management (TM) and Innovation Management (IM) is a critical focal point for the development of new products. These disciplines are closely related and play integral roles in the process of bringing innovative products to market.

As mentioned before, innovation can manifest in different forms including technological innovation. In this type of innovation, TM is understood to steer the wheel by focusing on the technological aspects of the products or services, emphasizing the effective utilization of technological knowledge, and ensuring alignment with business objectives. IM, on the other hand, has a wider scope, facilitating the smooth transfer of technical expertise and insights from various areas, including marketing and production, into commercially viable offerings. IM takes over and moves forward the initiatives instigated by TM (Jorna, 2017). It synchronizes a set of activities, including various disciplines across the entire

organizational. IM at the same time strives to optimally position the company's value-added offerings in the market by integrating the complete knowledge (Trauffler et al., 2007).

This synergetic relationship between Innovation Management (IM) and Technology Management (TM) is represented as Technological Innovation Management (TIM) in this research (Figure 6), and it is recognized as a critical framework for the success of innovations in high-tech industries. TIM's outcome is considered to exceed the sum of the individual contributions of IM and TM. This highlights the unique and valuable interaction created when IM and TM collaborate, leading to enhanced innovation and technological development.

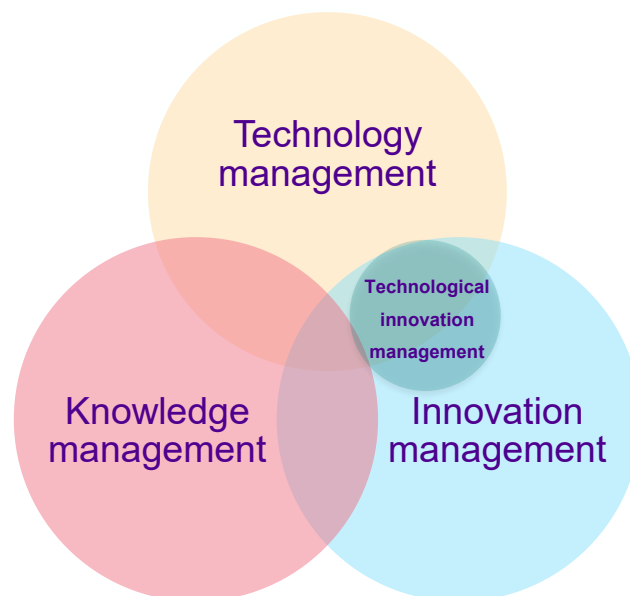


FIGURE 6. Technological Innovation Management as a part of Innovation management.

2.4 The market pull and the technology push paradigm

In today's fast-changing business world, staying competitive requires innovation. This prompts the question for many companies of how do we innovate best? The literature is full of innovation models that offer a range of approaches, however, the true is there is no one-size-fits-all formula. The best approach depends on various factors including industry, resources, and organizational objectives.

Typically, innovations are originated from “market pull” or “technology push”. Market pull innovation is driven by external factors, primarily customer demand and market needs. In this approach, organizations respond to identified market opportunities by tailoring their products or services to meet specific consumer requirements. This method effectively "pulls" technology development towards addressing established market demands. Market pull is an important aspect for example to companies in the business-to-consumer sector, as they need to consider end-user preferences and behaviors, making market pull a prominent to create successful innovation strategies (Brem et al., 2009).

On the other hand, “technology push” innovation is initiated from within an organization, typically by R&D or scientists. This approach is characterized by a focus on creating novel technologies and solutions, often driven by a desire to introduce cutting-edge products or services. This is why typically innovations originating from technology push tend to be radical and possess a higher degree of novelty (Trauffler et al., 2007).

Innovation models have evolved over time into complex models that consider market needs and organizational capabilities. The linear model of innovation, which dominated post-World War II industrial policy, assumed a sequential process, driven by technology. In this approach, scientists uncovered new knowledge, technologists put it to use, and engineers created prototypes, ultimately leading to marketing and sales efforts to promote the product. However, this model didn't fit all scenarios, leading to the emergence of the market-pull model, which made strong emphasis on customer needs. In this model, marketing interacts closely with customers to generate ideas, which are then conveyed to R&D for design and manufacturing for production. Later, integrated models were introduced which recognized the multifaceted nature of the innovation process, and the complex interaction between science, technology, and the market in driving innovation (Trott, 2011).

Literature suggests the need for balance within different models (Brem et al., 2008; Levin et al., 2008). However, organizations might still face the internal challenge of “disconnection” as the different preferences and approaches of

technologists, commercial functions, and technology managers can lead to conflicting strategies for innovation. This can result in a lack of alignment and coordination in the innovation process, potentially leading to inefficiencies or missed opportunities. Therefore, any framework should consider both improving technological capabilities and understanding customer needs, as well as cross-functional knowledge transfer.

Levin et al. (2008) argue that innovative companies excel in aligning their technological capabilities with a deep understanding of their customers' needs and preferences. Matzler et al. (2007) agree by stating that top performers place a lot of emphasis in understanding not only present needs, but also excel in foreseeing future market trends and customer demands. Their focus extends beyond meeting current customer requirements; they actively work towards creating innovative solutions for the markets of tomorrow.

In conclusion, as stated by Brem et al. (2009), the question on what the best way is to manage innovation, it's a bit like asking whether the chicken or the egg came first. There is no straightforward answer because there are examples of companies that focus on technology and others that focus on what the market wants, and they both do well. However, it's not about which way is right or wrong, but about finding a practical way to combine or include both approaches in the process, along with other related factors. This dilemma forms the core of this research as it seeks to provide valuable insights and recommendations for enhancing innovation by bridging the gap between commercial insights and technical expertise.

This theory sheds light on the dynamic relationship between market and technology capabilities, highlighting the importance of communication and knowledge transfer in successful technological innovation management. The takeaway is that innovation should not be a one-sided effort. Ensuring that R&D efforts align closely with customer preferences and needs is crucial to avoid creating products that diverge from market demands. This reinforces the importance of a holistic approach to innovation management.

2.5 Knowledge management and its role on innovation

“Knowledge management is about supporting innovation, the generation of new ideas and the exploitation of the organization’s thinking power” (Rahimi et al., 2017).

On the past decades, the significance of knowledge has gained much attention, transforming the business environment to what is known as the “knowledge economy”. In this economy, organizations place increased emphasis on the value of knowledge as a driving force for innovation and competitive advantage. Unlike traditional economies, where physical assets and labor were dominant, the knowledge economy revolves around the creation, acquisition, and utilization of knowledge and information (Hidalgo et al., 2008).

Knowledge can be defined as information in context with understanding to applying that knowledge (Brooking, 1999). Unlike information, which consists of raw data or facts, knowledge involves a deeper level of comprehension and interpretation. It is not only about having the facts, but about understanding the relationships between them and being able to draw meaningful conclusions. Knowledge requires the ability to synthesize information, discern patterns, and apply this understanding in practical contexts (O’Dell et al., 1998).

Knowledge can be either tacit or explicit. Tacit knowledge is defined as the personal knowledge individuals gain through studies or experiences; while explicit knowledge is born only when individuals are capable to articulate their tacit knowledge. Therefore, explicit knowledge is more formal and systematic and can be managed and shared within the organization (Nonaka, 1991).

In the organizational and commercial context, knowledge is what individuals within the organization know about their customers, products, processes, as well as the lessons learned from both mistakes and successes, whether this knowledge is tacit or explicit (O’Dell et al., 1998). This knowledge can be considered as an intangible and unique organizational resource and plays a pivotal role in creating competitive advantage (Cepeda-Carrion, G., 2006). And therefore, according to the Resource Based View (RBV) theory knowledge

should be managed and leveraged to add customer value through products, services, innovation, synthesizing knowledge, and globalizing local expertise.

Considering this, Knowledge Management (KM) is a crucial aspect of modern organizational strategy. KM is a systematic and organization-specific framework for creating, organizing, managing, utilizing, and facilitating the sharing of both tacit and explicit knowledge among employees. This enables enhanced effectiveness and productivity, ultimately maximizing an organization's knowledge capital (Rahimi et al., 2017). KM encompasses more than information management, it involves different tasks aimed for the creation of new knowledge and overseeing its dissemination and application (Davenport et al., 1999). According to O'Dell et al. (2011), KM represents a systematic effort to cultivate information and knowledge, creating value and fostering processes that ensure that the right knowledge is delivered to the right people at the right time, promoting informed decision-making and improving organizational performance.

KM can be considered as cyclical process because it involves a continuous process of knowledge creation, capture, storage, dissemination, and application. Each stage feeds into the next, creating a continuous loop of knowledge management activities. Figure 7 presents the main activities in a KM framework according to Rahimi et al. (2017).

The first step involves **creating knowledge**, often derived from employees' experiences and skills. It happens when people find new ways of doing things or develop specialized know-how. Sometimes, knowledge can also be acquired from external sources, e.g. from research laboratories.

The second step aims at **capturing the knowledge**. The newly created knowledge needs to be stored in its raw form in a database. Many organizations use various knowledge repositories to save this knowledge.

To make new knowledge actionable, it needs to be put in context. The **refine knowledge** step involves generating knowledge by capturing and refining human insights or tacit knowledge, along with explicit knowledge. This phase is also known as "knowledge generation".

The next step consists of **storing knowledge**. Codifying both tacit and explicit knowledge helps in making the knowledge understandable and usable in the future.

Knowledge needs to be kept current. In the **manage knowledge** step, knowledge is periodically reviewed to ensure its relevance and accuracy. Many well-established companies have dedicated departments responsible for maintaining current knowledge.

The final step is **disseminating knowledge**. Knowledge must be made available in a useful format to anyone in the organization who needs it, regardless of time or location. Modern technologies like groupware or the intranet can be used to share the knowledge.



FIGURE 7. The continuous process of knowledge management in an organization. Adapted from Rahimi et al. (2017).

In the literature, various knowledge management processes have been proposed, each presenting distinct approaches to capturing and leveraging

organizational knowledge. One reason for this could be that KM systems are often tailored to the unique needs, goals, and organizational culture of each company context. This diversity also leads to the use of different terms, for instance, the process of making knowledge available may be referred to as sharing, dissemination, distribution, or transfer. However, as described by Obeidat et al. (2016) knowledge management in essence consists of three primary processes: knowledge acquisition, knowledge sharing, and knowledge utilization.

Knowledge management practices have proven to have strong correlation with a firm's innovative performance. KM enhances the organization's capacity to innovate by actively identifying and utilizing know-how, experiences, and judgment. It achieves this by facilitating the sharing of practical insights, promoting collaborative learning, and creating an environment where employees can draw upon their collective knowledge to generate innovative ideas and solutions. In a way, KM serves as a driving force behind the innovation process, enabling organizations to stay competitive and adapt to evolving market needs.

According to Paterson (2013), effective application of knowledge leads to accelerated development of new products and services, optimization of R&D investment, and a closer alignment with market needs. This, in turn, results in more successful product introductions, better anticipation of customer needs, and improved differentiation from competitors – all of which are essential components of organizational innovation.

Nonaka et al. (1995) say that the example of how knowledge plays a key role in business can be appreciated from the successful Japanese companies. Their ability to respond quickly to customer needs, create new markets, rapidly develop products and dominate emergent technologies has been attributed to their unique approach to managing the creation of new knowledge. These companies consistently generate new knowledge, disseminate it widely, and quickly integrate it into new technologies and products (Nonaka et al., 1995). This highlights the impact that a well-structured KM approach can have on innovation and business success.

The role of knowledge management practices takes a center stage in this research, given the focus on enhancing knowledge flow to bridge the gap between commercial and technical levels and to foster idea generation and innovation. The application of KM practices in technological innovation management is critical to ensure the seamless flow of knowledge across all levels of the framework and to align technological initiatives with overarching business objectives.

As noted by Phaal et al. (2000), KM stands as the pillar in any robust TM framework. When combined with functions, processes, and a deep business understanding, KM principles drive internal teamwork, leading to the fulfilment of strategic goals. Innovation also relies on effective assembly and management of knowledge so that new ideas and creativity for new products flow. Without the continuous accumulation and dissemination of knowledge, an organization's capacity for generating innovative concepts will be hindered (Trott, 2011).

In this context, this research places specific emphasis on knowledge acquisition (creation, capture, and generation) and knowledge sharing between the commercial and technical functions in VIM organization. This is because it is imperative to recognize that without the availability of knowledge, the process of sharing and collaboration becomes inherently limited. Moreover, this research considers that bridging the gap extends beyond mere knowledge flow, it also involves the quantity and quality of information garnered by the business functions and how this information is interpreted to generate actionable knowledge. This resonates with Trott's (2011) who highlights that the first activity to achieve innovation in new product development process is “the assembling of knowledge”.

Therefore, while this research is situated within the broader framework of knowledge management, it places particular emphasis on knowledge acquisition and sharing. This focused approach is aimed at providing targeted insights and actionable recommendations to enhance knowledge flow and foster innovation within the VIM organization.

2.5.1 Knowledge sharing as a critical component in KM

In the previous sections, it was explained the crucial role of knowledge management in driving innovation within an organization. Knowledge management facilitates innovation by ensuring a systematic acquisition, sharing, and ultimately, effective utilization of knowledge throughout the organization. In this aspect, sharing plays the central role in the process, acting as the link that enables the flow of insights and ideas across the organization and which connects the acquisition of knowledge to its transformative application. Knowledge sharing ensures that the right knowledge reaches the right person at precisely the right moment.

Foss et al. (2011) explained that while knowledge certainly plays a central role in fostering competitive advantage and driving innovation, establishing a direct and consistent relationship between the two can be elusive. Instead, the key lies in the organizational practices, particularly those related to knowledge sharing.

For instance, let's consider the scenario where R&D professionals who are responsible with creating new products and services, directly engage with customers. In such cases, a direct link between knowledge and innovation can be observed. However, when interactions with customers occur through intermediaries or other functions like sales, the organizational challenge becomes more complex. It's the implementation of robust organizational practices for knowledge sharing, which provide the strong mediating effect (Foss et al., 2011).

In this context, the full potential of technological resources can only be realized if knowledge flows efficiently and effectively between different levels of an organization (Phaal et al., 2000). The power of knowledge is truly amplified through active sharing and accessibility. Encouraging employees to distribute knowledge within the organizations not only enhances their capacity to generate and refine ideas, but also creates new opportunities (Obeidat et al., 2016). Therefore, it is important for organizations to invest efforts and resources in motivating and ensuring the seamless sharing of knowledge.

2.6 Customer knowledge: a driver to innovation

Customer knowledge has long been recognized as essential for organizations striving to gain a competitive advantage. Particularly for organizations aspiring to be customer-centric, it stands out as the most crucial type of knowledge (Khosravi et al., 2016). And thus, the extent of an organization's customer orientation is reflected by its capacity to extract and leverage insights from customers, strategically translating them into actions that meet their demands.

The innovation process requires different types of knowledges to fuel the creativity engine, and therefore it requires that organizations generate knowledge from different sources (Paquette, 2016). The knowledge can originate from within the organization, for instance from its own employees, or be acquired from external sources. Customer knowledge plays a significant role in this context. It serves as a valuable source of insights and information that can inspire and inform the innovation process. Companies can enhance their capacity to innovate and develop products or solutions that align closely with customer expectations and demands by capturing effectively what customers want.

The most innovative companies in the world understand the great value of customer knowledge. They don't view customers as mere transactions, but rather recognize them as individuals with unique needs and preferences (Davenport et al., 2001). These companies delve deeper than collecting data and information to forecast customer behavior, instead they seek insights from direct human interactions and dialogues, such as sales and support activities to truly understand their customers (Plyasunov et al., 2017).

This is because customer knowledge more than ensuring alignment of products with the market also serves as a source of business opportunities. Innovators in various industries closely observe how users interact with products, generating fresh ideas and improvements. Even customer feedback, including complaints, serves them as a rich source of innovation (Trott, 2011).

The top innovators in the world value deep customer knowledge in their innovation programs and consider it as the most important capability particularly

in the ideation stage (Jaruzelski et al., 2018). They consistently dedicate efforts to gather customer insights, fully aware that learning from their customers is an ongoing process. Companies like DIC and Adidas exemplify this approach by leveraging direct input from end-users to drive innovation and product development, securing substantial market shares in their respective fields. For these innovative companies, customer knowledge is not just a resource, it's a strategic asset that pushes them to the forefront of their industries.

In this context, organizations striving for innovation and to become industry leaders should strategically generate customer knowledge through a combination of direct interactions, observations, and data analysis. They should also place emphasis in capturing human data from unconventional means. Information and data can help to forecast customer behaviors and market trends, but human data provides deeper understanding of the customer needs (Davenport et al., 2001).

Leonard (2011) explains that in this context the role of marketing professionals cannot be emphasized enough. They are in constant interaction with the customer and market and by absorbing the insights from customers they can envision products and services that add value. These are insights that are particularly critical for new product or service development, and therefore they should act as bridges between the customers and the creators.

Moreover, the sales teams within organizations play a key role generating customer knowledge and new business opportunities. They engage closely and daily with customers, observing and analyzing how they interact with products. They spend a large part of their time with customers in conversations about their own products, needs and learning about competitors. In a way, the sales teams serve as a real-time market research resource, providing information that, if effectively utilized, can be a driving force for innovation (Salesforce Canada, 2019).

Trott (2011) says the sales team plays a crucial role especially in technology-intensive industries, highlighting the need for organizations to develop a qualified salesforce that can act as scientists or engineers capable of engaging customers in meaningful conversations and collecting valuable insights. The role of sales

team is so important that many companies insist their sales teams provide weekly reports on all the companies they have visited, noting any possible product development opportunity.

It's essential to recognize that customer knowledge extends beyond traditional transactional relationships. Entities such as lobby groups, government organizations, and various professional associations, though not conventional customers, hold significant influence over the business environment. Organizations should also acknowledge these stakeholders as valuable sources of external knowledge that impacts the company's operations and help to understand its business context (Paquette, 2006).

This insights on the key role of customer knowledge in driving innovation have important implications for the focus of this thesis. Customer knowledge must be recognized as a strategic asset, emphasizing the importance of effectively harnessing and leveraging customer insights to support product development and innovation initiatives. This helps in bridging the gap between commercial and technical levels by ensuring the alignment between customer demands and the organization's technological capabilities.

However, it is acknowledged that customer and market knowledge is only a piece of the puzzle. To refine the scope of this research, the focus will be on customers engaged in transactional relationships with our organization. This includes those who have either made or have the potential to make purchases or utilize our products. Furthermore, we will prioritize knowledge collected through sales interactions as they play an important role in this context. These individuals serve as the forefront of customer interaction, offering valuable insights into customer needs, preferences, and behaviors. Given their extensive engagement with customers, their role should be strategically positioned to provide invaluable input for new product development.

In summary, these findings support that the effective utilization of customer knowledge is not only crucial for aligning innovation with market demands but also acts as a fuel for generating new business opportunities. Moreover, it highlights also the central role of frontline employees who are in daily contact with

customers in acquiring this knowledge. This reaffirms the central principle of this thesis, stressing the important role of knowledge flow, particularly from customer-facing functions like sales, in pushing innovation within the organization.

2.6.1 Types of customer knowledge

Before moving forward, it is important to recognize the different dimensions of customer knowledge. Customer knowledge is not a uniform topic, but it encompasses a variety and mix of information, insights, and perspectives. The distinction between different types is essential for effective knowledge capture and utilization, especially in the context of innovation.

This research follows Gebert et al.'s (2003) classification of the three primary types of customer knowledge: knowledge for customers, knowledge about customers and knowledge from customers.

Knowledge *for* customers refers to all the information provided by firms to their customers in order to meet their needs. This refers for example knowledge about the firm's products or applications. Knowledge *about* customers is all the information the firm has collected about its customers that help to improve the firm's operations and personalize the interactions with them. This could be for instance, details like their history, connections, requirements, expectations, and what they typically buy. And finally, knowledge *from* customers is referred to all the knowledge held by customers, gathered through interactions with organizations during their operations. Interacting with customers allows firms to obtain this valuable information, which can be used to make continuous improvements, such as enhancing services or developing new product (Gebert et al., 2003).

Plyasunov et al. (2017) explain that the type of knowledge and its purpose are strong determinants of the knowledge capturing instruments that should be used. Therefore, it is crucial to specify that, in the context of this research, our focus is on knowledge from customers. As highlighted by the authors, this type of knowledge plays a vital role in new product development. Companies leverage

insights gathered from potential customers for new product development, as well as conduct market research to identify specific needs.

Knowledge from customers at the same time can be classified into knowledge about products, knowledge about services, knowledge about brand, knowledge about business processes, knowledge about market and knowledge about partners. In the context of this research three main types of knowledge from customers are identified as critical in the process of innovation: knowledge about products, business processes and market (Plyasunov et al., 2017).

Product knowledge is all the information and understanding that customers have about a company's products. It includes things like what features they want in a product and their experiences with it. Market knowledge is about what's happening in their market. It involves market trends, what competitors are doing, and what customers in that industry prefer. Finally, business process knowledge refers to the customer's technologies and how their business and processes work. These types of knowledge are crucial for new product development and innovation. As Plyasunov et al.'s (2017) research shows, these different types of knowledge from customers are used by companies to make sure they're creating and offering products that customers actually want and need. They also help to monitor on what's happening in the larger market to identify opportunities and to stay competitive. Moreover, they dive deep into understanding how their customers' businesses operate to provide solutions that serves them better.

Table 1 presents a summary on the types of knowledge from customers, their purposes and applications and the most common tools or methods used to capture this knowledge.

2.6.2 Importance of customer knowledge management (CKM)

Customer knowledge is part of the intellectual capital of organizations, and it is considered one of the most important resources to achieve competitive advantage. This underscores the importance of its systematic management, aligning it with core knowledge management practices.

TABLE1. Type of knowledge from customers (adapted from Plyasunov et. al, 2017).

Type of knowledge	Application/goals	Tools for capturing
Product knowledge	Features of desired products, positive/negative product experiences, quality enhancements, needs and pain points.	Focus groups, brainstorming, content analysis, surveys, interviews.
Market knowledge	Market trends, competitor analysis, customer preferences.	Surveys, questionnaires, partner portal, seminars and webinars, design thinking tools.
Business process knowledge	Sophisticated projects, new product development, business process improvement, alignment with market needs.	Surveys, trial operation periods.

Customer Knowledge Management (CKM) is recognized as a strategic initiative in forward-thinking organizations, aimed at shifting customers from passive consumers to engaged knowledge-driven collaborators. This approach, refers to a continuous systematic process focused on generating, disseminating, and utilizing customer knowledge within and between organizations. It involves acquiring, sharing, and expanding knowledge present in customers for mutual benefit (Khosravi et al., 2016).

Effectively managing customer knowledge is paramount for organizations, particularly in the context of innovation. However, this can become a challenging task due to the diverse nature of customer knowledge, which covers a wide array of data and information. As Davenport et al. (2001) explain, the key in CKM lies in selectively collecting, storing, and distributing knowledge that is directly relevant to specific activities, thus avoiding the wasting time and resources on useless information.

Organizations often rely on Customer Relation Management (CRM) technologies to efficiently absorb and manage knowledge for, about and from their customers. CRM serves as the central hub for gathering and accessing to up-to-date insights,

preferences, and trends, allowing organizations to construct a comprehensive understanding of customer behavior and provide relevant solutions (Gebert et al., 2003). In this context, there should be a strategic approach that ensures organizations focus their efforts on harnessing the knowledge that genuinely contributes to their innovation and customer-centric objectives.

The integration of CRM and KM concepts has garnered significant attention in both business practice and academia. While these approaches are often viewed as distinct fields of study, Gebert et al. (2003) propose that there exists substantial synergy in adopting an integrated approach. In their work, they emphasize the importance of CKM for successful outcomes in customer-centric processes.

Customer knowledge, when effectively managed, it goes beyond traditional CRM and KM boundaries, becoming a powerful tool for innovation. The challenge, as the authors explained, lies in overcoming the misconception that knowledge inherently possesses value without its application. This perspective shifts the focus towards the practical use of knowledge, emphasizing the need for organizations to align their customer knowledge management efforts with specific business goals and processes (Gebert et al., 2003).

The management of customer knowledge ensures that customer insights reach all processes that benefit from it. CKM enables process owners to pinpoint exactly what they need to know and manage this information effectively to streamline processes and to find opportunities for improvement and optimization. The strategic integration of customer insights into business operations empowers organizations to enhance their offerings and stay ahead in a competitive landscape.

2.7 Factors influencing knowledge sharing in organizations

The significance of knowledge management is to ensure individual knowledge is turned into organizational knowledge and leverage it for competitive advantage. In that sense, knowledge sharing is crucial to ensure the knowledge flows and

that the organization reaches its objectives. As Zahedi et al. (2023) explain, the concept of “flow” in knowledge can be compared to the motion of a wave. Much like a wave moves the sea forward, a continuous stream of knowledge within an organization is crucial for sustaining organizational knowledge. Without this ongoing flow, knowledge may lose its organizational relevance.

In high-tech companies, knowledge flow is particularly crucial due to the advanced technology and technical expertise they handle. These industries rely on innovation and creativity for their growth, thus requiring a robust knowledge management system. This system ensures that individuals access the knowledge they need to drive innovation effectively, ensuring that technological advancements are realized to their full potential.

Many studies have identified barriers and facilitators of knowledge sharing within organizations. This thesis places focus on those factors that can particularly break the connection between commercial and technological levels in an organization. Understanding these factors are crucial to address them and ensure seamless flow of knowledge for driving innovation. After all, the difference between a firm succeeding or not does not lie in their scientific ability or commercial knowledge, but simply in the firm’s internal ability to share information and knowledge (Trott, 2011).

Three major factors can influence knowledge flow within an organization: human, technological and organizational (Khosravi et al., 2016; Razmerita et al.; 2016).

2.7.1 Human factors

Human factors refer to psychological, social, and physical attributes and characteristics of individuals that can influence their knowledge sharing behavior. Various human factors have been recognized in the literature as intrinsic and extrinsic to the individuals.

Intrinsic factors are those that originate from within the employee. These are factors driven by personal beliefs, values, interests, motivation, and inherent

desires. Intrinsic factors are those that come from a genuine sense of purpose or personal satisfaction, rather than external rewards or pressures.

For example, some employees are intrinsically motivated to actively share knowledge because they identify with the organization and genuinely want to contribute to its success. According to Nonaka and Takeuchi (1995), in a knowledge-creating company, the significance of fostering new ideas relates to the development of a strong sense of purpose and shared values within the organization.

These ideals encompass the company's overarching mission, creating an environment where all employees collaborate toward a common objective. Dyer et al. (2000) agree that when individuals identify as part of the collective (firm) the knowledge is more effectively generated, combined and transferred.

Besides commitment to the organization's mission and a strong sense of belonging, job satisfaction, and enjoyment of helping others are also known intrinsic motivators (Razmerita et al., 2016).

Extrinsic factors are related to those that do not come from within the individual, such as recognitions and rewards. This recognition can manifest in various forms, including monetary incentives, public acknowledgment, or opportunities for career advancement. Extrinsic motivators can be influenced by organizations to foster a culture of openness and collaboration, further motivating employees to share their knowledge.

2.7.2 Technology factors

Technology factors are crucial in enabling efficient knowledge management. Technological advancements provide tools and platforms to facilitate seamless communication and information exchange where teams can collaborate and communicate, and where knowledge sharing can occur in real-time.

Khosravi et al. (2016) emphasize that organizations should choose technologies that align with both the individuals and the organization. They highlight that what may be an effective technological solution for one organization may not yield the same results for another. Moreover, the authors say that the technological infrastructure an organization develops should include explicit online repositories, such as Customer Relationship Management (CRM) systems for customer knowledge, as well as knowledge maps with indexed and mapped knowledge for easy access and retrieval. Additionally, other tools are needed which are essential for enhancing communication, collaboration, and coordination among individuals or teams to share tacit knowledge, such as social media platforms.

The development of Artificial Intelligence (AI) technologies also enhances knowledge sharing (KS) in organizations by improving efficiency and strategic decision-making. AI-KS systems enable the creation of knowledge networks and dynamic social graphs that map interactions and pinpoint knowledge flow, aiding in recognizing valuable contributions. For instance, these systems can capture interactions between people and identified knowledge sources and bottlenecks in the organization. However, the success of AI in KS depends on the seamless integration with existing knowledge, the commitment to significant investment, and the motivation of employees to participate (HGS, 2023). Therefore, like other IT tools, AI-KS systems are a support tool rather than a complete solution.

In addition to selecting the appropriate IT, it is equally vital for organizations to invest in the development of their employees' skills in utilizing these platforms. Providing adequate training and support ensures that employees are capable to navigate and utilize these tools for knowledge sharing purposes. This proactive approach not only enhances the efficiency of knowledge sharing processes but also empowers employees to realize the full potential of the technology at their disposal.

Nevertheless, it is important to remember that while technology is essential, it still serves as a tool, not a standalone solution. Individuals still remain responsible for sharing information and knowledge within the organization (HGS, 2023).

2.7.3 Organizational factors

Organizational factors, including goals, culture, and structure, play crucial roles in promoting knowledge flow (Zahedi et al., 2023). It's widely acknowledged that the specific goals and objectives set by an organization are central in guiding knowledge management efforts. Alignment of knowledge sharing initiatives with organizational goals encourages employees to actively engage in knowledge creation, sharing, and utilization. When efforts are not aligned with the organization's goals, a knowledge gap may arise, potentially hindering competitiveness of the organization (Cepeda-Carrión, 2011).

For instance, if an organization aims to enhance customer satisfaction, it needs to clearly define the purpose of acquiring customer knowledge and align CKM efforts with these objectives (Davenport et al., 2001). This focus ensures that knowledge management efforts serve a specific purpose and directly contribute to overall organizational success.

The prevailing culture and values of an organization significantly influence knowledge sharing behaviors. In a culture that emphasizes openness, trust, collaboration, and continuous learning, employees are more inclined to actively engage in knowledge sharing (Seidler-de Alwis et al., 2008). Conversely, in cultures characterized by competition, secrecy, time constraints, and deadline pressure, knowledge sharing may be less prevalent (Rusuli et al., 2011).

Furthermore, the organizational structure should be designed to foster cross-functional cooperation and collaboration, mitigating the tendency for internal departments to function in silos, which can impede the benefits of knowledge sharing (Khosravi et al., 2016). Flat hierarchies and decentralized decision-making structures facilitate information flow more readily compared to highly hierarchical organizations. Additionally, the presence of cross-functional teams or project groups can promote collaboration and knowledge exchange.

2.8 Best practices for connecting the commercial and technological levels

After a comprehensive exploration of knowledge management, innovation, and their relationship, this section summarizes the theory and delves into the identified key points and best practices used by organizations for effectively bridging the gap between commercial and technological levels within organizations.

This section provides strategies based on methodologies and practical approaches from existing literature that have demonstrated success in optimizing this interface. These approaches have proven to be important in aligning technologies with market demands, leading to the creation of innovations and a competitive edge. This section serves as a framework for implementing knowledge-centric approaches in organizations in order to align market and innovations.

The framework presented in Figure 8 focuses on practices related to knowledge acquisition and sharing and they are discussed in more detail in this section. They are derived from a synthesis of the literature, supplemented by case studies and industry insights, providing actionable guidance for organizations keen on enhancing their innovation capabilities.

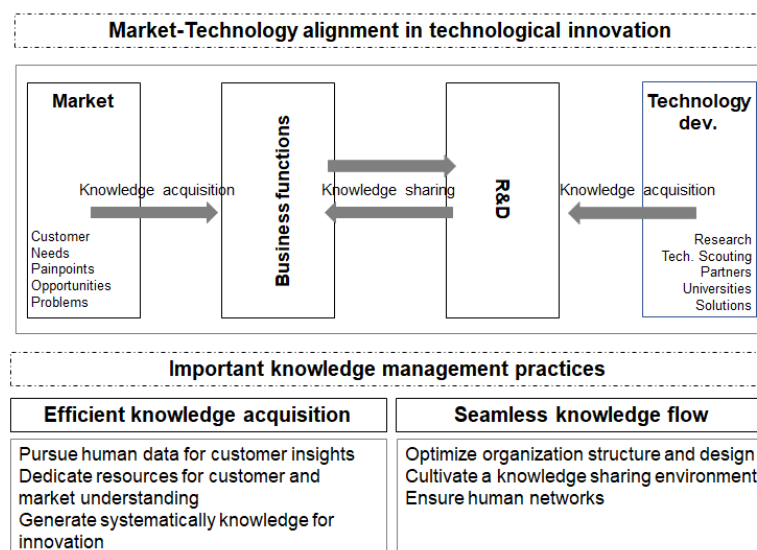


Figure 8. Framework for knowledge management best practices to align market and technology in innovation.

2.8.1 Effective knowledge acquisition

To bridge the gap between technological and commercial levels in an organization, it's crucial to have a deep understanding of market and customer needs. This understanding is the foundation for introducing successful products to the market.

Organizations often rely on a large amount of data gathered from their customers and markets to anticipate trends and create innovative products. However, at times, they struggle with interpreting this data which might be overwhelming and sometimes useless.

Organizations should ensure they effectively capture and generate knowledge that can be leveraged for innovation. The practice from leading companies suggests that the key to successful innovation lies in actively and systematically seeking customer and market knowledge, in combining it to support statistical and quantitative data (i.e. transactional data) and in transforming it into actionable knowledge that drives the innovation process forward.

Best practice #1: Integrating human data for deeper customer insights

Aiming for the right combination of quantitative or transactional data and qualitative data obtained from customer interactions is crucial for creating innovations and gaining a competitive edge. Transactional and market data provides essential insights into customers' purchasing patterns and behaviors, offering a clear view of what customers buy especially in the broader industry they operate. On the other hand, data from customer interactions provides qualitative information, such as feedback, preferences, and pain points. Combining these two types of data enables organizations to not only understand what customers do, but also why they do it (Davenport et al., 2001).

The world's top innovators highly value deep customer insights in their innovation programs, and they emphasize the ongoing nature of customer learning

(Jaruzelski et al., 2018). This deeper understanding forms the foundation for innovative solutions that directly address customer needs and desires. Innovative companies seek to identify customers' true needs by understanding the customers' world and the issues customers face (Cotterman et al., 2009, p. 18). The reality is that customers buy products with a specific purpose in mind - to get a solution, or to accomplish a specific task. It is only when companies adopt the customer's perspective, focusing on facilitating the accomplishment of tasks, that they can begin to discover opportunities for innovation (Bettencourt et al., 2008).

There are different methods organizations use to understand their customers' world and issues they face. For example, Bettencourt and Ulwick (2008) propose an approach called "job mapping", which involves breaking down the tasks that customers want to accomplish into smaller, individual steps. The goal is to use the company's know-how to brainstorm ideas for simplifying these steps, making them quicker, more efficient, or even eliminating them to improve customer experience.

In job mapping, the task the customer wants to accomplish is deconstructed into a sequence of process steps. This detailed analysis allows a company to gain a comprehensive understanding of the moments in the process where customers may seek products or services for help, precisely at each step in the task. A job map can systematically evaluate the main limitations of existing products and services that customers use. Moreover, job mapping helps to recognize metrics customers use to measure the success of task execution which can be translated into features and performance of new products.

Leonard (2011) agrees that non-traditional market research methods are needed to generate new product ideas and match what customers really want with the organization's capabilities. Statistical and highly sophisticated market analysis data is not sufficient for guiding new product development because it lacks the qualitative understanding required to create products or services that genuinely resonate with and address the desires and motivations of the target audience. This is why relying solely on statistical market data can lead to products that may not fully meet customer expectations or desires.

Other authors recommend companies pay close attention to users at the leading edge in their target market and interact frequently to find out what they are doing. This is because lead users recognize needs and problems earlier than others in the same industry and are motivated to find and innovate solutions quickly to their needs. Lead user research offers unique insights and perspectives that can shape preliminary product, service, strategic concepts, and viable business opportunities (Foss et al., 2011; Leonard, 2011).

In conclusion, it's the creative exploration of human data collected from direct customer interactions that distinguishes industry leaders from laggards (Davenport, et al., 2001). Companies should strategically seek for blending transactional data with rich human-centric insights, and continuously source market knowledge (customers, competitors, markets, technologies) to not only to fulfil current expectations but also anticipate future customer needs (Matzler et al., 2007).

Best practice #2: Dedicated resources for market and customer understanding.

Best practice number 2 emphasizes the importance of putting efforts and allocating resources specifically for this purpose, which is fundamental in bridging the gap between technical innovation and commercial success.

The “Most Innovative Companies” research underscores that key to success lies in the ability to think simultaneously about both products and customers (BCG, 2021a). The survey shows that, to achieve this, companies are looking for solutions to ensure market alignment. It was reported that some companies allocate up to half of the overall R&D budget to market-focused business units, which play a key role in determining near-term product development goals.

Companies seeking for customer orientation and market alignment must show true commitment to innovation. Matzler et al. (2007) emphasize that companies should dedicate substantial resources to acquiring market insights and understanding customer needs for enduring success. They explain that that top

performing companies actively engage in market orientation, continuously generating and distributing knowledge about markets and stakeholders. This commitment to market orientation is shown by their willingness to take risks, prioritize innovation and growth, and foster an entrepreneurial culture.

Moreover, Matzler et al. say that decision-makers in the organizations must be prepared to set-up marketing departments that play a proactive role in identifying new market opportunities and which expand their approach to market research activities.

Therefore, the strategic allocation of resources to ensure competence and to understand fully the markets is a fundamental component in the drive companies towards innovation and long-term success in today's dynamic markets (Cotterman et al., 2009).

Best practice #3: Systematic knowledge generation to feed the ideation wheel.

The mere accumulation of information and data is not enough for organizations to achieve meaningful innovation. Knowledge is generated when information is placed in context, filled with meaning, and prepared for practical application. While information may be widely available to a number of companies, only some will be able to convert the information into relevant knowledge and use this knowledge to achieve their goals.

To effectively utilize customer insights for idea generation and innovation, organizations must systematically transform them into actionable knowledge. After processing the information and contextualizing its meaning, such as identifying specific customer needs, this newly formed knowledge becomes a valuable resource. This provides understanding about what customers really want and the problems they need to solve and ensures that the solutions developed are aligned with actual customer needs, leading to more effective and successful innovations.

Boeddrich (2004) says that methodical, systematic and structured procedures at the beginning of the innovation process are needed for effective innovation management. These processes ensure the ideas identified are aligned with the strategic goals of the organization and avoid resources and valuable time are wasted into paying too much attention to ideas that are no good prospects. Cotterman et al. (2009) also pointed out that organizations that create breakthrough products and that are satisfied with their innovation results gather customer knowledge including unmet needs in a systematic way. This strategic alignment of innovation efforts is crucial and is a main characteristic of successful innovators (Jaruzelski et al., 2018).

Organizations that are effective at innovation have a KM system in place with supporting tools and processes that facilitate the collection, analysis, and application of customer data (Plyasunov et al., 2017; Davenport et al., 2001). This is because only when information is systematically codified and classified, it can be shared and fully leveraged (Nonaka, 1991). In fact, leading companies often implement multiple KM processes, each tailored to specific goals. Toyota, for instance, is renowned for its comprehensive approach to KM, employing distinct processes for facilitating knowledge generation, promoting knowledge sharing, and addressing different types of knowledge (tacit and explicit) (Dyer et al., 2001).

KM and IM converged at this point, facilitating the systematic exploitation of knowledge for idea generation. Organizations that want to excel in innovation should have a process in place where data and information collected is analyzed, interpreted, and organized. This entitles identifying the critical needs that must be met so that products can be successful and grouping them by similarity. This work helps prioritizing, decision making and project selection in the innovation process. Moreover, the incorporation of a structured process also provides the opportunity for reflection and continuous optimization (Boeddrich, 2004).

The translation of information into knowledge is particularly important in the context of knowledge gathered from customers by salespersons. This is because quite often it is ambiguous, vague or be in the form of tacit knowledge that needs interpreting and structuring to be able to share it within the organization. Without

timely capture of this information, there is a risk of losing valuable knowledge that may be critical for decision-making or innovation (Nonaka, 1991).

Knowledge from customers gathered by the sales teams should be strategically collected. Customer Relationship Management (CRM) systems are used by sales to capture data, and they can serve as an important and simple tool to systematically capture and extract customer information for the innovation process. Therefore, CRM systems should be designed with a holistic approach, so that they consider the significance of customer knowledge in enhancing innovation in their organization (Mehrabadi et al., 2021).

Midgali (2021, p.119) says that “innovation is one of the major outcomes of effective KM”, and that its benefit is amplified when it supports CRM systems. The author says that CRM has proved to be a highly effective and efficient tool to develop innovation capacity and create a competitive advantage within an organization. CRM is viewed as an imperative strategy to improve a firm’s innovative capacity and to enhance its competitive advantage.

This systematic approach helps to organize the Front End of Innovation (FEI), thus avoiding it turns “fuzzy”. To enhance the effectiveness, top performers dedicate more resources at the beginning of the innovation process. Assigning the right people and investing adequate funds into the FEI phase can significantly boost product innovation success. Many successful innovators devote a higher percentage of their budget to the FEI phase, emphasizing its importance in generating ground-breaking ideas (Giles et al., 2014).

Ulwick (2002) agrees that gatekeepers at the front end of innovation might be needed. For example, moderators are needed that can distinguish between the real outcomes the customer wants rather than the solution they think they want, and organizing the customer input for the company to truly understand how its customers measure value. Transforming the data and turning it into real knowledge requires that the needs are clearly stated, what are the features a product must have (rather than how to do it).

In conclusion, generating the correct knowledge early on to feed the innovation engine is critical. This helps to get the front end of innovation right because it guides everything downstream including idea generation, project selection and prioritization, product development, and so on. Understanding where to direct the company's resources and creative power is crucial, and it's the key factor that distinguishes leading firms in effectively managing the front-end of innovation and consistently achieving positive results (Wood, 2021).

2.8.2 Ensuring seamless knowledge flow

Throughout this literature review it has been much emphasized the need of knowledge flow between commercial or business functions and the technology functions in an organization to ensure appropriate balance between market pull and technology push, therefore creating successful innovations that truly align with the market needs.

That means that organizations have to make sure there is ways for knowledge to flow across functions (Phaal et al., 2000). Knowledge cannot flow without a well-defined knowledge sharing framework that encourages open communication, fosters a culture of collaboration, and provides accessible platforms for the seamless exchange of insights.

Moreover, the organizational structure determines how information moves through different teams and units, making it a critical component of this flow. On an upper level, knowledge sharing requires a shared understanding of the organization's goals and strategic objectives to ensure active participation and engagement from all stakeholders, from top-level executives to frontline employees, in order to facilitate a natural, continuous and fruitful exchange of expertise and ideas.

Best practice #4: An optimized organizational structure and design for knowledge sharing.

The way a company is organized plays a significant role in how it functions. It decides who is in charge, how teams work together, and who does what. But it also affects how people connect and communicate with each other and how decisions are made. Creating a structure that allows for easy sharing of knowledge and resources between different parts of the company is very important to foster innovation. It allows for companies to make smart decisions, solve problems, and work together effectively on new ideas (Szczepańska-Woszczyzna, 2021).

Managers can directly shape how innovative their organization is by setting up the structure in the right way. They should realize that traditional rigid hierarchical structures may hinder dissemination of knowledge and customer insights across different departments (Foss et al., 2011). Instead, a flexible, rather than mechanistic organizational structure, is often considered necessary for successful industrial innovation (Koc et al., 2007; Trott, 2011). Szczepańska-Woszczyzna (2021) explains that more flexibles and horizontal structures are known to be more effective when a company wants to be innovative. For instance, organic structures have less strict rules and fewer layers of management. People have more freedom to do different tasks, they talk to each other more openly, and feel encouraged to share knowledge and ideas.

Structures with limited delegation of decision rights can also pose significant challenges in establishing close customer relationships and accessing valuable customer knowledge (Foss et al, 2011). Organizations that operate with separate departments for development, engineering, marketing, and sales, limit customer feedback exposure, and fail to translate customer insights into innovations. To address these structural challenges, many organizations have introduced innovative organizational approaches.

Davenport et al. (2001) explains that many leading companies have restructured their organization around customer segments rather than product groups. Moreover, they emphasize that placing customer teams in the same physical

location enhances communication and collaboration. Leading companies ensure day-to-day interaction to bridge the product-commercial gap by co-location of people from different functions (BCG, 2021a). Co-location of teams is a straightforward solution to speed knowledge flow as well as to prevent individuals to withhold important customer knowledge. Of course, the structure should also carefully consider not to focus too much on one customer group, otherwise the company is not able to develop generalized solutions (Davenport et al., 2001).

Foss et al. (2011) suggest that the creation of “new ventures teams” in the organization meant to develop new markets and innovations can also improve the sourcing and utilization of customer knowledge. These teams hold the authority to involve individuals from different parts of the organization and connect them with customers. For example, they can “pull” people across the organization when needed, such as development engineers, and take them to customer meetings. The delegation of right to these teams enable collaboration between various departments and process engineers to interact directly with customers.

Khosravi and Hussin (2016) agree that organizations should shift from product-centric to customer-centric structures, and from individualistic to collective work mindset in order to successfully integrate customer knowledge in all business processes. Companies should support cross-functional cooperation and the development of channels for two-way communication with customers and between departments are crucial. Moreover, managing customer knowledge successfully requires making customer knowledge accessible to all employees dealing with customers, even beyond customer-facing departments.

The most innovative companies in the world address the challenge of bringing sales and product teams together by establishing clear lines of communication, mandates, and accountability in their organizations. For example, in multinational organizations the establishment of mirrored structures helps direct connection and clear lines of accountability between central (headquarters) teams and regional (local or branch) teams. The central launch support team plays a crucial role in disseminating insights and discoveries across regions. This enhances knowledge sharing and ensures that insights and discoveries are captured, shared and applied throughout the organization (BCG, 2021b).

An optimized organizational structure and design are fundamental in enabling the flow of knowledge within an organization and across departments. This certainly creates the foundation for a more customer-centric approach, facilitating innovation that aligns more closely with market needs. However, it's important to note that merely structuring or delegating decision rights is insufficient to foster innovation. Organizations must also implement complementary practices to support the change and increase internal communication (Foss et al., 2011).

Best practice #5: Cultivating a knowledge sharing environment.

The development of a culture that promotes open communication and trust is crucial for natural and effortless flow of knowledge within an organization. This is why top performing companies put strong emphasis in the development of their cultures (Matzler et al., 2007).

The “Global Innovator 1000 survey” revealed that 71% of top performing companies affirm having a culture aligned with their innovation objectives. Apple, a well-known industry leader, exemplifies this phenomenon by integrating innovation into its organizational DNA. Apple's unique culture is supported by an emphasis on hiring not only exceptionally smart individuals, but also people capable of cross-functional collaboration. The company values non-political and open-minded employees who focus on ideas and innovation rather than internal politics. This leads to a culture of open communication and idea-sharing suitable to drive innovation. Moreover, Apple values individuals who appreciate different points of view. This fosters a diverse and inclusive culture, where different perspectives are valued, contributing to generation of innovative ideas (Jaruzelski et al., 2018).

The development of such innovative culture is established by an organizational shared purpose that can inspire everyone's work. Employees must understand the vision and be motivated to contribute. Organizational values, shaped by shared beliefs and assumptions, significantly impact knowledge sharing behavior, especially when the contribution of knowledge is well understood.

When individuals identify with the organization's values and feel part of a shared purpose, they become intrinsically motivated and committed to help the organization reach its goals (Nonaka et al., 1995; Razmerita et al., 2016). Promoting this “one-team mentality”, is a key element in fostering knowledge sharing.

This shared purpose can be extended beyond the organizational goal's and adopted internally to create a collaborative environment. For example, companies can create cross-functional teams by bringing together individuals from different areas of expertise, like sales, operations, and so, to work collectively on projects from start to finish (BCG, 2021b). This way, each member becomes an essential part of the team, contributing with their unique skills towards a common goal. This collaborative mindset breaks down silos within the organization, encouraging open communication and deeper insights. When employees have a holistic view of the organization, they are more likely to recognize the importance of knowledge sharing. They understand that insights, information, and expertise from different parts of the company can be valuable in addressing common issues, fostering innovation, and improving overall performance.

In the context of customer-centricity, encouraging employees to proactively acquire and share knowledge from customers can be a challenge, but it is essential. Foss et al. (2011) say that the motivation can come from recognizing the value of customer insights for innovation. Employees can find commitment when they understand what it means and why it matters to the customers. It can take time, but organizations should place emphasis to help employees understand how customer knowledge offers deeper insights and understanding (Davenport et al., 2001).

Organizations can further motivate employees to actively participate in knowledge sharing through the introduction of monetary rewards. Performance-based bonuses, recognition awards, and other financial incentives can serve as powerful tools to acknowledge and appreciate the valuable contributions of individuals. These incentives not only recognize the efforts of employees but also provide benefits that can enhance their overall job satisfaction. However, it's

important to note that while monetary rewards can be effective, they are most effective when combined with a supportive organizational culture and a clear sense of shared purpose, creating a comprehensive approach to encourage knowledge sharing.

Best practice #6: Leveraging human networks to disseminate knowledge across the organization.

Knowledge sharing within an organization can be achieved by a variety of tools and platforms, including IT technologies and knowledge repositories. However, it's crucial to recognize that face-to-face interactions remain indispensable for the seamless transfer of knowledge. (Davenport et al., 2001). To facilitate this, organizations employ various mechanisms, including multidisciplinary teams and job rotation (Phaal et al., 2000).

Job rotation, a mechanism that encourages employees to periodically switch roles and responsibilities, plays a significant role in facilitating the flow of knowledge. Strategic rotation, especially between different areas of technology and between functions such as R&D and marketing, creates redundancy and helps employees understand the business from multiple perspectives. This enhances organizational knowledge flow and its practical application (Nonaka et al., 1995). Moreover, when individuals from R&D rotate into business units (or vice versa), they bring specialized knowledge from their previous roles. This knowledge transfer can lead to different types of innovative solutions.

In the same way, the creation of multidisciplinary teams brings together different perspectives, skills and expertise to find comprehensive solutions. They expose their team members with a diverse range of perspective and insights which enriches the understanding of a certain subject. This open communication and sharing of knowledge prevent information from being isolated within specific departments and, as a result, help break down organizational silos which typically prevent the flow of information. Multidisciplinary teams are a key characteristic shared by innovation leaders, especially to bring sales and product teams together (BCG, 2021a).

It is crucial for organizations to encourage interactions among employees, particularly those in the same business unit or who serve common customers. Ensuring that these employees work in close physical proximity within the offices facilitates daily face-to-face interactions. This, in turn, amplifies the casual exchange of invaluable customer insights. Such an environment naturally fosters the sharing of pertinent information, ultimately fueling idea generation (Davenport et al., 2001).

Bringing people together for brainstorming sessions, where people from various roles and backgrounds share their thoughts, are a powerful way to spark creativity in a cross-functional setting. This taps into both their obvious skills and their hidden experiences (Seidler-de Alwis et al., 2008). For larger firms, this is especially important as they possess extensive market and technological knowledge. This expertise is crucial for leveraging the accumulative nature of learning, which in turn enhances the quality of ideas (Koc et al., 2007).

Affinity groups and yearly meetings that foster collaboration between R&D and business development teams represent crucial initiatives in promoting cross-functional interaction. These platforms not only facilitate the showcasing of advanced technologies and early product concepts but also ensure buy-in from the business units, reinforcing the equal partnership between commercial and R&D functions (BCG, 2021b).

Moreover, effective communication should be encouraged within the organization. This is particularly important in the context of bringing together business and R&D functions because the timing of when information is shared plays a crucial role in facilitating cooperation. In other words, the success of collaboration between these two areas depends on when and how information is communicated and shared within the organization. Proper timing ensures that both technology and market teams can work together efficiently and effectively (Brem et al., 2009).

3 METHODOLOGY

3.1 Research approach

The aim of the research was divided in two parts. Research question #1 addresses the first part, which involves understanding the knowledge management practices and mechanisms used by organizations to ensure market-technology alignment for innovation (see Figure 8). Research question #2 aims to evaluate how these best practices can be implemented in other organizations, in this case in the business context of Vaisala's Industrial Measurements (VIM).

The research aims to study the current approach of VIM organization regarding technological innovation management and the knowledge management practices used to facilitate essential knowledge transfer between the commercial and product dimensions (see Figure 1). Specifically, the focus is on the business functions of Product Management and Sales, together with the technological dimension represented by the R&D department.

Product management teams are decision-makers responsible to drive product development and business growth and should be included in the research. Sales teams were included in the research scope as secondary representation of the business side, because of their unique position at the customer interface and their role in capturing knowledge from customers. The research scope focuses on the technology development team as part of technology (R&D) level.

The research approach focuses on a current state analysis of the company, including its existing processes, related documents, and on-site observation of the company's structure and layout. This input is aimed to gain understanding of how new products are innovated and the dynamics between these departments in the organization.

A semi-structured interview is used to help process owners and decision-makers to articulate their customer and market knowledge requirements, both for generating ideas and for sustaining the innovation process.

At the same time, the interview aims to discern the knowledge generated and available in the organization from the sales teams with the objective to identify possible knowledge gaps. The interview also allows to capture directly from the persons involved in the process how they perceive knowledge flows between business and technical functions. The results are used to support the findings from observations on site and through reading documents.

Recommendations then will be given based on the best practices presented in section 2.8 to ensure alignment between commercial and technology departments.

3.2 Data collection instrument

As mentioned above, this case study was based on interviews with individuals from different departments in the VIM organization (Product Management, Sales and R&D). A total of 10 interviews were performed. The interviews lasted between 35 to 65 minutes.

The semi-structured interview format was chosen for this study. In this type of interview, the protocol offers flexibility, allowing for variations in both the questions and their delivery. This provides the opportunity to delve deeper into responses if necessary. Some questions are open-ended, enabling the interviewee to freely express their thoughts, while others may be more focused, drawing on the participant's existing knowledge in the field of study. Semi-structured interviews were deemed suitable as they offer adaptability to various research objectives (Galleta et al., 2013).

The interview protocol is presented in Appendix 1. The structure and questions were designed to match the objectives and goal of the research and to progressively explore and gain understanding of the topic under study.

The interview protocol consisted of 4 main parts. The first part focused on introducing the research purpose and the researcher to the interviewee. In addition, a couple of open broad questions are asked to capture information from the interviewees on their role in the VIM organization, as well as their perceived role in the organization's innovation chain. This latter question was intended to elicit from the interviewee the central story that guided the interview and create space for them to narrate their experiences (Galleta et al., 2013). This question provided context and set the stage for the rest of the interview. It was meant to allow the participant to establish their perspective within the innovation process, which can serve as a valuable frame of reference for their subsequent responses.

The second segment of the protocol was tailored to each department, aiming to gain insight into the current practices that facilitate the connection between the commercial and technological aspects within the organization. Its purpose was also to reveal any potential knowledge gaps or bottlenecks in the process of knowledge sharing across departments. For Product Management and R&D, the questions are focused around identifying the knowledge requirements for generating new product ideas and facilitating decision-making processes, as well as the methods employed to access this knowledge. In the case of the sales function, the focus was on their efforts and the type of knowledge they gather from customers. Additionally, for all departments, this segment delves further into how knowledge is effectively communicated across departments.

Finally, the third and fourth part of the protocol focused on discussing challenges, opportunities, and successful practices in sharing knowledge and achieving cross-functional collaboration between Sales, Product Management, and R&D. The interviewees are also given at the end the opportunity to provide recommendations for improving knowledge flow and enhancing idea generation within the VIM organization.

Before conducting the main interviews, a pilot test of the interview protocol was performed with a participant who met the criteria for inclusion in the study. This pilot session aimed at providing valuable insights into the effectiveness of the

questions, their phrasing, and the overall structure of the interview (Galleta et al., 2013).

3.3 Interviewees' profile

The participants chosen for the interviews were selected carefully from the VIM organization (Product Management, R&D and sales) to meet a criteria. The criteria were developed based on theoretical understanding, practical considerations, and the characteristics of the organization.

The primary criterion was to select individuals actively involved in the new product development or innovation process within the organization. This ensured that the participants had direct experience with processes relevant to this research and were able to provide insights into the organization's approach to aligning market needs with technological capabilities.

The research also targeted individuals with at least 5 years in the organization. This criterion was established based on the assumption that such experience would allow individuals to have a deep understanding of the organization's processes and culture. Experienced participants are more likely to provide nuanced insights into the evolution of practices, the impact of different strategies, and the complexities of cross-departmental collaboration.

Moreover, preference was given to individuals who have experience in cross-functional collaboration or in working in several roles between departments, particularly between commercial and technological functions. This is based on the idea that individuals with cross-functional experience can offer a unique perspective that bridges the gap between different organizational silos. They are likely to have a broader understanding of how different parts of the organization interact and the challenges and opportunities that arise from these interactions.

Lastly, the research focused on including participants from all product areas in the organization. This criterion was crucial to avoid biases that might emerge from focusing on a single product area. It ensured that the interviews captured a wide

range of experiences and perspectives, thereby enriching the data by considering differences in product types, market demands, and team practices and cultures.

The list of participants selected is presented in TABLE 2.

TABLE 2. List of participants selected for the interviews and data collection.

Participant	Role in the organization	Department
1	Director, Technology Strategy	Products and Systems
2	Head of Business Development	Sales
3	Chief Scientist	R&D
4	Product Manager	Product Area
5	Technology Manager	R&D
6	Sales Manager	Sales
7	Director	Product Area
8	Head of Region	Sales
9	Sales Manager	Sales
10	Vice-president	Products and Systems

3.4 Limitations in the research approach

This research aimed for a comprehensive approach; however, it was still subjected to certain inherent limitations due to the chosen data collection method.

The number of interviews in this research was limited to 10 due to time limitation. Although this amount provided rich data, it still presents a constraint to the diversity of perspectives, particularly considering the organizational structure of VIM. For instance, the product management department in VIM have multiple managers with distinct approaches. Therefore, interviewing only few of them may not capture the full reality of views within the department. Although the research included directors and managers overseeing the teams to provide a more encompassing view, the limitation of not including more voices and its effect on the data collected it is still acknowledged.

The focus on participants with extensive experience and cross-functional roles may also have overlooked insights from other key employees. Although this focus was intentional to capture the interplay between commercial and technological

functions, it potentially excluded perspectives from others directly involved in the technology development process, such as scientists and engineers. To mitigate this, previously conducted internal surveys were used to integrate a broader scope of experiences and viewpoints.

The presence of the researcher during interviews might have influenced responses due to social desirability bias, where participants could tailor their answers to what they perceived as expected. Some participants also initially felt intimidated, which could influence the openness of their responses. However, the significance of the research topic within the organization and the assurance of anonymity likely encouraged participants to share their genuine perspectives.

These acknowledged limitations define the research findings and emphasize the importance of a cautious and balanced interpretation of the results.

3.5 Interviews' results analysis

The data collected in the interviews was transcribed and analyzed in Microsoft Word. After reading the answers from the participants, the data was coded by using a hybrid coding method, combining both inductive and deductive approaches.

Deductive coding involved creating a set of predefined codes (also known as propositions). Inductive coding was used when new themes, patterns, or concepts emerged in the data that did not fit the initial propositions. This method allowed for keeping an open mind, and for the generation of new codes that were not originally anticipated.

The original propositions for the coding were based on section 2.8 in this report, which focus on the best practices used by organizations to ensure technology and market alignment from an early stage on the innovation process. These best practices were used as they reflect important theoretical issues that guide where to look for relevant evidence (Yin et al., 2018). The original propositions served

as themes and sub-themes to draw initial codes to link the data to the research questions (Atkinson, 2002).

The pilot interview was used to check the validity of the codes and create more codes if needed. The pilot interview revealed the initial propositions fitted well the flow of the interview, but in some instances some new codes were needed.

The coded data was then processed in Microsoft Excel tool, which made it easier to group, refine and filter to fit the needs of the analytical approach.

3.6 Ethical considerations in data collection and analysis

Since this research involved that participation of humans, particularly through face-to-face interviews, it was crucial to address concerns related to privacy and data protection.

Prior to the interviews, potential participants received invitations detailing the research processes. They were explicitly informed that the interviews would be recorded to enhance the accuracy of transcriptions. Additionally, participants were assured of the confidentiality of their responses, with a clear statement that all transcription records would be accessed only by the researcher and securely disposed after the completion of the project.

To reinforce ethical integrity, participants were also reminded of the data protection and privacy also at the beginning of each interview session. This served not only as a reaffirmation of the initial agreement but also as an opportunity to secure their consent explicitly before starting the recording (See interview protocol in Appendix 1). At the beginning of the interview the approach to data analysis was also explained, emphasizing that the results would be presented on a departmental rather than personal approach.

The project adhered to the principle of informed consent, ensuring that participants were aware of the nature and purpose of the data collection, and how their information would be used.

4 RESULTS AND FINDINGS

This research focuses on the role of knowledge management practices on technological innovation management, more specifically, how knowledge management practices can be leveraged by organizations to create market-technology alignment and ensure the generation of robust ideas for products, which align closely with customer needs.

This section explores results and finding from the research obtained through the semi-structured interviews, internal documents, meeting memos and observation for key factors affecting knowledge acquisition and sharing. The results focus on the status of knowledge acquisition and generation that supports innovation, as well as the sharing of this knowledge between business and technology levels.

4.1 Knowledge acquisition for customer and market understanding

4.1.1 Product management teams

The acquisition and management of knowledge from customers appear central to the role of product management teams in the organization. They are responsible for comprehensive customer understanding and consolidating information and knowledge to develop a global perspective on customer and market needs. Product managers are expected to continuously learn about the markets and customers at the same time they manage other tasks such as product portfolio.

Participants from product management agree that in order to drive innovation and make decisions they require concrete market or industry knowledge, but also specific knowledge gathered directly from the customers. Efforts are made to try to balance between market trends with customer-specific requirements. This mix of knowledge is identified as the key knowledge requirement for product managers at Vaisala. As one participant from product area stated:

"I think there are different types of knowledge that it's important to have. A general market understanding, and then customer understanding. They are not the same. It's the combination of these we need to have to make right decisions on business investment decisions on new products".

In general, data reveals knowledge from customers is valued. Product managers employ a range of methods to seek knowledge from customers and gain a deeper understanding of customer needs. These include customer visits, as well as participation in trade shows and events, which allow them to connect with customers directly and gain firsthand insights.

Product managers also monitor competitor activities, for instance thorough competitors' products and marketing materials on the internet. This practice helps in understanding industry trends and competitive dynamics.

In addition, product management considers the sales department as an important and the primary source of knowledge, with their interactions with customers serving as a crucial channel for knowledge acquisition. One participant emphasized this, stating:

"That kind of input for doing product development or improving the product, it mostly comes from the sales. I would say that this is the primary source."

A close collaboration with distributors and joint customer visits is recognized as essential for gathering customer knowledge effectively. This approach fosters productive discussions and information sharing. Product managers perceived the collaboration with their sales network at a good level. However, they also stated that this knowledge is not systematically collected.

All participants from product management also highlight the difficulties they face as they deal with a large and diverse customer base. The challenge lies in finding the commonalities to drive technologies and products development that can cater customers in different industries which have different requirements. Product managers perceive as difficult the acquisition of sufficient customer contacts to generalize data effectively. One participant expressed this challenge by saying:

“In our line of business, at least I personally feel that it's a little bit difficult to arrange a sufficient amount of customer contacts in order to get a large enough sample, sufficient data, and to make decisions.”

Therefore, product managers accept it is not possible to understand all customers at a deep level and tend to prioritize their efforts on what can they really understand. Overcoming this challenge is perceived as a key strength of product managers and one of the biggest responsibilities they have. One participant explained it as:

“The biggest job of product management is to find the signal between noise. They should be able to understand customers, but not single customers, but customer groups, entities globally in a market space.”

In this sense, the sales teams are instrumental to create customer understanding by relaying customer insights from different regions in the world to the product management team, to provide sufficient input that help them consolidate from a global perspective the customer needs.

Product managers use also in the knowledge captured by the sales managers in the organization's CRM systems. They acknowledged the importance of CRM systems as a source of information for understanding customer and market dynamics. However, challenges arise when there is need to analyze large volumes of free-text data to find recurring patterns and opportunities for innovation.

Unclearities also arise regarding ownership of gathering knowledge regarding customers and markets. A product manager raised questions about how to obtain systematic feedback, and who is responsible for examining industries that could bring future success, and the level of detail required in this analysis.

“How do we get systematical feedback and who's looking into what are the industries that could drive our business in the future... I'm not sure who is doing that on a high degree of detail.”

Product managers rely on the sales team's insights for identifying and understanding opportunities for innovation in new markets. However, the current way of working places the sales team's focus on existing markets. This situation is encapsulated by a product manager's observation:

"If we have a totally new, market or business, where our sales department is not really involved, then we don't have resources and time in our sales team to go and dig deeper on those."

Product management teams present different approach to generate knowledge for customer and market understanding. While in some teams this is responsibility of the product managers, in one team they have dedicated resources for business development in different industries to assist the product manager in driving product development and finding opportunities for innovation.

4.1.2 Sales teams

The data collected from interviews with sales professionals offers valuable insights into the current dynamics of their knowledge acquisition efforts. In general, sales teams exhibit a proactive approach to engaging with customers, seeking to understand their processes, requirements and needs.

Participants from the sales teams expressed they actively gather application knowledge, asking critical questions about the functionality and suitability of the company's products for specific customer tasks. This inquiry extends into a comparative analysis with competitors, as sales personnel collect data on alternative methods and technologies used by customers.

Participants from the sales team show a customer-centric approach that facilitates a deeper understanding of the customer's needs. For example, one participant highlighted the intention to not merely sell a product but to act as a problem-solving friend for the customer:

"I try to collect information about their process. What they are looking for and trying to do before proposing a solution to solve their issues."

Sales team members also acknowledge the dynamic nature of the markets and the need for continuous learning and listening to customer needs. There were remarks on how they contribute to the innovation process by identifying customer needs that the company is not currently meeting:

"If we hear something, and we hear it repeatedly, we know that this is information that the product management and R&D would like to know to be able to find out if there's a business potential there."

There are key factors sales deem as facilitators in the interactions with customers and in collecting relevant knowledge. The importance of having a knowledgeable sales force with the right education to sell the company's products becomes apparent, as sales teams' members leverage their background and expertise to not only propose products, but also suggest alternative solutions. The expertise of the salesforce in the field cultivates trust and motivates the customer to share more information. The emphasis is on being more than just a salesperson, acting as a helpful resource and friend to the customer.

Additionally, the emphasis on relationship building emerged as a key strategy, with sales professionals highlighting the significance of creating a friendly and collaborative atmosphere during interactions. This relational approach was viewed as instrumental in gaining access to valuable customer insights. Moreover, the brand recognition of Vaisala was identified as a valuable asset, acting as a facilitator in initiating discussions with customers.

The sales team focus to gather information not only from customer opportunities, but also from lost projects. There are dedicated roles inside the sales organization dedicated to business development and to study alignment of products with customer needs, pre- and post- launch, as well as to further analyze lost projects to leverage that information for innovation. This role though, does not exist in all sales regions.

The collaboration with external agents and distributors is acknowledged as crucial. Extracting relevant information from these external sources is considered a vital step in broadening the scope of knowledge acquisition. One sales manager stated:

“We get more open and honest input from our distributors as they speak with the voice of several customers. While we visit a few customers during the week when we are traveling, our distributors they visit a lot of customers on an everyday basis, and they develop a better view from the market and what's needed there.”

Sales consider the distributors as important partners also when it comes to knowledge flow into the organization and the innovation chain as they know better their markets. At the moment, this input from agents and distributors is communicated a lot through informal communications, for instance by e-mails and calls, and it is not captured in any system.

It was perceived during the interview the differences in capturing customer knowledge that is around different markets where the organization operates in. Smaller business areas are more active in studying customer needs and learning from lost projects than the more mature markets. Sales working with established markets and products find it more challenging to capture knowledge from customers as the orders flow naturally. A member of the sales team explained this stating:

“The reality is that this business has been established for 40-50 years and it has so much momentum... so most orders come to us naturally and we don't know much about them”.

In such established markets, the experience and intrinsic motivation of salespersons play a crucial role to put effort to capture any customer knowledge from orders. As one sales participant explained, the drive to gather and share market insights must go beyond merely meeting key performance indicators:

“Our sales should be proactive to capture knowledge from their own market and be motivated to share info from the market. Numbers are growing everywhere in

Europe, and so they say that's enough. Why do I have to do something more and or in another way?"

The information or knowledge gathered by the sales teams during interaction with customers and distributors for example in customer visits, exhibitions and meetings is typically captured in the organization's CRM systems or then share informally internally with product managers through e-mails, or online platforms such as Teams chats. However, not every case is captured in the system.

There are variations in the use of CRM systems to capture the knowledge from customers. Perceived challenges are the lack of time and prioritization to record customer opportunities in the system. Sales teams' members prioritize meeting key performance indicators (KPIs, such as net sales) and do not see value in spending time writing down information in the system. They more often tend to write details of a sales opportunity is case only if the sales deal is large, or when the order has already come.

This challenge in getting sales team members in capturing information in the CRM system is acknowledged by management. They also acknowledge the need for systematic knowledge generation from sales activities and opportunities, emphasizing the importance of capturing sufficient data for analyzing trends and patterns for strategic decision-making.

While data shows there is are active efforts to gather knowledge from customers, it was also mentioned during the interviews the possible interplay between the organization's position as market leader and customer knowledge acquisition. Participants feel there should be a balance between market leadership with a deep understanding of customer needs and warn against falling into complacency. This was summarized by a participant of the sales team:

"We are leading. We have the knowledge, the brand, the quality, but it could be useful to incorporate some humility — to listen to the customer, monitor the competitor's portfolio, and adapt our instruments or philosophy. This approach will help us be closer to our customers."

The results and findings on knowledge acquisition from sales and product management teams are summarized in Table 3.

TABLE 3. Summary of methods and knowledge from customer acquired by business teams (Sales and Product Management).

Aspect	Product management	Sales
Role in knowledge acquisition	Central to role; responsible for consolidating customer and market insights.	Proactive and daily engagement with customers to understand their needs and processes.
Key knowledge requirements	Market trends, customer-specific requirements, global customer understanding.	Application knowledge, competitor analysis, customer requirements and needs in assigned areas.
Methods	Customer visits, trade shows, monitoring competitors, collaboration with sales and distributors.	Customer visits, comparative analysis with competitors, relationship building with customers, studying lost projects.
Sources of knowledge	Primarily from sales teams, CRM systems, and direct customer interaction.	Direct interaction with customers and distributors or agents.
Approach to customer understanding	Seeks a global perspective, understanding customer groups and entities.	Customer-centric, focusing on solving customer issues and understanding their processes.
Collaboration with external agents	Depends on product area; some have structured collaboration; others lack systematic approach.	Crucial for broadening knowledge scope; relies on distributors for wider market insights.
Challenges	Balancing market trends with specific customer needs, handling diverse customer base, analyzing CRM data.	Time constraints, prioritizing sales targets over data entry in CRM systems, capturing knowledge in established markets.

4.2 Knowledge sharing and collaboration

4.2.1 Business-business level

Effective knowledge sharing across business departments (represented by sales and product managers in this research) is important because it ensures that critical insights from customer interactions translate into knowledge that can help identify opportunities in the market and fuel innovation.

Sales teams are uniquely positioned to engage directly with customers to gather real-time market needs and competitive intelligence. When knowledge from customer is efficiently shared with product managers, it can lead to the development of new products and services that are closely aligned with customer demands, thereby enhancing the company's competitive edge. However, if the current practices limit this flow of knowledge it can result in missed opportunities, slower reaction to market changes and misalignment of products with the evolving preferences and requirements of the customers.

The participants' perceptions of the current level of knowledge sharing across the business level vary in terms of engagement and effectiveness. There is a mix of structured and unstructured practices in place, reflecting both strengths and areas for improvement.

Knowledge and insights captured from customers and market by sales employees is typically communicated to product management through several tools and platforms. The interviews reveal most knowledge and information sharing happens through emails, Teams chats and calls. Knowledge sharing also happens in person during the time product managers travel together with sales for customer visits. Moreover, online forums to ask technical questions to product management teams is also a way to communicate open projects and customer cases.

There are also regular meetings between sales teams (e.g. regional and sub-regional) and product management teams. The calls are recorded and shared

through the intranet for persons who were not able to attend. Some product areas also have calls for global sales teams. However, sales teams perceive these calls as one-way communication where only numbers about sales targets are presented and they do not have the opportunity to provide their own insights:

"In the one-hour regional calls we typically don't have much of a chance to give feedback... or then we have understood its purpose wrong".

One product manager also explains that sharing of customer and market knowledge typically happens through unstructured and informal feedback sessions:

"We don't have any regular meetings to give customer feedback or such. So, it's mostly informal type of communication."

Results show clear differences on knowledge sharing practices between product areas. For instance, one product management team keep working groups with selected participants from sales and product managers that work globally around a target customer base as a platform for learning through knowledge sharing about the needs of the customers. The idea is to share customer needs and find patterns in customers that can identify opportunities and develop products that truly meet customers' needs. However, it is a practice that sales from other product areas are lacking. They express they are missing the right platform to share needs from specific customers or industries.

Product managers sit in proximity to sales managers and spontaneous conversations, for example over coffee breaks, happen to discuss market insights and feedback from customer interactions and are considered very important.

However, there does not seem to be a clear process where sales could share knowledge effectively with product managers. Knowledge capture in the CRM system, as explained in the previous section, is not consistently and the tool as such is perceived as an unsuitable for sharing knowledge and for analytics. However, sales teams are still eager to share knowledge gathered from customers to product area and wish for a more efficient and clear way to do it.

One participant summarized this by expressing uncertainty on the existing methods to share customer knowledge to product managers:

“What is the channel and a platform that sales could, on a frequent basis, give feedback to the product area so that they would know what's going on in the market? We don't have that.”

Participants from the sales team highlight the challenges related to the lack of clear processes and platforms for knowledge sharing, where they can on frequent basis share customer and market insights. They emphasize the need for a structured approach. They wish for a structured way for product areas to analyze easily the data provide by them, to find patterns and run innovation.

When it comes to knowledge sharing from sales to product areas, the attitudes are similar to that of capturing knowledge from customers, with some salespersons eager to share information, but others holding back. However, in general there seems to be a positive attitude to knowledge sharing. One participant highlighted the proactive approach from sales to share knowledge from customers:

“I feel that the sales team is proactive, and when they see potential somewhere, they communicate it to the product areas.”

Another participant also highlights the positive attitude of sales to share what they capture from customers, but remarking there is room for making knowledge sharing seamless:

“If you ask, they start immediately telling. They are happy to share, but we have to make it easier”.

While data suggest a proactive approach from the salespersons to product area, it also suggests a potential gap in the proactive solicitation of knowledge by product managers. One participant from the sales team states:

“It's impossible to pass knowledge on competitors' products. I haven't had a chance to share my experience to someone in Vaisala. It's a pity because knowing competitors, we could improve and benefit from that.”

Some factors that can hinder knowledge sharing at the business level came up during the interviews. Salespersons highlight concern for information overload, causing sales teams to be reluctant to share insights if they feel it would not be processed effectively, or could lead to an excess of information for product management to handle. They also question whether the knowledge shared to product management is reaching the right audience or being utilized at all.

There is also the feeling that the collaboration between sales and product managers can be a one-sided flow of communication where sales input is not reciprocated with feedback or information from product management, leading to frustration and a potential decrease in further communication attempts.

Moreover, there seems to be a lack of motivation and incentive for sales teams to share knowledge. Sales teams are rewarded on sales outcomes, but knowledge capture and sharing are assumed to be inherent to their job. Finally, the topic of unsuitable tools and processes also are common perceived barriers to knowledge sharing.

4.2.2 Business-technology level

Knowledge sharing between business (product area and sales) and technology levels (R&D) is essential for driving innovation and maintaining competitive advantage. Effective knowledge sharing between these teams ensures that market needs are accurately translated into technological developments and that the innovative potential of R&D can be directed towards commercially viable solutions.

Data collected in this research express clear efforts in the organization to facilitate knowledge sharing between these two departments by using a blend of structured

mechanisms to support cross-functional dialogue. However, it becomes clear there are different perspectives and practices from both departments.

From the product management perspective, it is acknowledged the importance of their role in conveying knowledge from customers and market to R&D. As explained by one participant:

“It’s the role and responsibility of the product manager to bring a consolidated view of the market needs to R&D.”

Therefore, members from the product management teams engage in different practices to share market and customer knowledge with R&D. For example, annual strategy meetings are organized where product managers present to R&D managers market strategies and business statuses. Regular meetings are also kept within the product management and R&D leadership teams, where product areas update their business highlights and concerns and R&D present updates regarding technology development. There are also different types of info calls that include the R&D employees where sometimes customer cases are presented. Some product areas also run what are known as “business hubs” where customer and sales cases are also introduced.

These regular meetings are means to create the connection between the market and R&D staff. Joint customer visits are rare but are still sometimes organized. Product management recognizes that while customer visits are an invaluable avenue for gaining firsthand market insights, the practicality of involving a large R&D team in regular customer interactions presents logistical challenges. As one member of the product management team pointed out:

“We have such a big R&D team. We cannot bring all of them to customers every day, so we need to have other ways of working to bring more of the market needs to R&D.”

Despite the efforts to convey customer and markets insights to R&D, product managers still perceive challenges. They feel it is difficult to disseminate knowledge and information throughout the broader R&D team and to translate

customer knowledge and market insights into early actions for the R&D team. A member of the product manager team states that:

“What more can we do so that we transfer at early phases of development market and customer knowledge to R&D? That’s the million dollars question.”

Product managers also have the feeling they need to re-educate and re-establish fundamental market knowledge with R&D teams in product development projects, despite the organization having many years of market presence and accumulated experience with their products. They feel although a lot of knowledge is shared, each new project still represents a fresh start, rather than a continuation upon existing insights and experiences. One participant from product management articulated this disconnect, stating:

“... We are in the market, we have been for many years, and we already have experience in these products. But when we start to initiate a product development project, it often feels that we start from zero, and we need to start explaining to R&D the very basics of the market.”

From the R&D perspective though, the flow of knowledge on market trends and customer needs could be more regular and continuous. Especially the sharing of strategic goals and vision comes up in the research from the point of view of R&D as “scarce”. Such gaps in communication can be critical, particularly in an innovation-driven environment where understanding market needs, and strategic direction is vital for R&D to align its efforts effectively.

In a recent survey performed to the technology development team it became clear the team is missing improved internal collaboration and communication with product management teams, as well as clear goals, especially long-term plans, strategic goals, and areas where innovations are particularly needed.

One participant in the interviews also supported this thought by saying R&D members seek clearer direction and more substantial input from product areas to better understand focal points for innovation and technology development:

“People really want to have clear direction and understanding where we are aiming to be... we need to have more input from the product areas on what would be interesting and where should we concentrate.”

Data from all teams show that cross-functional collaboration is valued, however, it is described as limited in daily practice. Some members from R&D might have frequent interaction with business functions, but it seems to be limited to expert roles or employees with longer track in the organization.

Communication and collaboration between product managers and R&D teams is more prevalent during active projects. Daily interaction, however, is limited. Many participants, both from product management and R&D referred during the interview to the time when teams were in proximity to each other and when spontaneous communication was possible. One participant stated this as:

“Now it's maybe a little bit different and maybe it relates also to the remote work style too. You don't get to see spontaneously people on the corridors or in the cafeteria or coffee machine. That's the important part of everyday information transfer.”

Both teams, product management and R&D also agree that there is need for a bi-directional exchange of knowledge, where not only market needs but also technological possibilities are shared.

Many participants refer to the “technology push events”, which are special occasions where R&D showcases new ideas and capabilities they are exploring or developing. These events are intended to stimulate discussions about market opportunities for new technologies. However, these events have not been organized recently, partly due to the Covid-19 pandemic.

In addition to these events, knowledge sharing occurs within the context of ongoing projects, particularly in the concepting and feasibility study phases, where product managers and R&D teams meet to discuss customer needs and market opportunities. However, it was pointed out this type of meetings are not very cross-functional at the early phases of development. The cross-functional

collaboration in these steering groups is perceived as crucial, as stated by one participant from R&D:

“These interactions are really crucial for developing really good products and innovations.”

In general, it seems there is a realization of the importance of ensuring knowledge sharing between business and technology levels. More recent practices include the development of a technology strategy including members from both product management and R&D teams. Moreover, for the future there are plans also for running regular technology sharing sessions, at organization level, and also at technology development level sharing sessions. These sessions are designed to disseminate information about current developments and upcoming innovations from R&D to the rest of the organization, including product areas. One participant explained:

“We will have actually a technology sharing event where we are sharing every quarter kind of what's happening, what's coming up to the businesses functions and product areas.”

Knowledge sharing between R&D and other business functions, such as sales, is not frequent and may also depend on the roles. The workflow in the organization is designed so that product managers are the gatekeepers of customer and market knowledge and communicate it to R&D. This was explained by one sales participant:

“Sales is not really in touch with R&D, which may or may not be good thing. On the other hand, everybody cannot be talking with everybody, it's not efficient either.”

However, there are instances where salespersons are invited by product area members to participate to brainstorming sessions together with R&D. Moreover, the role of R&D in providing input to business development is highlighted, particularly in the context of technological developments which is vital for exploring new opportunities.

Participants also identified challenges in collaboration between R&D and product managers. Lack of time came up frequently in the interviews as a critical barrier to effective knowledge sharing. Moreover, the level of communication seems to fluctuate based on individual relationships, with some experiencing “good level of knowledge sharing” and others describing it as “limited”. It became evident the relationship between individuals in product management and R&D plays a critical role in the effectiveness of knowledge sharing. Good personal relationships, as one participant with long track in the organization observes, can lead to better communication:

“I think that because personally I know our product managers quite well, I have daily discussions with them.”

However, this is not a uniform experience across R&D. Another participant points out an uncertainty in R&D about whom to contact in product management, highlighting a gap in cross-departmental familiarity and structured communication channels.

Furthermore, another challenge that comes up is that of transforming knowledge from market insights into actionable R&D initiatives. One participant stated:

“Knowledge may flow, but what we will do with that information is maybe the biggest problem.”

When it comes to the utilization of IT tools for knowledge sharing between R&D and business teams, the data shows that the potential and practice are not fully aligned. Despite having access to various platforms and systems these are not utilized for flow of knowledge from customers that can spark ideation and innovation. In fact, data suggests a sense of fragmentation, with each department using its own digital workspace. This was encapsulated by a participant who notes:

“Typically, we have Team sites that are mostly used within the units. Technology people have their own sites, and then product areas have their own. So, I’m

unsure how much we have joint sites where we can share information across departments”.

The results on knowledge sharing between business and technology levels are summarized in Table 4.

TABLE 4. Summary of results on customer and market knowledge flow between different departments in the organization.

Aspect	Business-Business	Business-Technology
Purpose of knowledge sharing	To translate customer interactions into knowledge for market opportunities and innovation.	To leverage knowledge to align market needs with technological developments for viable solutions.
Methods of knowledge sharing and communication	Emails, Teams chats, calls, customer visits, online forums, regular meetings.	Strategy meetings, leadership team updates, info calls, business hubs, technology sharing events.
Challenges	Lack of systematic collection, unstructured feedback and processes, one-way communication in meetings.	Difficulties in disseminating information across R&D, re-educating on market basics for new projects, limited daily interaction, individuals' relationship, lack of continuous knowledge flow.
Opportunities	Structured platforms for regular feedback, better processing of sales insights.	More regular and continuous input from product areas, improved internal collaboration.
Impact on Innovation	Potential for missed opportunities and misalignment with customer needs.	Challenges in translating market insights into actionable R&D initiatives

4.3 Review of factors influencing knowledge sharing

4.3.1 Organizational structure and design

The VIM organization consists of 4 product management teams: liquid measurement products, industrial measurement products, power and transformers and continuous monitoring products for the life sciences industry. Each product management team, known as “product areas”, is responsible for driving the business of their product lines including product development project portfolio, which is carried out by VIM’s own R&D departments.

The product areas responsibilities are not only to develop and sustain product portfolio, service offering and platform development, but also work on a daily basis with other teams such as sales to provide application support and guide other functions such as marketing of VIM products.

The structure of the organization for about 10 years has been that product management and R&D teams belong to the same “Products and Systems department”. The decision to have product management leaders and R&D leaders under the same department and manager was done to ensure interaction between business and technology levels, and to ensure cross-functional decision-making.

The product managers and R&D teams used to sit in proximity in the same building which promoted daily formal and informal interactions. Nowadays, as the organization has grown, the teams are still located in the same campus, but are sitting in different buildings. R&D has its own building, while product managers sit in another building close to other business functions such as sales. This physical separation, as noted by several participants in the interviews, impacts the natural flow of knowledge and informal interactions.

The VIM sales organization on the other hand is separated from Products and Systems. The sales organization has the main role to create revenue, and it is

divided typically to match the product management teams. The VIM sales organization in turn also is divided by regional teams.

The strategy of VIM of to continue to grow through product leadership by continuing to create winning measurement technologies. Therefore, company is highly technology and science oriented, with continuously high and increasing investment in R&D. The R&D budget has doubled in the past 6 years alone. The fast growth of the organization in recent years has introduced challenges. Important to note is the recognition of challenges in learning and maintaining the effectiveness of knowledge sharing due to organizational growth. One participant from R&D observed:

“We have grown. Half of the people in this organization have come after 2016. So that means that many don’t have the old connections and haven’t been in the smaller company environment where everybody knew everything”.

4.3.2 Current technological innovation processes

The technology development process is kicked off by an initiative or idea. It starts by general research of the hypotheses and questions resulting in proposals. In general, it consists of the development of concepts, proof of concept, determination of technical and performance features, validation and verification before it can move on to new product development (NPD).

The process states ideas for new technology can originate from any member of the organization, be it a research scientist or a salesperson who has identified a potential market opportunity. Moreover, product managers are involved in studying the business potential of the ideas, typically together with R&D.

The origin where ideas come from, and the opportunity identification phase is not clearly stated in documentation nor was clear in the interviews. The process from technology development is missing critical inputs e.g. from market planning. Moreover, the path from an idea to a development project seems to lack clear ownership and stakeholder involvement. While product management is seen as

responsible for taking ideas forward, the exact roles and processes are not well-defined.

The lack of clarity and planning in the process could also be perceived in the interviews, with members of product areas wishing more definition on the owners of development projects and R&D members commenting there are more ideas getting in than they can properly evaluate.

The technology development process is very linear and sequential, following a waterfall approach, and with a primary focus on deliverables. The process itself is not considered suitable for cross-functional innovation, particularly because it restricts information sharing and the ability to iterate quickly based on new knowledge. As a member of product area stated:

“Our system does not foster innovation based on information sharing, because at least when it comes to the R&D process, the process is built very heavily on the waterfall model”.

Therefore, while the sequential process style might provide a clear structure and stability in the development, it does reduce interaction between business and technology teams during the development process, which is crucial for effective knowledge sharing, idea iteration and adaptation to evolving markets. As described by another product area member:

“We have some technologies developing in R&D and we think: let’s give them five years and then they come with the perfect technology. And then on the market side, we wait... they will say then when they are ready”.

A recurring topic in the interviews was the slow development cycles of new products in the organization. Participants from all departments pointed out the innovation process is not effective, it is slow and cumbersome, and resulting mostly incremental innovations. A member of R&D expressed this issue as:

“It takes a huge amount of time and effort to get some idea all the way to the finalized product you can sell. And the world is changing. I feel this is like a race that it's very difficult to keep up.”

4.3.3 Collaboration tools and practices

The most important tools for collaboration in the company are Microsoft Teams, One-Drive and the company's own intranet. MS Teams is used mostly for daily communication within the organization, for project and organizational teams (meant for a restricted audience), and to share within a specified group all types of information and files such as memos and slides. One-Drive is mostly used for personal documents, but is also be used as a collaborative tool.

Perhaps the most important knowledge management tool in the company is its own intranet. Defined as the “main communication channel for internal and support material”, the intranet intends to encourage internal information sharing, knowledge management practices and serves as a portal to other tools in the company.

The intranet contains specific online forums meant for knowledge sharing between product areas and sales. These are portals initially designed for anyone to find useful information on VIM products and applications, ask and follow support questions and start or browse discussions on various topics, such as market news, new product ideas or customer comments.

Its goal was that by browsing the discussions and customer questions coming from sales personnel, anyone in Vaisala can get an idea of their customers' needs and the applications where customers use the products. The aim was also to increase competitiveness and customer satisfaction by providing information for innovative development efforts.

A widely used portal used by R&D is “Confluence”, which is a collaborative tool meant for knowledge sharing and refining, including customer knowledge. However, the tool seems to be used more actively for sharing knowledge and

documents in the context of projects, rather than sharing knowledge from markets and customers that could spark ideas for innovation.

4.3.4 Customer knowledge management tools

At the moment customer knowledge (from and about) is captured, stored and shared in Vaisala's own Customer Relationship Management (CRM) system. The CRM is used in the sales process for creating and editing customers, lead and opportunity funnel management, and for account management. It is a tool also for recording sales activities with leads and customers.

The CRM tool is used as a source of customer knowledge for different departments for their activities, including marketing for campaign and budget management, and technical support and service to input cases and work orders.

Moreover, the CRM tool has been designed to include information about deals won, including the value to the customer, which is meant as a source of knowledge for the product areas. However, as presented before, participants express difficulties for using the CRM tool for knowledge sharing, questioning its efficiency for retrieving information that can be used to detect opportunities in the market.

4.3.5 Knowledge sharing environment

The knowledge sharing environment within the organization plays a crucial role in fostering cross-functional collaboration and innovation. The data presented here reflects the organizational culture, individuals perceptions and motivations which impact the effectiveness of knowledge flow between different teams.

In terms of communication, the response from participants from the sales teams show there's a palpable sense that communication often feels one-sided. Sales teams express frustration about their market insights not being adequately

considered or acted upon, leading to a perception of ineffective reciprocal communication:

“We have often the feeling that they don't really listen to us.”

However, there's a general awareness and acknowledgment across departments of the importance of cross-functional collaboration. Many employees are willing to share knowledge and understand its value in driving the company forward.

The data suggests a prevailing process-oriented culture over a customer-centric one. This orientation towards perfecting a process sometimes overshadows the focus on customer needs. One participant stated this by saying:

“I've been used to having the customer on a different level of importance, and that's a bit perhaps describing that Vaisala is very much a product and technology-driven company.”

Despite current efforts to enhance customer-centricity in the organization, data suggests there's a feeling that this cultural shift hasn't fully happened.

There's a notable absence of formal reward or motivation systems for knowledge sharing. The prevailing belief in the organization is that the motivation to share knowledge should be intrinsic, recognizing the collective value it brings. One manager expressed this by saying:

“Paying people for capturing customer knowledge doesn't make sense to me. If that is the only benefit they see, then we have failed.”

Yet, individuals find themselves often absorbed in meeting their departmental KPIs, potentially limiting their capacity to engage in broader knowledge sharing activities.

Trust issues, particularly between R&D and product managers, are evident in the data. There's a reluctance from R&D to fully trust the information provided by

product managers, indicating a gap in mutual understanding. As stated by a member of product management:

"I get the feedback from product managers that the R&D team in product development is not believing what they are saying."

Despite these challenges, there's a sense of shared purpose within the organization, and employees believe in the company's mission. When asked about their contribution to the innovation chain of the organization, participants from all departments were able to articulate it well and understand how their work impact the company's goals.

However, there were many remarks and a notable perception around the organization not being inherently innovative, focusing more on small product developments, with a participant even questioning the need for radical innovation:

"Maybe the level of innovation that we have is sufficient for the setup of the company."

This aligns with the perception of a culture more inclined towards incremental improvements rather than groundbreaking innovations.

4.4 Perception of technology-market alignment in the organization

Several participants emphasized in the interviews the importance of finding a balance between the organization's technological capabilities and the needs of its customers, with efforts acknowledged but room for improvement highlighted. However, there seems to be a common perception of a tendency towards a technology-driven approach. As a Product Manager explained:

"We typically begin with potential solutions rather than identifying problems first. Then, we assess whether there's a problem in the market for the solution."

While some participants emphasized the strengths of the organization's products and the importance of maintaining a strong connection between R&D and business levels, others identified areas for improvement, such as better integration of technology development with market studies. One participant expressed this as:

"We still lack a clear understanding of how to effectively integrate business and market studies and validation, which is crucial for successful innovation."

Overall, results show ongoing efforts to align market needs with technology, and a proactive approach to connect R&D and business levels. This was deemed crucial by the VIM Vice-president, who described it as *"the most single critical thing"*.

5 ANALYSIS OF RESULTS

This section presents consolidated key findings from the current state of the organization, highlighting its strengths and weaknesses identified in the data. The analysis is supported by the literature review and particularly with the best practices presented in [section 2.8](#).

The best practices reflect important knowledge management practices top innovators use to bridge the gap between technology and commercial levels. They emphasize the need for integrating human data for customer insights in technological innovation management (Best practice #1), dedicating resources for customer understanding (Best Practice #2), systematically generating knowledge to feed the innovation wheel (Best Practice #3), optimizing the organizational structure and design to ensure seamless knowledge flow (Best Practice #4), cultivating a knowledge sharing environment (Best Practice #5), and leveraging human networks in the organization (Best Practice #6).

These best practices serve as a conceptual framework for interpreting the results. This comparative approach will allow to align observations with proven strategies by top innovators in the world, shedding light on areas where the organization excels and where it can enhance its practices. The objective is to offer a clear grounded picture of the current status and to pinpoint areas for improvement and potential growth.

5.1 Identified strenghts

The strengths of the organization are rooted in a proactive culture that values knowledge sharing, the availability of an infrastructure that supports knowledge management, the balance between market trends and customer knowledge, and an organizational structure supporting collaboration.

5.1.1 Proactive engagement and individuals' attitude towards knowledge sharing.

The proactive engagement and employees' attitudes towards knowledge sharing in the organization is the first strength identified. Employees in the organization demonstrate willingness and intrinsic motivation to share knowledge. This came up in the research as openness to share knowledge, the understanding of everyone's role in the innovation chain, intrinsic motivation and enjoyment to perform their job, proactive engagement and efforts to share knowledge and a customer-centric mindset. All this creates the strong foundation to cultivate a knowledge sharing environment in the organization as described in Best Practice #5.

This intrinsic motivation, especially from job satisfaction is a crucial aspect for knowledge sharing as described by Razmerita et al. (2016). Moreover, the intrinsic motivation also resonates with Nonaka and Takeuchi (1995), who emphasize the importance of a strong sense of purpose and shared values within a knowledge-creating company. As Dyer et al. (2000) suggest, when individuals understand their organization's collective mission, the generation, combination, and transfer of knowledge become more effective.

Customer centricity in especial plays an important role in the context of this research. Sales and product management teams' proactive engagement in capturing and sharing recently acquired knowledge from customers and markets is intrinsically linked to their focus to create value to customer and the understanding of the importance this knowledge brings. As Foss et al. (2011) stated, when employees recognize the importance of customer insights in driving innovation, they are more committed to acquiring and sharing this knowledge.

Moreover, the knowledge sharing environment in the organization is supported by a cross-functional collaborative culture. Leadership in the organization recognizes the value of bringing teams together, promoting cross-functional collaboration and thus ensures regular meetings within relevant departments to enhance and promote knowledge sharing.

5.1.2 Available Knowledge Management (KM) infrastructure

The organization recognizes the importance of knowledge sharing and provides diverse tools like CRM, Microsoft Teams, OneDrive, and dedicated intranets for capturing, storing, and sharing customer knowledge. The availability of these KM tools presents a significant opportunity for the organization to enhance its knowledge sharing capabilities and foster a culture of continuous innovation.

These technological factors are vital for enabling seamless communication and cross-functional knowledge exchange, which are crucial for collaborative innovation. These tools help break down barriers between different departments and facilitate real-time interaction, essential for fostering an environment where ideas can be shared and developed collaboratively.

This approach aligns with insights from Khosravi et al. (2016), who emphasize the importance of having technological solutions that align with the needs and goals of the organization. The tailored IT tools in the organization, for example a CRM system adapted to capture key customer knowledge on products and applications, exemplifies this alignment. These tools not only enable efficient management of explicit knowledge through online repositories but also facilitate the sharing of tacit knowledge from team members anywhere in the world through interactive platforms.

Furthermore, this strength is closely linked to Best Practice #3 which emphasizes the systematic knowledge generation to feed the ideation wheel. If used efficiently, CRM and other platforms facilitate this practice by systematically capturing and transforming customer information into actionable knowledge, thereby fueling the innovation process.

Moreover, the availability of this infrastructure not only facilitates immediate knowledge sharing but also provides the opportunity to the long-term building of organizational knowledge, crucial for sustaining innovation. This allows for all knowledge to become part of the organization's collective intelligence, which is

especially important in large organizations where knowledge can easily become siloed or lost due to staff changes.

5.1.3 Efforts to balance market quantitative data with qualitative human data

The organization's strategic focus on balancing market analytics with human data represents a significant strength. This approach aligns with Best Practice #1, emphasizing the critical role of knowledge from customers in aligning market trends with innovation efforts. The proactive engagement in capturing customer and market insights reflects a deep understanding of the need to integrate quantitative market trends with qualitative customer feedback.

Davenport et al. (2001) highlighted the importance of combining transactional data with customer interaction data to create a more comprehensive understanding of customer behaviors and needs. This approach enables organizations to understand not only what customers are buying but also why they are making these purchases. The organization's efforts to blend market trends and transactional data with specific customer requirements demonstrate a strategic approach that resonates with this concept.

Despite recognizing the challenge product managers face in generalizing customer requirements across various industries, they counter this by utilizing diverse methods to gather direct knowledge from customers. These methods include customer visits, trade shows, competitor analysis, and collaboration with distributors. Furthermore, the recognition and utilization of the sales force as a primary source of customer knowledge is crucial in this context for achieving a comprehensive and continuous understanding of market needs. This proactive approach positions the organization well for finding successful innovation opportunities.

5.1.4 An organizational structure that supports business-technology collaboration

The last identified strength is the existing organizational structure that supports business and technology collaboration. The integrated structure of having leaders from both product management and R&D under the same umbrella promotes cross-functional interaction and decision-making, which is critical for aligning product development with market needs. This structure shows a well-considered effort to connect R&D with market knowledge, which has a high potential to lay a solid foundation for collaborative innovation.

This organizational approach aligns with Best Practice #4, which emphasizes the importance of an optimized organizational structure and design to ensure knowledge sharing and market-technology alignment of innovations. Szczepańska-Woszczyzna (2021) stated the importance of creating structures that allow for easy sharing of knowledge and resources between different parts of a company to foster innovation. This approach enables organizations to make smart decisions, solve problems, and work together effectively on new ideas.

The organization's structure resonates with this principle by intending already by the design to facilitate on the same table the flow of market insights and business strategies directly to the R&D team, as well as insights on technology development to the product management directors, thereby creating an environment that can spark innovation.

5.2 Identified weaknesses

The strengths in the organization presented in the previous section are counterbalanced by significant weaknesses in communication and trust, inflexible innovation processes, underutilization of knowledge management tools, lack of systematic knowledge collection, organizational culture barriers, and challenges arising from physical and organizational separation.

5.2.1 Communication barriers and trust issues

Communication barriers and trust issues emerged in the research as important human and organizational factors that limit effective knowledge flow and collaboration. One-sided and insufficient communication, trust issues, and the physical separation of teams were common themes mentioned that can create barriers to effective knowledge sharing and integration of knowledge across departments. This reflects a need for a stronger alignment with the organization's shared purpose and values to foster a more open, collaborative and innovative culture (Nonaka et al., 1995; Razmerita et al., 2016).

The physical separation of R&D and product management due to the organization's growth has reduced the natural flow of knowledge and the informal interactions that were previously beneficial for innovation. Despite the proximity now of product area teams to sales teams, the current separation from the R&D team means that crucial customer and market insights do not flow spontaneously and informally to the technology level for ideation, nor do technological capabilities get communicated effectively to the business side to spark new innovations. Moreover, the fast expansion of the organization might have amplified the communication and trust issues as new employees may lack the established connections and understanding of the company's collaborative culture.

A significant finding is the differing narratives from business and R&D teams that reveals the misalignment in communication. Business teams perceive their knowledge sharing efforts as substantial, whereas R&D teams find the communication from the business side to be "scarce". This suggests a potential gap in understanding the specific knowledge needs of the R&D team or possibly a lack of leadership in guiding the knowledge sharing process. Furthermore, this misalignment could come from cross-functional misunderstandings, where the distinct "languages" or terminologies used by each team lead to a communication disconnect.

This misalignment might be contributing to the internal perception of a technology-push approach, where R&D initiatives are perceived to be driving

technological development and innovations rather than market insights. It's important to note that the exact reasons for this misalignment are not fully clear and would benefit from further investigation to enhance collaborative efforts and ensure that knowledge sharing is effective and meets the needs of all involved departments.

These communication barriers and trust issues show a disconnect with Best Practices #5 and #6, which focus on cultivating a knowledge sharing environment and ensuring human networks within the organization. Seidler-de Alwis et al. (2008) emphasize that a supportive culture and organizational structure are crucial for facilitating the free flow of knowledge. A culture that values openness, trust, and collaboration, encourages employees to engage more actively in knowledge sharing. Likewise, an organizational layout that ensures physical closeness of business and technology teams, promotes cross-functional cooperation and help to break down silos, ensuring that insights from different departments are integrated effectively (Davenport et al., 2001; BCG, 2021a).

Effective communication within the organization is key, especially to bridge the gap between business and R&D functions. Addressing this will require a focused effort to understand and align the knowledge sharing needs and methods across these teams, alongside fostering a culture of open communication and mutual trust.

5.2.2 Process rigidity over customer focus

A second weakness is the predominant culture of process rigidity over customer focus. The company's culture is more process-oriented rather than customer-centric, which may limit its ability to fully leverage customer knowledge for innovation. Hofstede et al. (1990) note that in process-oriented cultures, individuals tend to be risk-averse, focusing on methods and processes rather than innovative problem-solving. This aversion to risk can stifle creativity and hinder the organization's ability to respond to customer needs with agility and innovation.

This weakness contradicts Best Practice #5, which emphasizes cultivating a knowledge-sharing environment. Matzler et al. (2007) and the “Global Innovator 1000 survey” findings show that top-performing companies prioritize developing a culture that aligns with their innovation objectives. To address this weakness, it's essential to shift towards a more customer-centric approach. This involves understanding and valuing customer insights as a driving force for innovation, as suggested by Foss et al. (2011). It is essential to encourage employees to actively acquire and share knowledge from customers, and this initiative must be a deep part of the organization's culture. When an organization prioritizes and values a customer-centric approach, it shapes the shared organizational values, significantly impacting employees' perceptions and behaviors.

5.2.3 Lack of reward systems and adequate incentives

The absence of reward systems and adequate incentives for effective management of customer knowledge in the organization is a notable weakness. This lack can potentially discourage individuals from creating knowledge for the organization and engaging in knowledge sharing behaviors, particularly when their efforts are not aligned with departmental KPIs nor recognized.

Intrinsic motivation from understanding the value of knowledge and alignment with organizational values plays a crucial role, but it may not be enough on its own as highlighted by Nonaka et al. (1995) and Razmerita et al. (2016). This is particularly important in the current organizational context, where a gap exists between the aspirational customer-centric culture and its practical realization. Extrinsic motivators may be required to swiftly address this gap and to fully engage employees to leverage customer knowledge for innovative purposes.

Foss et al. (2011) highlight that recognizing the value of customer insights can be a source of motivation for innovation. However, intrinsic motivators must be complemented with appropriate extrinsic motivators to fully engage employees in knowledge sharing activities contributing the organization's innovation goals. This researched showed that employees seem to understand and share the

organization's mission, but without extrinsic motivation, their commitment to actively contributing to these objectives may not be fully effective.

Best Practice #5 underscores the need to cultivate a knowledge sharing environment by combining intrinsic and extrinsic motivators. Introducing individual goals for knowledge sharing, performance-based bonuses, recognition awards, or other incentives that acknowledge everyone's contribution can motivate employees to become "knowledge workers" for the organization. These measures not only serve as tangible acknowledgment of the employee's contribution, but also set a positive example for others.

However, it is essential to note that the effectiveness of such rewards is maximized when they are part of a supportive organizational culture with a clear and shared purpose. Maintaining this balance is key. The organization is already on the right track in communicating its shared purpose and striving towards a customer-centric culture. To support this, introducing extrinsic motivators could further reinforce active participation in knowledge generation and sharing. This strategy ensures that the existing intrinsic motivation for collaboration is sustained, while providing concrete incentives for employees to actively contribute to the organization's innovation objectives.

5.2.4 Challenges with the current development process

The current technological development process within the organization presents some weaknesses that should be addressed. Despite the existence of a formal structure for development, there is a lack of clarity and specificity during the ideation stage. Additionally, ambiguities in roles and responsibilities, particularly when transitioning ideas into development projects came up during the research. These issues can lead to inefficiencies and missed opportunities for innovation, suggesting a need for more streamlined and well-defined processes.

Another concern is whether the process is agile enough to ensure cross-functional collaboration and knowledge sharing throughout development. The organization's reliance on a sequential, waterfall approach to technology

development may be hindering the necessary interaction between R&D and business departments and restricting rapid iteration of ideas. This is problematic in dynamic market environments, where the ability to quickly adapt to changing demands is crucial.

The ambiguity in roles and responsibilities especially when translating information and knowledge from customers into opportunities for the organization, and the vagueness in the ideation and development stages suggests the need for structured processes in idea management. Following Best Practice #3, organizations should ensure a systematic approach to effectively utilize customer insights for idea generation and innovation. Clear procedures for idea generation, evaluation, and development are necessary to ensure that valuable ideas are not lost. This allows the best opportunities to be effectively developed into innovative products. This also aligns with Boeddrich's (2004) emphasis on structured and systematic procedures in innovation management.

5.2.5 Underutilization of technological resources

The underutilization of technological resources for knowledge management is another identified weakness. Despite the availability of several platforms for knowledge sharing, there is an indication that these tools are not fully leveraged for sharing market and customer knowledge that could spur innovation. Their primary use appears to be for project documentation rather than for actively sharing insights cross-functionally that could stimulate innovative ideas. This misalignment with the organization's strategic objectives, particularly in fostering innovation, underscores the need to reconsider how these tools are integrated into daily operations.

Customer knowledge is a crucial aspect of an organization's intellectual capital and should be systematically managed and aligned with core KM practices to achieve competitive advantage. In line with Best Practice #3 on systematic knowledge generation for innovation, innovative companies have a KM system in place with supporting tools and processes that facilitate effective management of customer knowledge (Plyasunov et al., 2017; Davenport et al., 2001). However,

the challenges faced with CRM systems within the organization indicate a disconnect in leveraging this asset effectively. Ideally, CRM tools should not only capture and store customer data but also facilitate its analysis and application in innovation processes.

The results also showed that the organization's rapid expansion and the influx of new employees have created the challenge of maintaining effective knowledge sharing. Technology tools are important to enhance organizational learning and ensure that experiences are built upon, rather than restarting from zero with each new project.

5.2.6 Lack of systematic knowledge generation that fuels innovation in the organization

A key weakness is the lack of a systematic knowledge generation that can kick-start innovation. A common theme in the research was the challenges in systematically collecting knowledge gathered from customers and markets, along with limited resources for new market exploration, which can hinder the organization's ability to innovate responsively. These gaps indicate the need for better alignment with Best Practices #2 and #3 which focus on dedicated resources for effective knowledge acquisition, and systematic knowledge generation.

Best practice #2 emphasizes the importance of committing resources to understand markets and customer needs, which is vital for aligning technical innovation with commercial success. Matzler et al. (2007) emphasize that market orientation is a driver of innovation and growth in top-performing companies. The organization's current challenges suggest a need to allocate resources more strategically towards understanding market dynamics and customer requirements. This also involves continuously generating and distributing knowledge about customers to stakeholders involved in the innovation process.

Cotterman et al. (2009) also pointed out that organizations leading in breakthrough innovations allocate specific resources dedicated to the innovation

process, effectively bridging market insights with technical expertise. This strategic allocation of resources is important so that the process of innovation is not hindered by the need to divert time and attention from other departmental responsibilities and key performance indicators (KPIs). This is particularly relevant considering the challenges highlighted in the results, which indicate sales members' focus on KPIs rather than capturing customer knowledge, and the lack of time from product area and technology teams to dedicate to the evaluation of all ideas coming in.

Effective innovation management requires methodical, systematic, and structured procedures, especially at the beginning of the innovation process (Boeddrich, 2004). The organization's current approach may benefit from implementing defined procedures to ensure that customer and market insights are not only captured, but also translated into actionable knowledge. This transformation is essential to prevent missed opportunities and enhance idea generation. A systematic approach provides alignment with strategic goals and ensures that the best ideas are identified, therefore preventing that valuable time and resources are wasted.

A systematic approach would involve not only collecting data and knowledge from customers but also analyzing, interpreting, and organizing it to identify critical customer needs and innovation opportunities. This approach can also address other identified challenges within the organization, such as difficulties in generalizing customer data for new product development and overcoming barriers in organizational learning.

5.2.7 Risk of potential organizational complacency

The last weakness is the risk of potential organizational complacency towards customer learning. This complacency, rooted in the position of the company as a market leader, could potentially hinder the organization's commitment to continuous improvement and customer-centric innovation.

Best Practice #1 highlights the importance of creating continuous customer understanding for innovation. Jaruzelski et al. (2018) stated that top innovators, especially those reporting faster growth, recognize the significance of customer insights for their innovation programs and understand the need for continuous learning about their customers.

This reflects a need for a cultural shift towards continuous learning and customer focus, essential for sustaining innovation. The organization should avoid allowing the perception of being a market leader to lesser focus on in-depth customer knowledge acquisition. The commitment to continuous learning is important for knowledge acquisition and sharing. Without a culture of continuous improvement, the organization is at risk that knowledge becomes outdated, and that its growth and innovation potential diminish.

5.3 Summary of key findings

Table 5 presents a summary of the key findings of this research. As it can be observed, the key findings indicate that the organization possesses a robust set of pillars and demonstrates significant strengths that can be leveraged to foster a more innovative and successful environment. These strengths include proactive individual engagement, a balanced approach to integrating market trends with customer knowledge, and an organizational structure that supports business-technology collaboration. These are valuable assets that the organization can leverage to overcome the listed weaknesses.

However, the current operational methodologies present notable barriers that hinder the full realization of this potential. Addressing these barriers is crucial for the organization to transform its existing strengths into a more innovative and successful environment. In the next section, this report explores actions and steps the organization can take to ensure knowledge management practices are leveraged to ensure innovation is fostered in the organization.

TABLE 5. Summary of current state analysis. Strengths and weaknesses of the organization.

	<u>Strengths</u>	<u>Weaknesses</u>	
	<ul style="list-style-type: none">• Proactive individual engagement and attitudes• Available Knowledge Management infrastructure• Balance between market trend data with knowledge from customers• Structure that supports business and technology collaboration	<ul style="list-style-type: none">• Communication barriers and trust issues• Lack of reward systems and incentives• Process rigidity over customer focus• Challenges in development process• Underutilization of technological resources• Lack of a systematic knowledge generation that fuels innovation• Risk of organizational complacency	

6 RECOMMENDATIONS

The aim of this research was to understand the role of knowledge management in innovation, and how the most innovative companies in the world leverage knowledge management practices to bring customer knowledge to their R&D to align their technological capabilities with the needs of market (research question #1). Moreover, the research aimed to understand how these best practices can be adopted by other organizations to enhance knowledge flow, ideation and innovation (research question #2).

After a comprehensive study of the current state of the VIM organization regarding the flow of customer knowledge, key strengths and weaknesses were identified. This section of the thesis presents recommendations derived from the key findings of the research, aimed at leveraging knowledge management to enhance idea generation and innovation. These recommendations are grounded in best practices identified in the literature review and are adapted to align with Vaisala's VIM organization's specific context and needs.

The recommendations summarized in Figure 9 are explained in detail ahead in this section. Each recommendation is designed to address challenges and opportunities identified through the analysis, with a focus on practical implementation and potential impact. The aim is to provide Vaisala's VIM organization with the right direction to enhance its innovation framework by leveraging its existing strengths and addressing the identified gaps in knowledge management and collaboration.

6.1 Develop a KM strategy that promotes and supports innovation

VIM's goal to maintain product leadership in selected markets calls for the strategic alignment of a Customer Knowledge Management (CKM) with the organization's main innovation strategy. The creation of a KM strategy would serve as the bridge that ensures that customer and market knowledge flows seamlessly to the right areas within the organization, particularly to the R&D team, where it can spark creative ideas and innovations. The organization should

formulate a KM strategy that effectively connects customer knowledge (market pull) with technological capabilities (technology push), thus maintaining the essential balance necessary for fostering innovation.

The core of this KM strategy should be a systematic approach that not only captures and stores customer data and information but also analyzes it and synthesizes it into valuable insights. This strategic approach ensures innovation opportunities are not missed.

The integration of a KM strategy can provide a structure and order to the uncertain early stage of innovation, the fuzzy front end. It can streamline the collection, analysis, and application of essential customer and market information. This ensures that the information is not only up-to-date but also significant and relevant for decision-making. Such structured approach in the fuzzy front end is vital for informed and strategic innovation, leading to better alignment of products with market needs and enhancing the overall innovation capacity of the organization.

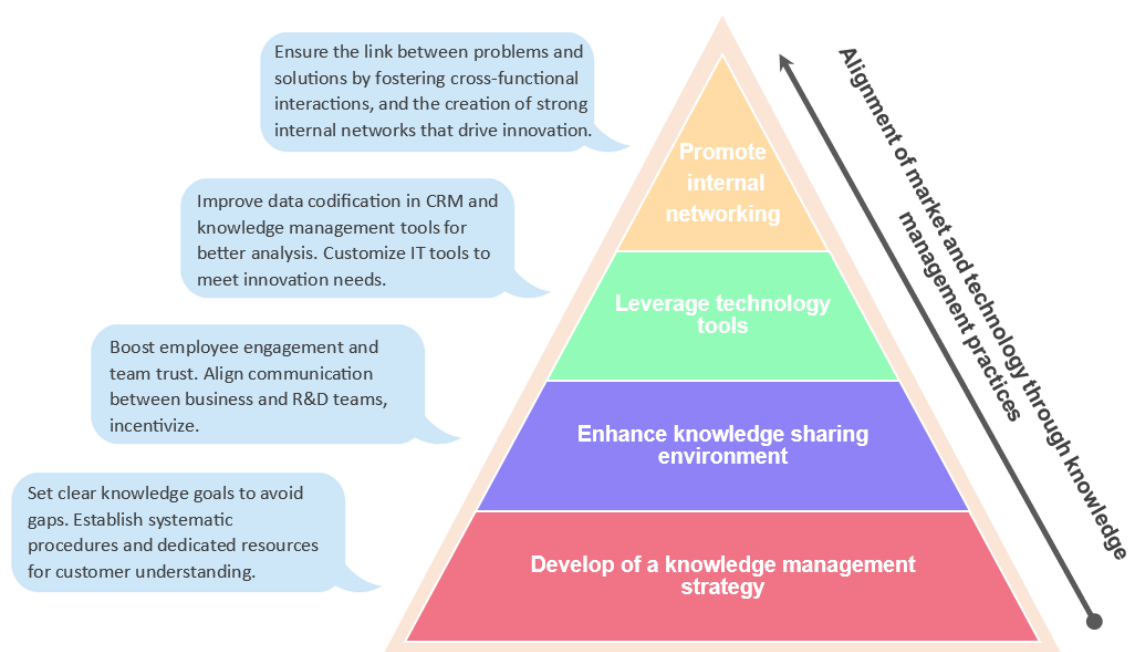


FIGURE 9. Summary of recommendations for utilizing KM practices to connect business and technology levels in Vaisala's VIM organization.

The implementation of a KM requires dedicated resources and defined roles and responsibilities. This is necessary to ensure that critical information for business decisions is continuously and effectively gathered and utilized. This implies a potential redefinition of existing roles or the allocation of dedicated resources for market exploration and customer knowledge acquisition. Particularly, product managers, who have expressed they struggle with consolidating market information, would benefit from this strategic support. The allocation of dedicated resources also ensures the knowledge captured by the sales teams is expanded to other markets where sales might not yet operate.

One product area already consists of business developers that help to continuously develop customer understanding and seek for new opportunities. The VIM organization could consider expanding this approach across different product areas, reducing the workload of product managers and allowing for more focused efforts for opportunity identification and validation.

Another approach could be the establishment of a dedicated “innovation team”, that can act as a bridge between business units and R&D, ensuring that customer needs and market opportunities guide the innovation process from inception to launch. This innovation team should include a blend of business and technical skills, and people capable of networking with other functions. A dedicated team would serve as a strategic approach for continuously generating essential customer and market knowledge that can be utilized by R&D, ensuring balance between market and technology. In the same way, the innovation team would bring technology knowledge to the business teams to match it with the right customer needs.

An innovation team would play a pivotal role in coordinating ideation activities, identifying new opportunities, and effectively evaluating ideas. The main goal would be to seamlessly connect opportunities with technological capabilities, driving forward innovation initiatives. This team also could act as a central hub for customer and market knowledge, bridging the gap between commercial and technological functions by streamlining the flow of information and bringing both functions together. This strategic move would not only optimize knowledge sharing but also align it more closely with the organization's innovation goals.

Moreover, the creation of an innovation team would mark the VIM organization's commitment to innovation and would help in fostering cross-functional understanding and a culture of innovation among employees.

The creation of a CKM strategy recognizes customer knowledge as a prime asset in the organization's customer-centric environment. Managing this knowledge effectively is not just about collection and storage; it's about ensuring the right procedures and channels exist to ensure knowledge is distributed efficiently, and fostering a culture where this knowledge is seen as a key driver of innovation. This requires clear communication of the strategy's goals and the value of customer knowledge in the innovation process, ensuring buy-in and engagement from all stakeholders.

The implementation of a KM strategy begins with defining clear KM objectives linked to organizational and innovation goals. For example, the knowledge the organization needs to understand customer and markets and how it is distributed and applied for the organization to run effectively. Involving key stakeholders, such as product and R&D managers, in this process ensures that the strategy is grounded in the real knowledge needs for fueling innovation. It is important to note this also implies setting metrics for regular monitoring (e.g. improved collaboration or shorter development time), and continuous development of the strategy to keep it aligned with evolving market demands and organizational changes.

The findings of this thesis show that the organization is getting plenty of customer and market information through the sales and product teams, which helps prevent knowledge gaps. However, the information from sales is not always transformed into actionable knowledge or might be siloed in product areas. Managers in the organization should clarify practices, and provide platforms for sales teams to methodically document and relay customer needs and market insights concerning desired solutions and emerging technologies.

Effective communication of the strategy across different product areas is instrumental in guaranteeing that pertinent information is utilized for innovation. Moreover, establishing regular meetings that enable sales to share newfound

market needs is critical in enriching the customer knowledge base. Additionally, it is recommended the adoption of “business hubs”, a commendable practice from one product area that promotes cross-functional knowledge sharing around a single product line, to other product areas.

The implementation of a KM strategy will also support the development of a culture of continuous organizational learning and development. A clear KM practice will help the organization to build upon its knowledge base continuously, ensuring that the organization's collective intelligence not only grows and evolves, but that it is also effectively retained.

6.2 Enhance knowledge sharing (KS) environment

The alignment of technology capabilities with market needs cannot be fully realized by merely capturing and generating knowledge; this knowledge must also flow naturally and efficiently throughout the organization. Management of knowledge requires ensuring that the right knowledge is available to the right person at the right time to enhance innovation. In this context, the internal environment of the organization is an important factor in promoting and driving knowledge sharing.

This research showed that a key strength of Vaisala's VIM organization is its proactive and motivated workforce. This human factor demonstrates a robust foundation for effective knowledge management. The employees' intrinsic motivation and positive engagement in knowledge sharing form a crucial element in any organization's knowledge management framework.

The organization should focus to further cultivate this environment to reinforce and celebrate these behaviors. It is imperative that the organization focuses on developing an atmosphere of open dialogue and trust to overcome the communication barriers. Initiatives such as regular cross-departmental workshops and forums, transparent communication policies, and trust-building activities could be implemented. These initiatives will not only bridge gaps in

communication but also foster a sense of community and collaboration, essential for a thriving knowledge-sharing culture.

The observed misalignment in communication between the product areas and technology development teams is a critical issue that requires more investigation and resolution. Managers could address this by facilitating joint workshops involving both teams, aiming to foster mutual understanding. These workshops present a valuable opportunity for team managers and members to share their perspectives, workflows, and challenges, thereby identifying the root causes of miscommunication. In these sessions, teams can collaboratively brainstorm and establish what information is essential to drive innovation and support technology development and how it should be shared to achieve effective collaboration. These workshops could also serve as a platform for creating networks, initiating trust-building activities and fostering a culture of transparent communication.

Furthermore, managers should recognize that extrinsic motivation is needed for knowledge sharing and innovation. It is important for the organization to incentivize and establish rewards that acknowledge and celebrate individuals and teams who actively participate in cross-functional collaboration and knowledge sharing which aligns with the organization's innovation goals. This could include "innovation champions" awards or spotlight features in company communications. This type of recognition not only provides extrinsic motivation but also visibly reinforces a culture where knowledge sharing, collaboration and innovation are deeply valued and rewarded.

Knowledge sharing environment comes hand in hand with the organizational culture. In order to cultivate a culture where customer knowledge is valued and utilized effectively for innovation, the organization should promote the transition to a customer-focused culture. This shift involves recognizing the importance of customer focus and the value of continuous customer learning, preventing the company from falling into complacency. Managers could endorse this change by actively modelling customer-centric behaviors, for example making decisions based on customer insights or the value products and services bring to the customer, rather than solely on procedural compliance.

6.3 Leverage the organization technology systems to enhance KS and collaborative ideation

The existing KM infrastructure within the organization includes diverse IT tools like CRM systems, Microsoft Teams, OneDrive, and a widely used intranet, which present a significant opportunity for bolstering knowledge sharing and collaboration. However, a notable finding from this research highlights that these valuable resources are not fully utilized for sharing market and customer insights, which could potentially help connect R&D expertise with business knowledge to drive innovation.

The innovation capacity of the organization can be enhanced by setting appropriate KM systems that leverage and contribute to CRM success in terms of fostering innovation. It is important for the organization to not just view CRM and other knowledge management tools as mere repositories of data, but as dynamic engines driving the innovation process. The CRM should be tailored to not only capture customer data but also to facilitate the easy identification of market opportunities and patterns. Information on customer needs or lost projects, especially due to technological features or requirements should be recorded clearly in the CRM systems. This approach allows not only accumulate relevant customer information but also to build valuable customer knowledge, thus transforming of customer data into actionable insights.

The change towards using CRM as a tool to support CKM should include thorough training for the sales team. This training will help them see the importance of collecting information and give them practical skills for gathering knowledge and using the system with ease. It is important for the organization also to invest in developing the tool to make it more user-friendly and to enable easy data analytics for decision-making.

Other technologies can also be leveraged to enhance the accessibility of customer and market knowledge to the organization's employees. For example, a creation of a centralized knowledge base or knowledge repositories to capture, store, and organize essential knowledge, such as customer and market

knowledge, would be crucial in connecting individuals with information. These repositories would be instrumental in providing access to current knowledge, particularly for project development initiatives, thus preventing the need to start from scratch.

These repositories benefit not only current staff but also new members, facilitating efficient onboarding and enabling rapid familiarity with the company's business. Furthermore, knowledge repositories are indispensable for promoting organizational learning and reinforcing organizational memory, enabling the organization to preserve the expertise and insights of employees, even after their departure from the organization.

Moreover, the organization can capitalize on its existing technology tools to foster collaboration and facilitate discussions, comments, and contributions from employees across various departments. Leveraging platforms like the intranet can be particularly beneficial, as it allows for the creation of forums dedicated to innovation. These forums could serve as spaces for initiating discussions, prompting individuals to share customer cases, engage in brainstorming sessions with colleagues from different departments, and disseminate valuable information, such as customer feedback and market insights. The promotion of such platforms can help in cultivating an environment that fosters creative and collective thinking, fosters cross-departmental interaction, and facilitates knowledge sharing across the organization.

The organization could significantly enhance knowledge management by further developing the intranet forums that sales personnel already use to exchange customer cases and market insights with the product areas and R&D teams. These forums should be able to allow for categorization and codification of information more effectively. When specific categories are available, for instance for identified customer needs, knowledge can be more easily retrieved and analyzed for decision-making.

As AI technology continues to evolve, its integration into IT systems like CRM is becoming increasingly common, highlighting the role of AI to enhance the KM

within organizations. It would be important for the organization to further study the integration of AI into the CKM framework.

For example, AI systems can intelligently categorize information, including customer feedback and market trends, by automating the combination and processing of large data, even from different databases and systems. This creates a searchable, centralized knowledge repository that can be accessible to all relevant stakeholders, including R&D teams. This level of analysis would be particularly crucial in Vaisala, where different departments use different systems and tools to manage knowledge, as it can utilize all available information and knowledge in the organization to provide a comprehensive understanding of customer and markets.

6.4 Promote internal networks and cross-functional understanding

As VIM's Technology Strategy Director said: "Innovation occurs when the right problems are identified and matched with the right solutions". This involves creating an understanding and connection between technology and business levels. In the context of VIM which is a large, functionalized organization, we can thus interpret that innovation can only be born from human interactions and the seamless flow of ideas throughout the organization.

Innovation is fundamentally a human-centric process because it thrives in informal networks where knowledge, especially of the tacit type, is shared and exchanged in day-to-day interactions. Tacit knowledge resides in the mind of people and is held by experienced individuals. Tacit knowledge is not easily captured in a written format, but it is crucial for innovation. Therefore, as Nonaka's SECI model indicates, tacit knowledge can only be shared and articulated into explicit knowledge (which can be documented and shared) through socialization. In this sense, managers must realize that creating opportunities in the organization where knowledge can be shared informally is vital, especially when departments often work in isolation.

As this research revealed, the organization actively promotes collaboration through cross-functional teams and conducts regular meetings between departments to ensure alignment between business and technology. However, there is a recognition that this interaction could be further improved to bring together the expertise from both business and technology departments and enhance innovation.

It's important to recognize that while formal meetings and structured collaborations are valuable, the spark of innovation often ignites in informal settings. A creative spontaneous exchange of ideas or casual brainstorming session can occur over a shared coffee or a chance encounter at the office. Therefore, it is important for the organization to provide the opportunity for individuals to connect and create internal networks, and to address any physical or structural barriers that impede these interactions.

The organization should actively encourage interactions between business and technology teams and promote cross-functional collaboration, especially in the context of innovation. One effective approach is to organize innovation or ideation challenges, such as hackathon events, where employees from different departments can collaborate on solving specific problems or developing new ideas. To facilitate this, it is advisable to encourage the formation of teams that include at least one member from R&D and one from business functions. This strategy ensures the establishment of networks, fosters a blend of technical expertise and market insights, and cultivates diverse perspectives in the ideation process.

The creation of Communities of Practice (CoPs), where professionals from different functions in both R&D and business units can interact, share knowledge, and collaborate on problem-solving, would be beneficial. CoPs can be a good approach to enhancing internal networking and fostering innovation by connecting individuals across departments and encouraging cross-pollination and collaboration in the development of new ideas. These CoPs could be structured with clear objectives aligned with innovation goals, such as improving product development, enhancing customer understanding, or fostering innovation in specific product areas or markets. These facilitated groups could establish

communication channels like email lists or team channels, enabling continuous exchange of ideas and the identification of intriguing topics that may lead to innovation.

Some product areas in this research expressed to have planned similar practices called “working groups” around target customers or applications to share knowledge between product management and sales. CoPs can complement these groups by also expanding the reach to any other teams including R&D.

Job rotation is another important knowledge management practice that can help break down departmental barriers and promote cross-functional understanding. The organization should actively promote job rotation programs, whether short-term or permanent, between the R&D and business departments. These programs can enable business employees to gain a deeper understanding of the organization's overall operations as well as for R&D employees to develop customer and market understanding. Job rotations are an excellent way to facilitate cross-functional knowledge transfer and create human networks that endure even after the assignment has concluded, therefore creating a bridge between the business and technology levels.

For instance, when an employee from the R&D department rotates into a business role, they can share valuable technical insights with the new team, enhancing their understanding of technology capabilities and constraints. Likewise, as R&D employees become more familiar with business aspects, they can link real-life problems with potential solutions based on their technical expertise. This integration of knowledge helps to identify opportunities and fosters better alignment between technological capabilities and market demands.

As this research revealed, there are also communication barriers arising from the fact that new employees may lack established connections and an understanding of the company's collaborative culture. The organization could address this issue by establishing mentorship programs that foster cross-functional collaboration and knowledge transfer. These programs could be designed not only to introduce new employees to key contacts in different departments but also to immerse them in the original organization's culture of knowledge sharing. Additionally, it would

be beneficial for the organization to create knowledge directories, enabling employees to easily find expertise within the organization. This would facilitate connections for cross-functional collaborations and speed up identifying the right people at the right time.

Dr. Kondal Reddy Kandadi (Kandadi, 2018) said that innovation rarely occurs in formal meetings but rather in informal daily interactions. In this context, the organization's infrastructure plays one of the most crucial roles in facilitating knowledge sharing between the business and technology levels and in ensuring alignment between market and technology. One of the challenges identified within the organization is the physical separation of business and technology teams, which can impede the free flow of ideas and collaboration. Many participants in the interviews recall a time when product management teams were in close proximity to the R&D teams and when everyone “knew about everything”.

The organization should consider redesigning or reconfiguring its physical layout to encourage interaction between business and R&D teams to minimize communication barriers and maximize the spontaneous transfer of knowledge and ideation. If physical relocation is not feasible, the organization can utilize flexible workspaces, regular cross-departmental meetings, workshops, and shared projects to ensure collaboration.

Introducing flexible working or innovation hub spaces and encouraging employees, especially those working on teams focused on specific product areas, to utilize them, could significantly enhance interaction and collaboration. These flexible environments can be tailored to promote collaboration, creativity, and knowledge exchange, allowing teams to blend physically as required. Such spaces foster spontaneous interactions and idea exchanges, which frequently serve as the foundation for innovation.

Coffee talks play a crucial role in sharing tacit knowledge and fostering innovation. As it was proven in this research, having close interactions between product managers and sales teams, where they exchange insights gained from customer visits, has proven valuable. Unfortunately, such interactions are currently lacking between the technology and business levels due to their

physical separation in different buildings and lack of common office spaces. Managers in R&D and product areas can ensure the interaction between their teams by organizing monthly or quarterly cross-departmental coffee talks. These sessions can offer a structured yet informal environment for employees to gather, exchange ideas, and cultivate relationships. The location can be rotated between R&D and business unit areas to ensure equal participation and variety.

Innovation showcases are highly valuable for technology-driven organizations to showcase the achievements of their R&D teams. As a final recommendation, it is suggested that the organization reinstate the technology push events that were held before the COVID pandemic. These events allowed R&D teams to promote their innovative ideas and solutions effectively. Additionally, it would be beneficial to host these showcases in both directions, including business side contribution to innovation. Business teams could demonstrate their strategic views or insights on market trends and customer feedback, share success stories and testimonials, and highlight strategic partnerships or collaborations with external organizations. This approach could potentially align market demands with technological capabilities, by bringing them together in one place.

7 CONCLUSIONS

The research aimed to explore how knowledge management (KM) contributes to driving innovation within organizations, with specific focus on facilitating the seamless flow of critical customer and market knowledge from the business to the technology side to inspire ideation and develop innovative products that truly align with market needs.

The first research question focused on identifying the mechanisms utilized by leading innovative companies to facilitate knowledge flow and bridge the gap between commercial insights and technical expertise in technological innovation. A comprehensive literature review was conducted to understand the role of KM in innovation and to identify relevant practices. Throughout the research, it became apparent that aligning innovation with market needs requires the continuous incorporation of knowledge from customers, which is a critical type of knowledge for innovation. Systematic knowledge capture emerged as crucial, as it helps organize the fuzzy front end of innovation, ensuring the early-stage alignment of new products and services with business goals. The success of KM in this context can be realized by linking innovation strategy with knowledge management strategy to facilitate the timely utilization of problem-solving knowledge and resources for innovation.

The literature review resulted on a set of best practices employed by top innovators in acquiring and sharing knowledge for innovation. The key among these practices is the continuous effort to understand customers beyond transactional data, and as it is through this deep customer understanding that businesses can identify unmet needs, anticipate future demands, and create solutions that truly resonate with their target audience, driving meaningful value and differentiation in the market. This also required dedicated resources to generate knowledge from market and customer information from different sources and methods.

Additionally, the research identified the importance of building an innovation-friendly environment and culture characterized by open communication and collaboration. Establishing human connections, particularly between technology

and innovation teams, is crucial for matching problems with potential solutions. This involves considering organizational structure and design to enhance physical proximity and facilitate knowledge flow between business and technology functions. In essence, top innovators focus on having the right knowledge sharing culture and environment, the right processes and the right infrastructure to effectively create knowledge for their organization and spark innovation.

The second research question examined how customer and market knowledge can be effectively shared between business and technology level and effectively integrated to innovation efforts. This was explored through a case study of Vaisala's VIM organization, complemented by best practices identified in the literature review, which served as a guiding framework. The interviews revealed a strong foundation for leveraging KM practices in VIM, but highlighted operational barriers related to processes, practices and organizational design. To address these challenges, recommendations were formulated to create a KM strategy, particularly for customer knowledge management. The proposed recommendations aim to foster a more customer-centric approach and to emphasize the significance of customer insights in a customer centric organization.

The VIM organization can benefit from aligning knowledge management practices with strategic innovation goals, prioritizing systematic knowledge capture and sharing, fostering an innovation-friendly environment, and dedicating resources to understanding customer needs. Moving forward, the organization is in a good position to foster a collaborative environment and innovation.

7.1 Reflections on the research process

Throughout the development of the thesis, it became apparent the importance of knowledge sharing in the VIM organization, even to other departments not included in the research. The significance of the topic made it easy to engage people in the research and helped in development of this thesis project. However, this also amplified the amount of data collected and the complexity of the work.

Therefore, it became crucial to look at the data collected from the point of view of knowledge management, and how can KM help in the context of connecting customer knowledge with innovation.

It is acknowledged, that the number of participants in the interview are just a small representation of the whole VIM organization and all its business and technology departments. While this thesis focused only a subset of teams within technology and business functions, it still provides the organization with understanding on how knowledge is flowing and with preliminary insights into weaknesses and opportunities for further investigation.

This research succeeded in explaining the importance of effective knowledge management in driving innovation and highlights the need for ongoing efforts to optimize KM practices within organizations. The research also gathered comprehensive information on the topic and provides a conceptual framework that can be used for effectively aligning business and technology capabilities through KM practices in organizations, allowing KM to play a pivotal role in driving innovation and ensuring organizational success.

7.2 Limitations and further recommendations

The organization's complex nature, characterized by different product management and sales teams, presents a significant challenge in fully covering all practices used to ensure alignment between market needs and technological developments. Although the research offers a comprehensive overview of the current status and highlights the most pertinent challenges, it does not claim to generalize every aspect of the VIM organization's efforts in this regard.

Another significant limitation of this research is related to the flow of customer knowledge within the organization. Customer knowledge in an organization flows across different dimensions and originates from various departments. This research did not account for contributions from departments such as technical support or marketing. These areas are crucial for a comprehensive strategy and effective management of customer knowledge. For instance, technical support

departments often possess valuable insights into customer feedback on products, while marketing teams play a critical role in identifying customer needs through leads generated, for example from webpage inquiries. All sources are vital for innovation, yet the flow of knowledge from these departments to R&D was not considered in this study. Incorporating these aspects into the organization's knowledge management (KM) strategy would likely yield significant benefits.

Lastly, the topic of knowledge sharing emerged prominently throughout the interviews conducted for this research. Although the thesis was focused on specific areas, it became apparent that the scope of knowledge sharing within the organization was much broader than initially anticipated. Participants expressed a general willingness to share knowledge, along with a recognition of the need to receive knowledge in return. For example, sales personnel highlighted the importance of product managers understanding and sharing knowledge about customer needs and applications. This would enable the sales team to identify better sales opportunities. However, due to the focused nature of the thesis, the exploration of these aspects was limited.

7.3 Suggestions for further research

The limitations presented in section 7.2 suggest areas for further investigation about knowledge sharing practices in the VIM organization. They also highlight the need for a more integrated approach to customer knowledge management within VIM.

It would be beneficial for the organization to study how knowledge from customer flows in the organization through other functions and how they can be integrated to the innovation framework. Knowledge sharing needs from the sales department to improve their work are also worth to evaluate.

One important finding of this research was the different perspectives about knowledge sharing between the R&D and Product Management departments. While this issue likely is grounded on communication barriers and lack of

interaction between these teams, the exact reason was not found in this research. It would be important for the organization to further investigate this misalignment to take targeted actions that improve collaboration between business and technology departments.

Additionally, the expansion of structured KM practices to other departments and other strategic objectives has the potential to enhance the organization's operations, performance, and competitive advantage, ultimately driving the organization to a path of enduring success.

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9 APPENDICES

Appendix 1. Interview structure and questions.

1. Introductions

1.1 Introduce myself and the research

- Interviewer background
- Research topic and objectives
- Explain confidentiality of the data
- Permission for recording the interview
- Provide outline of the interview

1.2 Introduce the interviewee

- Interviewee's position in the VIM organization and role and responsibilities
- Interviewee's role in the innovation chain or process within the organization

2. Understanding the current state of knowledge flow

2.1 Product management

- What are the specific knowledge needs of the product management team in terms of customer and market insights for effective decision-making and driving innovation?
- How does your department mainly gather or access that knowledge? How do you perceive the role of sales teams in gathering and sharing this knowledge?
- Can you describe common practices or strategies of how knowledge from customers and the market are shared (between product management, R&D and sales teams) for idea generation?
- In your opinion, how does the organization ensure that market demands and technological capabilities are effectively balanced to drive successful innovations?

2.2 R&D

- What are the specific knowledge needs of the R&D team in terms of customer and market insights for idea generation and driving innovation?
- How does your department currently gather or access that knowledge? How do you perceive the role of sales teams in gathering and sharing this knowledge?

- Can you describe common practices or strategies of how knowledge from customers and the market are shared (between product management, R&D and sales teams) for idea generation?
- In your opinion, how does the organization ensure that market demands and technological capabilities are effectively balanced to drive successful innovations?

2.3 Sales function

- From the sales team's perspective, what is the primary focus when interacting with customers and gathering market insights? What type of knowledge from customer do you typically gather in your daily work?
- How do you collect and communicate knowledge from customers to the product management and R&D teams?
- Can you describe instances where knowledge from customers gathered by sales has directly contributed to idea generation for product development or innovation?

3. Identifying challenges and opportunities

- What do you perceive as the primary barriers and challenges in effectively sharing knowledge and achieving cross-functional collaboration between sales, product management, and R&D in the context of innovation?
- Are there any specific strategies or practices that have proven successful in enhancing knowledge flow to support innovation? Can you provide examples of successful collaborations between product management, R&D and sales departments in generating innovative ideas?

4. Recommendations for the future

- Based on your experience, what recommendations would you have for improving knowledge flow and bridging the commercial-technological levels to enhance idea generation within the organization?
- How do you envision these recommendations contributing to a more innovative environment in the context of VIM organization?