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Applicability of ISO 56002 in Production Processes

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ABSTRACT

The popularity of the term *innovation* is growing rapidly. Its significant role in the increasingly competitive world is not deniable. Consequently, to secure their profitable growth, enterprises across the world try to improve their innovation capabilities.

After publishing the first international standard by ISO, in the realm of innovation management system, this current thesis project is performed to investigate the challenges and motivations that production units may have in implementing the new standard, ISO 56002, in their production processes. The empirical part of the project is carried out in cooperation with five Swedish industrial companies. A variety of companies regarding to the type of activities, size, age, etc. were selected.

Based on the content of standard ISO 56002, the collected data from prior research and empirical findings, an analysis is performed. The results shows that organizations have different approaches toward managing innovation activities and their current innovation management's capabilities is a determining factor for challenges with ISO 56002. However, all respondents have positive attitude toward the implementation of ISO 56002 in the production processes and consider it as a useful standard with many potential benefits for their organizations. Challenges that companies may confront, in applying ISO 65002 in the production processes, are culture, involvement of leadership, immaturity in working with processes, etc. Considering the consensus about the culture as a challenge, a model to enhance the employee's engagement is suggested.

This thesis is one of the pioneers in investigating the applicability of ISO 56002:2019 in a production process. It can provide production units with useful information and contribute to the innovation management community.

The empirical information is collected from companies that have not implemented ISO 56002. Future studies by focusing on the companies with ISO 56002, can shed light on new aspects of the standard's applicability in the production processes and develop findings of the present thesis. Additionally, the implementation of standard's various features in production processes can be inspected individually.

Keywords:

ISO 56002:2019, ISO 56000:2020, Standard, Innovation, Innovation Management System, Production Process

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Finally, I dedicate this thesis to my parents and lovely children.

Zeinab Sayahi
Katrineholm, June 2021

Contents

ABBREVIATIONS

CIRP	The International Academy for Production Engineering
HLS	High-Level Structure
IMA	Innovation Management Assessment
ISO	International Organization for Standardization
ISO/TC 279	Technical Committee of ISO in Innovation Management
MBCE	Model-Based System Engineering
MSS	Management System Standards
OECD	The Organisation for Economic Co-operation and Development
PDCA	Plan-Do-Check-Act (cycle)
SDG	Sustainable Development Goals
SIMS	Standardized Innovation Management System
TQM	Total Quality Management

INTRODUCTION Chapter 1

This thesis studies the applicability of ISO 56002 in a production process. ISO 56002 provides generic and comprehensive guidance for the establishment, implementation, maintenance, and continual improvement of an innovation management system for use in all types of organizations (ISO 56002:2019).

This chapter is dedicated to an introduction of the thesis work. In addition to explaining the background and the context, the problem is formulated, and the aim, scope and outline of the thesis is presented.

Background

Countless published research papers and literatures focus attention on the innovation and benefits that it creates in human life. Sveiby et al. (2012) considers innovation one of the most commonly mentioned concepts in social science. Regardless of which aspects or types of innovation are studied, research works point out to a great deal of advantages. As a key driver for economic growth and national wealth, innovation is considered as the ultimate solution in the welfare related problems (OECD, 2010). Innovation has extensive effect on humans' life. "Innovation is central to improvements in living standards and can affect individuals, institutions, entire economic sectors, and countries in multiple ways" (OECD, 2018, p.19).

Furthermore, in a highly competitive context that many firms are subjected to fierce, innovation is the most reliable tool to cope with the competition (Mamasioulas et al., 2020). New customer requirements, emerging technologies and equipment (Romero, D. et al., 2017), digitalisation and sustainability (Karlsson, 2019a) are just some of the many factors that urges the companies to constantly improve and renew themselves and their offerings. According to The Organisation for Economic Co-operation and Development (OECD), innovation is the heart of value creation in small and medium enterprises, a key feature to improve productivity and sustainable resource use (OECD, 2013).

Many authors go beyond the benefits and consider innovation essential for a firm's existence. Bessant and Rush (2009) consider both product and process innovations important because without them, the businesses risk to be outpaced in the increasingly competitive world. Sveiby, et al. (2012), believe innovation is not only a key driver of organizations' success but also vital for organizations' survival. As an investment into future profits, innovation "will secure survival of the company in the market by maintaining or extending its market share" (Bullinger, 2008, p.14). Wind and Rhodes (2017) stress the innovation as an obligation for organizations' long-term success.

Innovation is not only a key element in the organizational level, but also an important factor to enhance the countries' competitiveness in a global scale. The Sweden's government considers innovation capacity essential to meet the challenges and opportunities of the global economy (The Swedish Ministry of Enterprise, Energy and Communications 2015).

The increasing global competition between companies and nations intensifies the importance of innovation. Consequently, the role of an *Innovation Management System* that can lead innovation activities in a structured and systematic way, is becoming more crucial. After explaining the importance of innovation in todays' world, Wind and Rhodes (2017, p. 223) note that "it is more important than ever that firms utilize effective approaches for facilitating breakthrough innovation". Success in managing innovation activities becomes even more vital when the companies go through critical periods. By comparing two innovative companies that faced same crisis, Cooper and Edgett (2010) explain how establishing and maintaining an innovation strategy can help organization to cope with crises and survive. And by contrast, lacking directions for innovation activities makes the firms' vulnerable in facing difficulties.

In one hand, although several decades of research on the innovation management have created many insights into the innovation process, but they have failed to provide mangers with coherent advice or a comprehensive framework for innovation management (Tidd, 2001). Tidd condemns the research works to be based on the experience of specific sectors, when attempting to identify some generic 'best-practice' or universal formula for successful innovation (ibid).

On the other hand, in performing innovation activities, the requirements in terms of working methods and abilities to succeed with innovation work is often underestimated by organizations (Karlsson, 2019a). He does not consider individual activities such as collecting ideas, performing brainstorming or collaborating with startup-companies, enough to succeed with innovation. He emphasized the need for a holistic approach to organizations' innovation management (ibid). The innovation goals, in creating high value and coping with uncertainties and risks, can be achieved through a proper innovation management system (Harrington & Voehl, 2020).

For many years, Management system standards (MSS) by defining requirements and offering guidance, have helped organizations to deal with their daily management issues in a rational and decisive manner (Kohl, 2020). Even though, their focus was on the quality management in the beginning (Kohl, 2020; Boiral & Saizarbitoria, 2015), but today they have a broad scope covering "almost all aspects of a modern management system: quality, environment, energy efficiency, information security, occupational health and safety, anti-bribery, social responsibility and more" (Kohl, 2020, p. vii). And by an upward trend, they are getting adopted by an increasing number of organizations around the world (Boiral & Saizarbitoria, 2015; (Casadesús, et al., 2011). Only the International Organization for Standardization (ISO) have more than 80 MSS including ISO 9001, ISO 14001 and ISO 50001 etc. (ISO, n.d.a).

During several years, production processes has been in the focus of several improvement concepts such as Total Quality Management (TQM) and Lean. And consequently, a great number of studies have been carried out to investigate the impact of their methods on production processes. The finding of empirical studies suggests that TQM significantly and positively has affected the organizational performance (Shafiq, M. et al., 2019; Punnakitikashem, P. et al., 2010; Prajogo & Sohal, 2003). Countless studies have been conducted to demonstrate the contribution of Lean to the improvement of production processes. For instance, the efficiency of Lean tools in reducing the production cost (e.g., Alifiya & Singgih, 2019; Deif & ElMaraghy, 2014), increasing productivity (Rewers, et al., 2016; Marin-Garcia, et al., 2009) and reducing environmental impacts (e.g., Chiarini, 2014; Belayutham, S. et al., 2017) is verified by plenty of empirical studies.

Today, that the world's first standard on innovation management system, ISO 56002, is available, it is motivated to explore its challenges and benefits in *production processes*. In addition to providing a common language (Hyland & Karlsson, 2021), the standard's guidelines assist organizations in employing a systematic and structured approach toward innovation management to improve their innovation capabilities and business performance. Implementation of the standard leads new ideas and opportunities in a right track to reach the intended goals.

The present thesis project studies the implementation of ISO 56002 in production processes by focusing on the challenges and motivations.

Problem formulation

Rapid changes in customers' expectation and the increasing pressure on the earth's resources arise the need to innovate. On the other side, the increasing global competition between companies make innovation inevitable for organizations in order to stay relevant in the competitive market and improve their economic growth.

Although the growing popularity of innovation has got lots of attention from researchers, but still some aspects of innovation are missing in the research works. Despite the immense attention paid to innovation in the literature and increased number of innovative firms, there is a lack of research investigating the challenges and barriers faced by companies to increase their innovative capacity (Segarra-Blasco et al., 2008; Galia and Legros, 2004). In addition, many companies lack a clearly articulated and well-communicated innovation strategy (Cooper & Edgett, 2010).

The problem is even more intensive, when it comes to innovation in production and manufacturing processes. Very few studies are performed to investigate the state of innovation in manufacturing organizations. After an extensive overview of literatures sources such as books and scientific papers, the authors of the article "A manufacturing innovation overview: concepts, models and metrics" are convinced that "although there is a huge variety of scientific publications and extended publicity regarding 'innovation', there was no extensive overview regarding the facets of the innovation notion and its use in manufacturing" (Mamasioulas et al., 2020, p.769).

In recent years, some national standards such as BS 7000-1:2008 (Great Britain), CEN/TS 16555 (Europe), UNE 166000:2014 (Spain) and FD X50-271:2013, (France) have been developed and published to systematize the innovation management. Although the implementation of such innovation standards, has significant positive effect on innovation capabilities and business performance (Mir, et al., 2016), but the standards were not globally acknowledged. Some other guidelines such as Oslo Manual (OECD, 2018) – *Guidelines for collecting, reporting and using data on innovation* – that are internationally recognized, have limited scope and application; and its guidelines do not cover all aspects of innovation management system. Apparently, many companies and enterprises, around the world, have a need to a systematic approach to their innovation management.

Eventually, after 10 years of international cooperation (Karlsson, 2019a) and with participation of more than forty countries (Merrill, 2019), in 2019, the first international standard for innovation management system, ISO 56002, was published.

ISO 56002 helps various types of organization to develop an innovation management system that helps them to determine their innovation vision, strategy, policy, and objectives, and to establish the support and processes needed to achieve the intended outcomes (ISO 56002:2019). "An organization can innovate more effectively and efficiently if all necessary activities and other interrelated or interacting elements are managed as a system" (ISO 56002:2019, p. vi). According to ISO 56002:2019, some of the potential benefits of implementing this standard are as below:

- "increased ability to manage uncertainty"
- "increased growth, revenues, profitability, and competitiveness"
- "reduced costs and waste, and increased productivity and resource efficiency"
- "engaged and empowered people in the organization"
- "improved sustainability and resilience"

As some other areas such as quality management and project management became more professionalized through introducing the standard, it is expected that the new ISO standard in innovation management will systematize innovation management field (Hyland, 2020).

Since the standard ISO 56002 has been published recently, it is well-known neither within academia nor industry. According to the author's search, no comprehensive empirical or theoretical research is performed to investigate the standard's implementation in production processes. Although a research project is going on to study the systematic innovation management in companies that are using guidelines of ISO 56002 (Hyland & Karlsson, 2021), but there is no evidence of any research to investigate implementation of ISO 56002 with focus on production processes.

The terms *ISO 56002* or *ISO 56000* are hardly mentioned in any academic works. Apart from the two books "ISO 56000: Building an Innovation Management System" by Merrill (2020), and "Innovation Systems Cycle" by Harrington & Voehl (2019), scant number of books have dedicated some parts to ISO 56000 family standards. For example, "Total Innovative Management Excellence (TIME)", written by Harrington & Voehl (2020), briefly highlights the principles and recommendations in ISO 56002. And the book "Corporate Standardization Management and Innovation" by Jakobs (2019)- which its publication coincides releasing ISO 56002 - gives a very short introduction to ISO 56000 family and the commitment of ISO/TC 279 in developing the family's standards.

Considering research articles, very few publications related to ISO 56000 series standards are available. Further, they have only presented shallow introduction to the elements of ISO 56002 or studied some aspects of the standard such as its integration with other systems. "The Great Eight" from Merrill (2020), "Towards a Management System Standard for Innovation" by Hyland & Karlsson (2021) and "Integrated AI and Innovation Management: The Beginning of a Beautiful Friendship" by Yams et al., (2020) are among such scholar works. After extensive search among organizations' websites to find any footprints of ISO 56000 standard series, the author of this thesis is convinced that other than the official website of ISO, it is just innovation consulting enterprises that have published short information, related to the standard series ISO

56000, in their websites. Such websites mostly prepare readers with the standard's content and its general benefits.

On the other side, previous studies have demonstrated variety of challenges that firms confront in implementing the management system standards such as ISO 9001 (Rybski, et al., 2017; Heras, et al., 2008; Singh, et al., 2006; Casadesús & Karapetrovic, 2005). Consequently, it is expected that organizations would face some challenges in implementing ISO 56002. Thus, there is a huge need to perform studies to investigate the implementation of the standard in the organizations and capture learnings (Hyland & Karlsson, 2021). This thesis investigates the implementation of ISO 56002 in production processes as a part of an organization. It includes the challenges that organizations may face and motivations to implement the standard. Despite being a small project, the collected theoretical information, the empirical study and the developed knowledge can help organizations to have a clearer picture of implanting the standard, improve their standardization practices and guide them in building sustainable innovation capabilities.

Additionally, the created knowledge in the present thesis can be useful in moving from a guidance standard ISO 56002 to an auditable standard ISO 56001. The knowledge can contribute to build the body of knowledge for establishing ISO 56001 (Merrill, 2019) which is under development. ISO 56001 is an auditable and conformity assessment standard in innovation management system and will replace ISO 56002 in the future (Hyland & Karlsson, 2021, Merrill, 2019).

Aim and Research questions

The purpose of this thesis is to investigate applicability of ISO 56002 in production processes, in the context of goods-production. The present thesis clarifies the challenges and advantages in standardizing innovation management. It creates a knowledge basis that can be useful for industries aiming to implement ISO 56002. The knowledge can also contribute to the community of innovation management.

Punch (2014) sees research as an organized, systematic, and logical process of inquiry to answer questions by using empirical data or information. In this viewpoint, answering questions is the core part of a research work.

In this thesis, the focus is on the following question:

> ***Research question 1:*** What are the challenges a production unit may confront in implementation of ISO 56002 and shifting to a systematic approach toward Innovation Management?
>
> ***Research question 2:*** What are the motivations that can drive a production unit to implement the standard ISO 56002?

Project scope and limitations

ISO 56002 is applicable to all types of organizations and all types of innovations, e.g. product, service, process and method. However, the aim of this thesis is to investigate the applicability of the standard in production processes. The thesis focuses on the innovations that are related to production and not products or services. Figure 1 shows the part of supply chain that is included in this project.

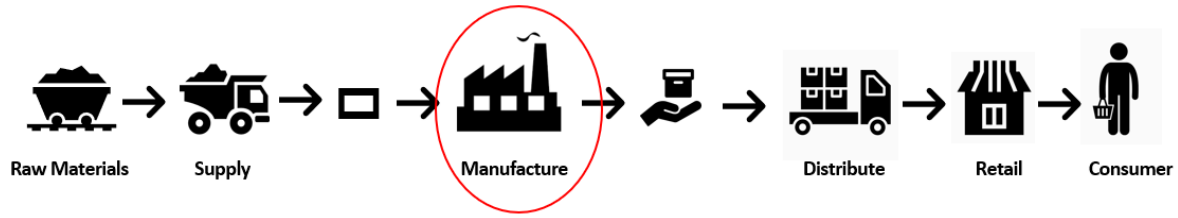

Figure 1: part of supply chain included in this project (Author)

Additionally, production organizations that are considered in this thesis are of such kind related to producing goods or manufacturing. All other kind of production such as production of service or other non-tangible items are out of the thesis's scope.

Outline of the thesis

This report is organized as follows:
Chapter 1 gives an *introduction* of the thesis work.
Chapter 2 presents the *theoretic framework*.
Chapter 3 describes the *research method*.
Chapter 4 describes *results (empirics).*
Chapter 5 is the researcher's *analysis* of the collected data.
Chapter 6 presents the *conclusion* of thesis work.
Chapter 7 is a list of used *references*.
Chapter 8 includes *Appendices*.

THEORETIC FRAMEWORK Chapter 3

This chapter reviews theoretical literatures related to the research area. Firstly, it presents definitions to some concepts, used in the thesis. Then, it describes aspects of innovation management. It introduces the standard ISO 56002 and finally, reviews the implementation of the standard.

Definitions

Innovation:

Numerous resources have presented their definition of innovation. In the following some of definitions will be considered.

In the book ”Innovation and Ontologies”, Bullinger (2008) considers the exact meaning of the term *Innovation* problematical since it is often interchangeably used with other terms with novelty characters such as creativity, invention and idea. She takes a deep dive into the realm of innovation and describes *Innovative Idea* and *Innovative concept* as preceding stages to reach *Innovation*.

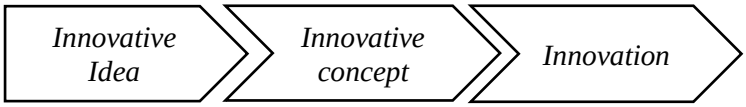

figure 2: Innovative Idea, concept and Innovation presented (Bulliger, 2008)

Bullinger (2008) defines innovation idea as *indefinite perception* of a combination of purpose and means in a new form that after developing might become a novel solution to a problem. After passing multiple innovative ideas through the first filtering process, concepts are created. Innovative concept is the first *predevelopment version* of a combination of purpose and means in a new form. An innovative concept is a developed innovative idea that might become a novel solution to a problem. According to Bullinger, innovative concepts that pass technical and economical filters, are innovations and can go forward to be further developed. “An innovation is an *exploitable* combination of purpose and means which is perceived as qualitatively different from existing forms. It is a novel solution to a problem and has been elaborated from an innovative concept” (ibid).

The authors of the article “A manufacturing innovation overview: concepts, models and metrics” present a comprehensive definition of innovation, a process that converts an idea or invention into a good or service in a way that creates value or customers intend to pay for it (Mamasioulas et al., 2020). In this point of view, innovation is defined as “the process of creating value from ideas*”* (Goller & Bessant, 2017, p. 4).

The third edition of Oslo Manual (OECD, 2005) focuses on the practical aspects in proposing the meaning of innovation: ”An innovation is a new or improved product or process (or combination thereof) that differs significantly from the unit’s previous products or processes

and that has been made available to potential users (product) or brought into use by the unit (process)" (OECD, 2018, p. 20). Oslo Manual considers the *novelty* as a crucial characteristic for innovation (ibid).

To create a common understanding of the term innovation (Hyland & Karlsson, 2021), ISO 56000:2020 presents a definition of *innovation.* Innovation is a new or changed entity such as product, service, process, model, method or a combination of them that results realized or redistributed value by satisfying needs and expectations, in relation to the resources used. In this sense, novelty and value are determined by the perception of the organization and related interested parties. Value can be financial or non-financial e.g., revenues, savings, productivity, sustainability, satisfaction, empowerment, engagement, experience, trust (ibid).

Depending upon innovation's context, which aspect of change in an organization is considered and what purposes innovation activities pursue, innovation can have several categories and types, such as Incremental or Radial, Major or Minor, open or closed innovation etc. The study of innovation's categories is not included in the scope of the present thesis.

Dilemmas about the meaning of innovation

Žižlavský (2013) believes although innovation is known as a basic prerequisite for economic development and the preservation of competitiveness, but there is still no generally accepted definition of innovation; and based on different concepts, individual authors use their own definitions. Reviewing various literatures and theoretical resources, within the domain of innovation, reveals some contradictions or misunderstanding in defining the term of *innovation*. It might create a dilemma of what exactly is considered as innovation. Some examples of such dilemmas are presented here.

Kenneth B. Kahn (2018) describes *innovation* as three different things either outcome, process or mindset; Oslo Manual (OECD, 2018) states that the term *innovation* can implicate both an activity and the outcome of the activity i.e., process and outcome. However, ISO 56000 emphasizes that *Innovation* is an outcome, and it shouldn't refer to activities or processes resulting in, or aiming for, innovation. ISO 56000 requires using some form of qualifier, e.g. *innovation activities* when "innovation" is used in any sense other than an outcome.

Schroeder, et al. (1989) believe that innovative activities that results in failures should also considered as innovation. Nevertheless, in defining the term innovation, ISO 56000 highlights the essence of realizing or redistributing value. Both standards, ISO 56000 and ISO 56002 distinguish innovation from initiatives and remind that all of innovation initiatives do not result in innovation.

Bullinger considers *invention* as one of the terms which tend to be terminologically confounded with innovation (Bullinger, 2008, p. 12). She argues that invention is mainly related to technical knowledge and not market issues. In contrast to innovation, an invention implies not necessarily an economic usability. Considering this aspect, creating value is the main characteristic that differentiates innovation from invention. According to Bullinger, an invention needs to be successfully used internally or in the market to become an innovation (Bullinger, 2008, p.13). The authors of the article "Innovation-Driven Organizations: What, Why, and How" mention another characteristic for innovation. They believe in comparison with invention, innovation is based on collective knowledge and experience (Keathley et al., 2010). And finally, Pisano &

Shih (2012) note that different from invention, the innovation includes the entire process, from taking a new idea to the marketplace.

Production, Manufacturing:

Production, as Murthy (2009) describes is the process by which goods and services are created. "Production is the conversion of raw materials to end product by using processes, machines, men, tools and so on" (ibid). Murthy obviously differentiate the terms production and manufacturing by relating manufacturing to tangible goods and production to both tangible goods and intangible services. Harmsen (2013) defines a manufacturer as companies that convert raw material from suppliers into products for their customers.

Aswathappa and Shridhara (2009) commence the first chapter of the book "Production and Operations Management" by a definition of production: "Production is the process by which raw materials and other inputs are converted into finished products". Aswathappa and Shridhara has the same approach as Murthy toward distinguishing production from manufacturing. They believe that manufacturing may be defined as the process of producing only tangible goods, whereas production means creation of both tangible goods as well as intangible service. The process of conversion sub-system is considered as the core of production function, wherein workers, materials and machines are used to convert inputs into products and services (Aswathappa & Shridhara 2009). Although the authors have a positive attitude toward drawing distinction between the terms production and manufacturing, nevertheless they used both terms synonymously in the mentioned book.

Mikell P. Groover (2007) in his book "Fundamentals of Modern Manufacturing: material, processes and systems" presents a detailed description of the term *manufacturing*. Groover states that the terms production and manufacturing are often used interchangeably. He considers a broader and more general meaning for production than manufacturing. The word *production* can be used in a verity of applications and contexts, even in the fields that manufacturing can seem out of place, for example 'crude oil production'. However, in the context of metal work or automotive industries both terms are suitable (ibid).

Groover (2007) introduces two types of approaches to study manufacturing, *technologically* and *economically*. Technological approach to manufacturing, defines it as "the application of physical and chemical processes to alter the geometry, properties, and/or appearance of a given starting material to make parts or products; manufacturing also includes assembly of multiple parts to make products" (ibid). As illustrated in the figure 3a, a combination of machinery, tools, power, and manual labour can be employed to carry out the manufacturing process. To study manufacturing with an economical approach, gives another definition av manufacturing; by this approach, manufacturing means "the transformation of materials into items of *greater value* by means of one or more processing and/or assembly operations" (ibid). As shown in the figure 3b adding value is the key point in this definition.

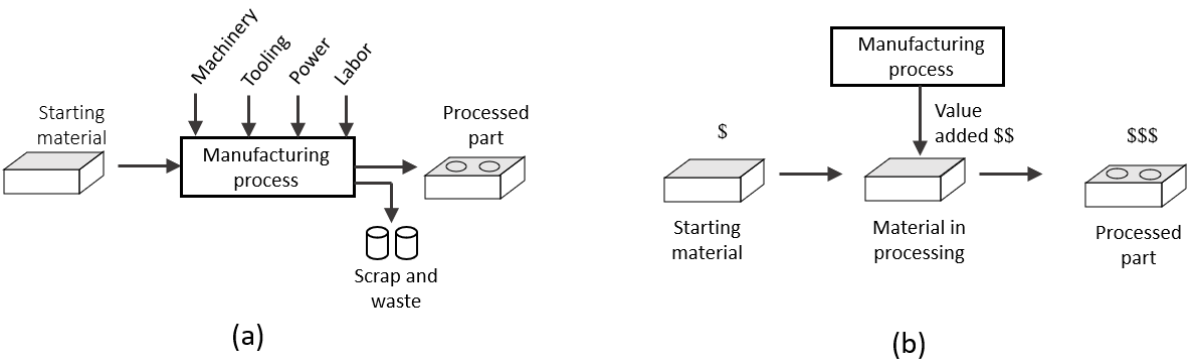

Figure 3: Manufacturing with technological approach, 3a & economical approach, 3b, (Groover, 2007)

Ramesh Babu (2011, p. 2) describes the term *production* as the act of transforming resource inputs to create useful goods and service. "Production is any progress or procedure developed to transform a set of input elements like men, machinery, capital, information and energy into a set of output elements like finished products and services in proper quality and quantity, thus achieving the objectives of an enterprise". Ramesh Babu presents the Figure 4 as a model for a production system.

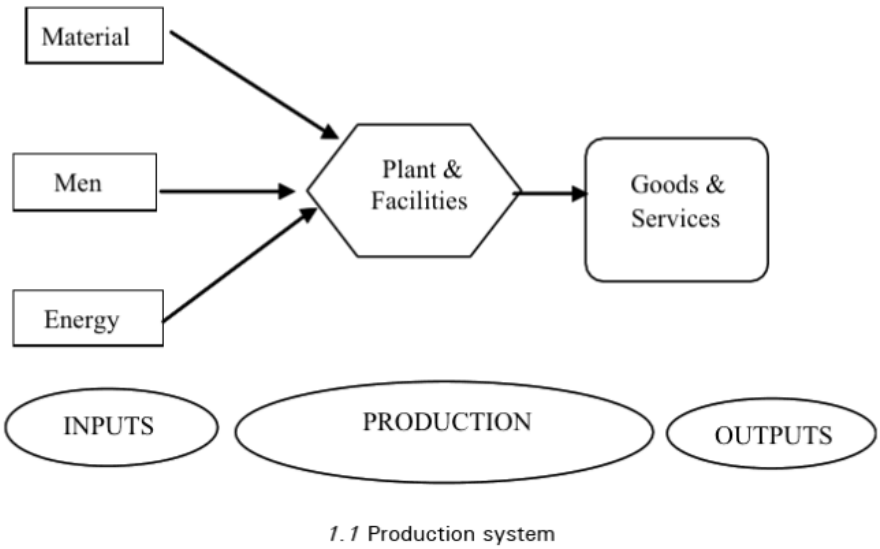

Figure 4: Production system (Ramesh Babu, 2011)

In his book, although Ramesh Babu (2011) has used the term *manufacturing* in goods-producing context, he has not differentiated clearly between terms *manufacturing* and *production*.

Hitomi (2011) in his book "Manufacturing Systems Engineering" defines production as *making something new either tangible or intangible.* He even includes intangible *ideas* under the heading of production. He distinguishes manufacturing from production but has a different point of view toward it. Hitomi describes *manufacturing* as "*the conversion of a design into a finished product'* and *production* as *'the physical act of making the products"*. Thus, according to him the term *production* has a narrower sense. He refers to the definition that The International Academy for Production Engineering (CIRP) made for the term *manufacturing* in

1983. CIRP defines manufacturing as '*a series of interrelated activities and operations involving the design, material selection, planning, manufacturing production, quality assurance, management and marketing of the products of the manufacturing industries*'. Hitomi considers manufacturing as a series of productive activities and believes that production is one of those activities and a part of manufacturing.

Process:

ISO 56000:2020 defines a process as "set of interrelated or interacting activities that use inputs to deliver an intended result" (ISO 56000:2020, p. 9). Many authors present almost similar definitions to the term *process*. Carr and Johansson (1995) describe a process as a set of linked activities that receive an object as input, make changes on it and then leave it out as the output of the process. Kohl (2020) presents a rough definition of process: "transformation of an input into an output". Even some authors that study the *process* from different perspectives, believe the center of attention in *production process*, is on the transformation function of a process (Harrison 1994; Schwarzer & Krcmar, 1995 cited in Schallmo et al., 2018). It is expected that the transformation applied by activities, adds value to the input object. It means the created output in comparison with the input object, is more useful, effective and desirable for the recipient (Carr and Johansson, 1995).

Process Innovation

Several literatures have presented nearly similar definitions to the term *process innovation*. Romero, D. et al. (2017) refers process innovation to the implementation of a new or significantly improved production or delivery method to improve production capability in a manufacturing or logistical system so that it adds value to the firm and its value chain. While product innovation is about changes in products or services, Bullinger (2008) notes process innovation involves changing the internal ways in which products or services are created and delivered. However, she believes process innovation primarily consists of optimization activities and removing problems from system (ibid).

By explaining process innovation as incremental or radical development, Schallmo, et al. (2018) believe process innovation can improve customer satisfaction through reducing cost and time or enhancing quality. Rapid prototyping and introduction of intranet (Bullinger, 2008) are examples of process innovation.

In addition to improvements in customer satisfaction, sustainability can also be the target of process innovation. As the discourse of sustainability matures over years and our understanding of the concept sustainability changes (Gaziulusoy & Brezet, 2015), we can see more researchers focus their attention on the importance of innovation in the context of sustainability. Partidario and Vergragt (2002), through doing empirical research show the importance of innovation in sustainability. And Gaziulusoy and Brezet (2015) observe process innovation as one of the necessary elements in achieving sustainability.

Innovation Management and Standardization

Innovation does not happen accidentally (Goller & Bessant, 2017). Innovation as a complex process that includes risks and uncertainties, needs to be managed systematically (Bessant & Tidd, 2015). Goller and Bessant (2017) explain although everyone might get lucky once, but to sustain the success, repeat the process and deliver a stream of innovative solutions, the organization needs to organize and manage the innovation. "Innovation is a *skill-based* activity, one which can be learned and developed" (ibid). Bessant & Rush (2009) acknowledge the importance of innovation, but they remind that the major issue is the capability within the organization to repeat the trick, to innovate continuously in a dynamic and changing context.

Bessant and Tidd (2015) emphasize to consider the innovation as "an extended sequence of activities – as a *process"* (Bessant & Tidd, 2015, p. 21); and by referring to empirical-based knowledge, suggest to *manage innovation as a process* to succeed in manging innovation (ibid). The authors think the challenge is in performing the innovation process in an organized way and making it to repeat.

Hyland and Karlsson (2021) believe, the domain of innovation management as an emerging profession, can take its well-recognized and legitimized position through the innovation management standard, ISO 56002.

In the following, some core elements in the domain of innovation management are explained. These areas have got a high attention from both prior studies and ISO's Management System Standards.

Innovation Capabilities

The organizations' ability to *innovate* is a crucial element that affect sustained growth, economic viability, increased well-being, and the development of society (ISO 56000:2020). Innovation can only occur if a firm has the capability to innovate (Laforet, 2011). There are many research literatures (e.g., Najafi-Tavani, et al., 2018; Ngo & O'Cass, 2012; Terziovski, 2008; Mark et al., 1998; Hurley & Hult, 1998; Gatignon & Xuereb, 1997) that highlight the important role of innovation capabilities in the firms' performance. Enhancing innovation capabilities improves the organization's ability to understand and respond to changing condition of its context, to capture new opportunities and furthermore, to reinforce employees' knowledge and creativity (ISO 56002:2019).

ISO 56000 defines *innovation capability* as "ability to perform innovation activities and innovation initiatives to achieve innovation" (ISO 56000:2020). According to this standard, examples of innovation capability are proficiency *in technologies, strategic intelligence, access to funds, operational functions and processes, competent and experienced people contributing to innovation objectives* (ISO 56000:2020). Mir, et al. (2016), by referring to CWA 15899, mentions nine major elements of "innovation capability": *innovation culture*, *strategy*, *competence and knowledge*, *technology*, *product and service*, *process*, *structure and network*, *market*, and *project management*.

Mir, et al. (2016) who have investigated the impact of the Standardized Innovation Management System (SIMS) among many different firms, conclude that SIMS has a significant positive effect on the companies' innovative capabilities. They believe some challenges, such as culture

and lack of the leadership's involvement, that companies face in performing the innovation practices could be mitigated by using a SIMS. Bessant and Rush (2009) believe that innovation capabilities are mostly affected by the firms' ability in developing and reinforcing key innovation management routines and the firms' competency in handling learnings, rather than the firm's size.

To determine the innovation capability or innovation performance in an organization, an *innovation management assessment (IMA)* can be done (ISO 56000:2020; ISO, n.d.f). A transparent picture of the organization's current performance is a pre-requisite to develop innovation management capability and performance (ISO, n.d.f). In addition to ISO 56002 that can help organizations in conducting an IMA (Karlsson, 19b), the standard ISO/TR 56004:2019 (Innovation Management Assessment – Guidance) is specially developed to help firms in performing such assessment (ISO, n.d.f).

Innovation Maturity

Bessant and Rush (2009) investigate the firm's learning routines and their capacity in acquiring and using knowledge to create new products, processes, and services. Based on the firms' capability to organize and manage the innovation process, from search to effective implementation of new knowledge, Bessant and Rush categorizes firms into four groups. The model ranges from firms that are 'unconsciously ignorant' through to high-performing, knowledge-based enterprises. Figure 5 is presented by authors.

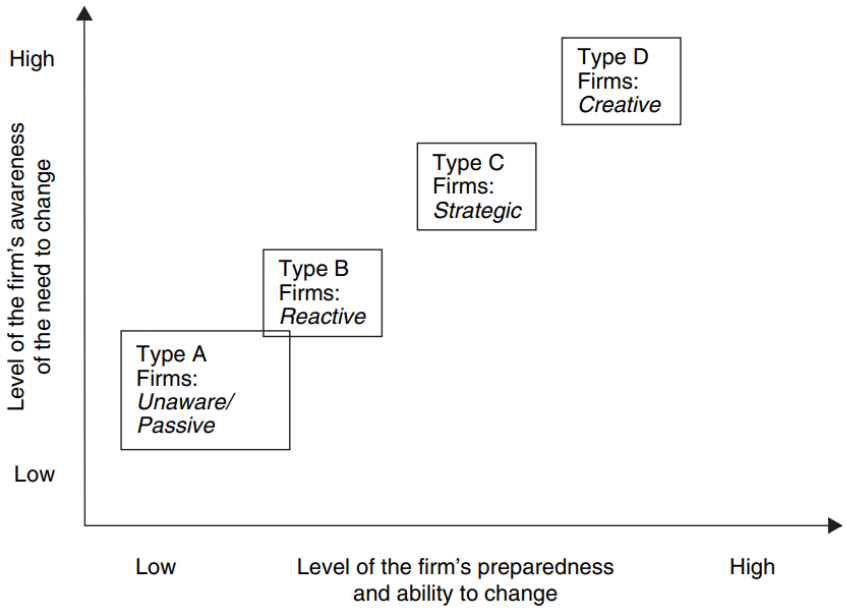

Figure 5: Group of Firms (Bessant and Rush, 2009)

Type A firms (*unaware/passive*) can be characterized as being 'unconscious' or unaware about the need for technological improvement, even if it is about for example a vital change to survive. They do not know where or what they might improve, are unable to receive signals and quickly respond and consequently are fragile in confronting with competitors. The most essential help to such firms to survive is to enable them to recognize the need for change. They need to develop a strategy to identify opportunities and build up frameworks to implement improvements and sustain the process of change over the long term (Bessant & Rush, 2009).

According to Bessant and Rush, type B firms (*reactive*) understand the challenge of change and continuous improvements, but they lack the knowledge on how to implement changes in an effective way. In the absence of the skill and competence, most of the technological capabilities come from suppliers or observing other firms in the same field. And obviously the are unable to distinguish the root cause of problem and instead treat symptoms of the problems. The first stage for such firms is to develop a strategic framework for continuous improvement. They need to work effectively to find new opportunities, develop innovative concepts and solution and address key priority areas (Bessant & Rush, 2009).

Type C (*strategic*) firms have a well-developed sense of the need for improvement. They are capable to implement new projects and have a strategic approach to the process of continuous innovation. They have developed successful routines in identifying opportunities and priorities, cultivating concepts and allocating resources. The available managerial and operational competence of such firms empowers them to receive signals for change and react quickly. But even though these firms have developed a strategic framework in terms of search, acquisition, implementation and improvement, they lack the capabilities to redefine markets or create new market opportunities. Being confined within the boundaries of their activity sector, they may have difficulties to identify opportunities beyond their traditional business. Providing complementary support to internal capabilities in the form of knowledge and access to new ideas and advanced technologies, besides challenging the existing business models, can assist type C firms to think 'outside' of their enterprise box (Bessant & Rush, 2009).

Type D firms (*creative*) have developed modern strategic frameworks for innovation and are able to create and implement creative solutions with respect to technology, markets and organization. They have established learning routines to acquire and use knowledge in creating new products, processes, services etc. In addition to complementing existing internal capabilities with outside sources, improvements can be around assessing risks and uncertainties. They can also develop new contacts with specialist groups to generate new opportunities (Bessant & Rush, 2009).

As one important feature of ISO 56002, the standard helps the organizations to evaluate their maturity level in the context of managing innovation activities (Karlsson, 2019b). Additionally, as it is explained before, the standard ISO/TR 56004:2019 is developed to help firms in performing an assessment of the innovation management (ISO, n.d.f).

knowledge

Many scholars (e.g., Ologbo & Nor, 2015; Crespi & Zuniga, 2012; Kamasak & Bulutlar, 2010; Koch & Strotmann, 2008; Storey & Kelly, 2002; Calantone et al., 2002; Tsai, 2001; Edquist, 1997) consider innovation closely related to organizational learning. Edquist (1997) considers the knowledge as a prerequisite for innovation which emerges the firms to interact with other organization to gain, develop, and exchange various kind of knowledge, information, and other resources. Calantone et al. (2002) defines the innovation as acquisition, dissemination, and use of new knowledge. The authors highlight the researchers' agreement on a significant correlation between the learning climate and firms' innovation capabilities. After analyzing data regarding to a broad range of firms, Galia and Legros (2004) conclude that the lack of knowledge is a big barrier that prevents firms from being innovative.

In addition to plenty of literature, ISO (2019) cast more light on the association between knowledge and innovation, "Capturing, conveying and transforming knowledge within an organization and its ecosystem is an essential driver for innovation" (ISO, 2019, p. 11).

The concept "absorptive capacity" that is the firm's capability to acquire and use knowledge to create new products, processes, services (Bessunt & Rush, 2009) has been in the focus of countless seminal and recent research (e.g., Brettel, et al., 2015; Bessunt & Rush, 2009; Liao, et al., 2003; Cohen & Levinthal, 1990). The firm's ability to construct learning experiences (by doing, by experimenting (R&D), by collaborating, by exporting, etc.) promotes the firm's innovation capability and empowers the firm for future innovative activities (Bessunt & Rush, 2009).

Although some academic literatures distinguish process innovation capabilities from product innovation capabilities (Najafi-Tavani, et al., 2018; Calantone et al., 2002), but regardless of the type of the innovation capabilities, there is a wide consensus among researchers about the significant effect of learnings on the innovation capabilities; which in turn promotes the firm's performance.

Culture

Many literatures acknowledge the significant role of culture in change management (e.g., Franklin, 2014; Denison, 2012; Gerstner, 2002). With this in mind and considering other literatures that defines change as a major part of innovation (e.g., ISO 56000:2020; Gaziulusoy & Brezet, 2015; Bullinger, 2008), the important role of culture in innovation performance becomes clear.

Several studies have discussed about the impact of culture on organizational innovation performance (Brettel, et al., 2015; Engelen, et al., 2014; Naranjo-Valencia, et al., 2011; Martins & Terblanche, 2003, Obenchain, 2002). Additionally, believing that employees are one of the most important sources for innovation (Linke & Zerfass, 2011), the essential role of culture in innovation efficiency becomes undoubtable. The purpose of innovation is creating value (ISO 56000:2020, OECD, 2013) and "culture is the engine of value creation" (Dawson, 2010). Thus, fostering a right culture can raise the organizational innovation capabilities.

Many theoretical and empirical research have tried to uncover the behaviours, values, norms and work environments that affect the innovation activities. After conducting an extensive literature review, followings characteristics are identified:

- Communicative (Linke & Zerfass, 2011; Martins & Terblanche, 2003)
- High levels of trust and loyalty in group (Brettel, M. et al., 2015)
- Collaboration and knowledge exchange (Brettel, M. et al., 2015)
- Creativity (Martins, & Terblanche, 2003)
- Openness to new ideas (Hurley and Hult, 1998)
- Encouraging and supporting personnel to generate new ideas (Amabile & Conti, 1999; Filipczak, 1997)
- Autonomy or freedom in conducting tasks that gives the sense of individual ownership and control over work (Amabile & Conti, 1999)
- Fair evaluation of ideas (Amabile, 1995)

- Supporting continuous learnings (Arad, et al.,1997; Samaha, 1996)
- Affirmation of raking risks and experimenting (Brettel, M. et al., 2015; Engelen, et al., 2014; Naranjo-Valencia, et al., 2011; Judge et al., 1997)
- Employee involvement and Motivated individuals that intend to contribute time and effort to the development of innovative ideas (Linke & Zerfass, 2011; Naranjo-Valencia, et al., 2011; Denison, et al., 2004; Fey & Denison, 2003; Denison & Mishra, 1995; Monge, et al., 1992)
- Strategic emphasis on growth (Engelen, et al., 2014)

Leadership

"Leadership has been suggested to be an important factor affecting innovation" (Gumusluoğlu & Ilsev, 2009). Evident theoretical and empirical studies validate leadership as a key variable that can enhance or hinder innovation activities in workplace (Hughes, 2018). In the article "Leadership effects on innovation propensity: A two-factor full range leadership model", the authors explain how leadership can influence innovation propensity (Ryan & Tipu, 2013).

In addition to many other responsibilities, "building a consistent, supportive organizational culture is one of the most important contributions a leader can make" (Dawson, 2010). Innovation activities involve changes and changes can cause emotional uncertainty among some employees as human beings. However, fostering a climate with great communication, trust, guidance, respect, a certain freedom of choice as well as high consistency in organization's decisions can mitigate this feeling and reduce reluctancy towards changes (Linke & Zerfass, 2011). It is the leadership who needs to assess how the existing culture will aid or hinder the required changes take required actions (Schein & Schein, 2017). By encouraging new and improved ways of working, creating a vision that emerges change and taking a positive attitude toward change, managers can create a culture that supports change (Arad. 1997).

Furthermore, through fostering a culture with "tolerance of mistakes", manager can contribute to a culture that supports innovation activities (Martins & Terblanche, 2003). "The way in which mistakes are handled in organizations will determine whether personnel feel free to act creatively and innovatively" (ibid).

Reid, et al. (2015) believe breathtaking innovations can't be created without leaders who share their vision and also build a sense of purpose around it. By creating a view of the future, and inspiring and motivating their followers, leaders improve innovation within the organizational context (Gumusluoğlu & Ilsev, 2009).

Engelen, et al. (2014) think *strategic emphasis on growth* is a common practice in successful innovative organizations. By defining a proper innovation vision for the future, the leaders can transform people's personal values and self-concepts, move them to higher levels of needs and aspirations, and raise the performance expectations; which in turn can change the organization's tendency toward change and positively influence innovation (Gumusluoğlu & Ilsev, 2009).

Considering the implementation of other Management System Standards, such as ISO 9001, management commitment is found to be crucial for effective implementation (Singh et al., 2006). Oppositely, a lack of efficient leadership has been identified as an important obstacle to the success of the implementation of standard (Heras, et al., 2008).

ISO Standard

Variety of standards are developed by standard organizations to make our lives safer, simpler, more comfortable and more efficient (CEN, n.d.). Through their rules, guidelines and definitions, standards help to increase the reliability and the effectiveness of many of the goods and services we use (IRENA, n.d.). Standards play important role in international governance and collective welfare (Abbott & Snidal, 2001), international trade (Mattli & Büthe, 2003), industrial economists (Swann, 2010), education (Pantović & Milovanović, 2020), Safety and health (Uhrenholdt Madsen, et al., 2020; Takala & Forastieri, 1998) and etc.

ISO, International Organization for Standardization, is an independent, non-governmental international organization with a membership of 165 national standards bodies (ISO, n.d.b). Based on international collaboration, ISO has developed over 23000 International Standards that represent guidelines and frameworks to support innovation and provide solutions to global challenges (ibid).

"Built around consensus, they provide a solid base on which innovation can thrive and are essential tools to help governments, industry and consumers contribute to the achievement of every one of the SDGs" (ISO, n.d.d). The Sustainable Development Goals (SDGs) represent an ambitious 15-year plan, that has been set by UN in 2015, to enhance peace and prosperity, eliminate poverty and protect the planet. Globally acknowledged, the SDGs are as essential to the world's future sustainability (ISO, n.d.d). Each ISO standard contributes to some SDGs (ISO, n.d.d). Table 1 shows to which SDGs, ISO 56000 members contribute. The list of SDGs is presented in figure 6.

Figure 6: SDG List (ISO, n.d.d)

The development process for ISO standards follows defined stages. The main stages are Proposal, Preparatory, Committee, Enquiry, approval and publication. Among these, Proposal, Enquiry and publication are obligatory stages (ISO, n.d.e). The stage column in table 1, shows the developing stage for each standard in ISO 56000 family.

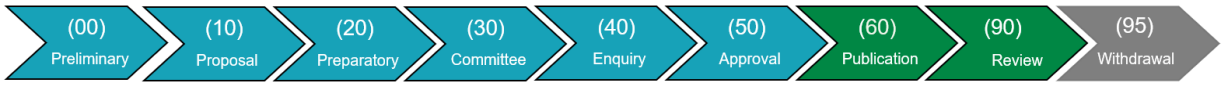

Figure 7: development process for ISO standards (ISO, n.d.e)

56000 Serie

An innovation management system is a set of interrelated and interacting elements that provides common framework to develop and deploy innovation capabilities, evaluate performance, and achieve intended outcomes (ISO 56002:2019). ISO 56000 is a family of standards that is developed by Technical Committee of ISO in Innovation Management (ISO/TC 279), (ISO 56002:2019) to "help businesses effectively respond to change in order to maximize opportunities for growth and development while reducing associated risks" (ISO, 2019, p. 5). The series standards enable organizations to capture the best ideas and subsequently improve to keep up with the market competition (Naden, 2020).

Alice de Casanove, Chair of the ISO technical committee responsible for the standard, argues the ISO 56000 series will help organizations to significantly improve their ability to survive in the changing and uncertain world. It allows organizations to continually evolve in a structured and effective way (Naden, 2020). In the video published by Innovation Division, Merrill acclaims the series of ISO 56000 standards as the collective knowledge of experts from over forty countries (Merrill, 2019).

The table 1 shows the members of ISO 56000 family including the area of *Sustainable Development Goals* and *Stages* – the status of developing.

ISO NO.	Description	SUSTAINABLE DEVELOPMENT GOALS	Stage *
ISO 56000:2020	Innovation management – Fundamentals and vocabulary	16 4 9 8	PUBLISHED ISO 56000:2020 Stage: 60.60
ISO/AWI 56001	Innovation management — Innovation management system — Requirements	1 2 3 4 6 7 8 9 11 12 13 14 15 16	UNDER DEVELOPMENT ISO/AWI 56001 Stage: 20.00
ISO 56002:2019	Innovation management — Innovation management system — Guidance	4 9 8	PUBLISHED ISO 56002:2019 Stage: 60.60
ISO 56003:2019	Innovation management — Tools and methods for innovation partnership — Guidance	4 9 8	PUBLISHED ISO 56003:2019 Stage: 60.60
ISO/TR 56004:2019	Innovation Management Assessment — Guidance	4 9 8	PUBLISHED ISO/TR 56004:2019 Stage: 60.60
ISO 56005:2020	Innovation management — Tools and methods for intellectual property management — Guidance	4 9 8	PUBLISHED ISO 56005:2020 Stage: 60.60
ISO/DIS 56006	Innovation management — Tools and methods for strategic intelligence management — Guidance	4 9 8	UNDER DEVELOPMENT ISO/DIS 56006 Stage: 40.60
ISO/AWI 56007	Innovation management — Tools and methods for idea management — Guidance	4 9 8	UNDER DEVELOPMENT ISO/AWI 56007 Stage: 20.00
ISO/AWI 56008	Innovation management — tools and methods for innovation operation measurements — Guidance	4 9 8	UNDER DEVELOPMENT ISO/AWI 56008 Stage: 20.00

* in March 2021 Table 1 , members of ISO 56000 family

ISO 56002

ISO 56002 is the most significant publication among 56000 Serie. It provides generic guidance - and not requirements- for the establishment, implementation, maintenance and continual improvement of an innovation management system for use in all established organizations regardless of the nature, type, sector, or size (ISO 56002:2019). The potential benefits of implementing ISO 56002 include: increased ability to manage uncertainty, increased growth, resource efficiency and employees' engagement, etc (ISO 56002:2019). Hyland (2020) points out to the role of standards in professionalizing the area of project management and quality management. She considers ISO 56002 as the first reliable standard in the area of innovation management and believes the standard by focusing on the system will drive the innovation management forward.

ISO 56002 provides guidance at a general level. The standard does not mention how tasks shall be performed; it neither describes detailed activities within the organization nor prescribes specific tools or methods (ISO 56002:2019).

Similar to other ISO's management system standards (MSS), the standard ISO 56002 follows the uniform of High-Level Structure (HLS). It means that the first and, in most clauses, the second level of structure is identical in the standard (Hinsch, 2019). "The concept of HLS is that management standards are structured in the same way, regardless of the domain of application" (ISO, n.d.a). Following the same MSS template, regardless of specific topic of focus, eases the integration of new standards with existing ones in the organization and makes them work together (ISO, n.d.a). It facilitates ISO standards to be integrated into one management system (Ordonez de Pablos & Edvinsson, 2020). Appendix 1 shows the uniform basic HLS and Appendix 2 presents the structure of two MSS, ISO 56002:2019 and ISO 9001:2015.

ISO's management system standards (MSS) include two types of standards A and B. The type A MSS contains requirements against which an organization, by fulfilling them, can claim conformance. In contrast, the type B MSS provides guidance without mandatory requirements. Thus, the type B does not have any certification processes to demonstrate implementation of frameworks through audits (ISO, n.d.c). The standard ISO 56002:2019 is a type B MSS and presents just guidance (ISO, n.d.c).

ISO 56002 gives guidance on many aspects of the innovation management such as leadership, strategy, culture, processes, metrics etc. to promote the organizations' innovation capabilities (Karlsson, 2019a). However, regarding the context and circumstances of the organization, the individual elements of standard can be gradually implemented (ISO 56002:2019). The guidelines of standard can be used as a checklist to get started with the systematic innovation work in a company or organization (Karlsson, 2019a). Nevertheless, to gain all benefits, it is required to adapt all the elements of the innovation management system (ISO 56002:2019).

The innovation management standard is based on eight principles: realization of value, future-focused leaders, strategic direction, culture, exploiting insights, managing uncertainty, adaptability, systems approach. The framework of the standard ISO 56002 consists of ten clauses. The clauses of the standard are:

1. Scope
2. Normative references

3. Terms and definitions
4. Context of the organization
5. Leadership
6. planning
7. support
8. Operations
9. Performance evaluation
10. Improvement

The first clause is about 'scope' and explains areas that the standard is applicable to. Clause 2 is 'Normative references' which indicates the standard "*ISO 56000, Innovation management — Fundamentals and vocabulary*" as support for using this standard. Clause 3 is 'Terms and Definitions' and it is referred to ISO 56000 for full Terms and definitions.

Similar to some other ISO standards such as ISO 9001, a Plan-Do-Check-Act (PDCA) cycle is used in ISO 56002 that groups clauses 6 to 10 in a cycle. The PDCA cycle that is a *Continuous Improvement method* forms the core of the standard ISO 56002 and is informed and directed by the context of the organization (Clause 4) and its leadership (Clause 5).

"*The Plan-Do-Check-Act (PDCA) cycle enables continual improvement of the innovation management system to ensure that the innovation initiatives and processes are adequately supported, resourced, and managed, and that opportunities and risks are identified and addressed by the organization*" (ISO 56002:2019). The *innovation initiatives* mentioned above is defined as "set of coordinated activities aiming for innovation" (ISO 56000:2020).

The figure 7 presented by ISO 56002:2019, illustrates an overall concept of the standard. explained shortly.

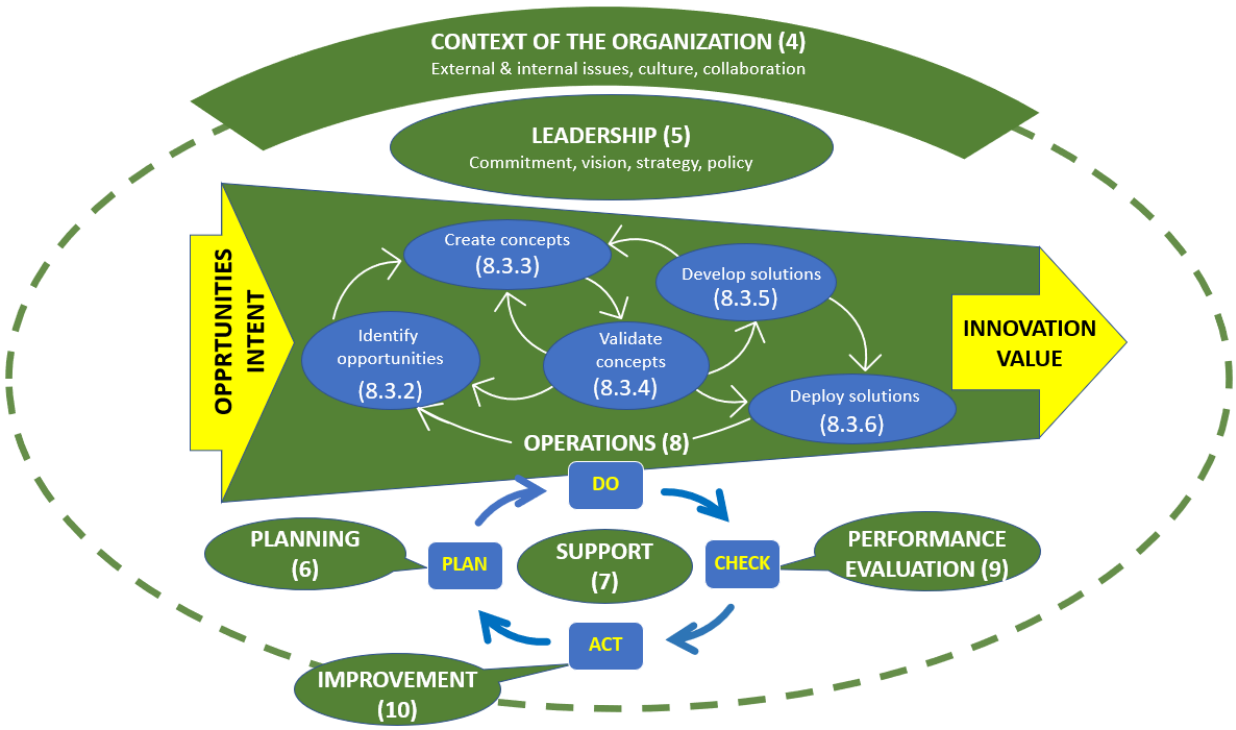

Figure 7: Representation of the framework of the innovation management system with references to the clauses of this document (ISO 56002:2019)

As a short summary of *PDCA* cycle in ISO 56002 (Figure 8), the first stage of *PDCA* cycle is *Plan* that the organization needs to define the objectives and determine required actions to address opportunities and risks. In the *Do* stage, the planned actions in the form of support or operation should be implemented. In the next stage, which is *Check*, the organization should monitor, control and (if applicable), measure the results against the objectives. And finally in the stage *Act*, required actions should be taken to ensure the continuous improvement of the innovation management system.

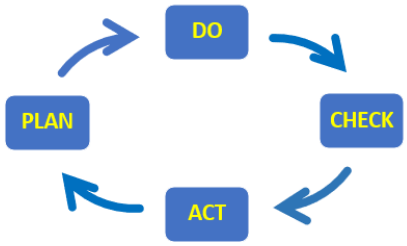

Figure 8: PDCA cycle

In the following, by using the standard ISO 56002:2019 as the reference, these clauses will be explained.

Context of the organization (Clause 4)

The process of innovation management starts from this clause when the organization should regularly observe and identify external and internal forces that affect the organization's ability to achieve the intended goals of its innovation management system. The potential opportunities for value realization should be determined regularly. The sub-clauses in this clause are:

- Understanding the *organization* and its *context*
- Understanding the *needs* and *expectations* of interested parties
- Determining the *scope* of the innovation management system
- Establishing the *innovation management system*

In clause 4, ISO 56002 dedicates the subclause 4.4 (Establishing the Innovation Management System) to *culture* and *collaboration*. The innovation intent that is the basis for determining innovation strategy is enabled by supportive *culture* and through collaboration (ISO 56002:2019, p. 4). In developing an innovation management system, high attention should be paid to the *culture*. The standard presents guidelines to promote a culture that enables the coexistence of creative and operation-oriented mindset and behaviours.

Openness, curiosity, encouraging suggestions, encouraging learning, creativity, change, and challenging current assumptions, encouraging risk-taking, collaboration, and participation internally and externally are some examples of a culture that supports innovation activities. Furthermore, it is of high importance to establish an approach to manage internal and external collaboration to share resources, knowledge, assets and competencies.

Leadership (Clause 5)

ISO 56002 emphasized the effective implementation of the innovation management system relies on the commitment by top management. The leadership is responsible for "*ensuring that the innovation vision, strategy, policy, and objectives are established, are consistent and are compatible with the context and the strategic direction of the organization*" (ISO 56002:2019). The leadership should analyse and evaluate the identified issues in the *Context* clause and with respect to *value realization*, establish and develop a flexible and adaptable innovation strategy. In addition, the leadership is responsible to ensure that the resources and support, needed for the innovation management system, are available.

The standard provokes the role of leaders in promoting innovation capabilities and a culture supporting innovation activities. The sub-clauses of clause Leadership are as below:

- Leadership and commitment
- Innovation policy
- Organizational roles, responsibilities, and authorities

Planning (Clause 6)

Planning is the first part of PDCA cycle. The sub-clauses of clause Planning are:

- Actions to address opportunities and risks
- Innovation objectives and planning to achieve them
- Organizational structures
- Innovation portfolios

Based on the issues from organization's context and the identified needs and requirements, the organization should first determine the opportunities and risks and then, establish a plan to address those opportunities and risks. The plan should ensure that the innovation management system can achieve its intended outcomes. Regarding to the second sub-clause, the organization needs to establish innovation objectives and furthermore, plan how to achieve them. Several criteria and characteristics are mentioned as necessary for objectives.

As discussed in the third sub-clause, it is the responsibility of the top management to ensure that relevant and adaptable organizational structures are available to achieve the intended outcomes. The standard ISO 56000:2020 defines *innovation portfolio* as a set of innovation initiatives that are grouped together. The standard ISO 56002:2019 requires organizations to provide, manage, regularly evaluate, and prioritize the portfolio (or several portfolios, if needed) of innovation initiatives. It should include the balance of risk versus return, different horizons in terms of time and scope, etc.

Support (Clause 7)

To implement the innovation management system effectively, the organization should provide and manage the resources that are required for establishment, implementation, maintenance, and continual improvement of the innovation management system. The resources can be people, time, knowledge, financial resources, Infrastructure. According to ISO 56002:2019,

organizations are responsible to determine, provide, and manage the necessary people for the effective implementation of the standard. Organizations also need to form teams with a diversity of people, to enhance cross-pollination and leverage the collective competence of the organization (ISO 56002:2109).

The organization should establish an approach for determining, developing and managing competencies to manage innovation activities, identify insights and opportunities, create ideas and concepts, develop and validate concepts and develop and deploy solutions to realize value. It should be ensured that all people involved in the innovation activities are aware of the innovation vision, strategy, policy, and objectives. The specification for all internal and external communications, within the area of innovation management system, should be determined. The standard ISO 56002 also requires the organization's innovation management system to include documented information based on the standard's suggestions and organization's criteria. However, the extent of documented information can vary based on the organization's size, type of activities, the complexity of processes and the competence of the people (ISO 56002:2019). The organization should ensure that the necessary tools and methods are available. In addition, a systematic approach should be established to manage strategic intelligence and intellectual property.

The sub-clauses of clause Support are:

- Resources
- Competence
- Awareness
- Communication
- Documented information
- Tools and methods
- Strategic intelligence management
- Intellectual property management

Operation (Clause 8)

The clause 8, *Operation* is the *DO* part of the PDCA cycle. The included sub-clauses are:

- Operational planning and control
- Innovation initiatives
- Innovation processes

In the first sub-clause, the issues, and requirements relevant to the planning, implementing, and controlling the innovation initiatives and processes are explained. The organization needs to establish the criteria for the innovation initiatives and processes; and according to determined criteria, control of the innovation initiatives and processes should be performed. The second sub-clause is designated to the management and implementation of innovation initiatives.

In the third sub-clause, the standard presents guidelines for configuring innovation processes that suit innovation initiative. The figure 9 illustrates an overview of the innovation processes. Depending on, e.g. the types of innovations and the conditions of the organization, the innovation processes can have different configuration. The innovation processes can be connected to other processes within the organization or be carried out independently.

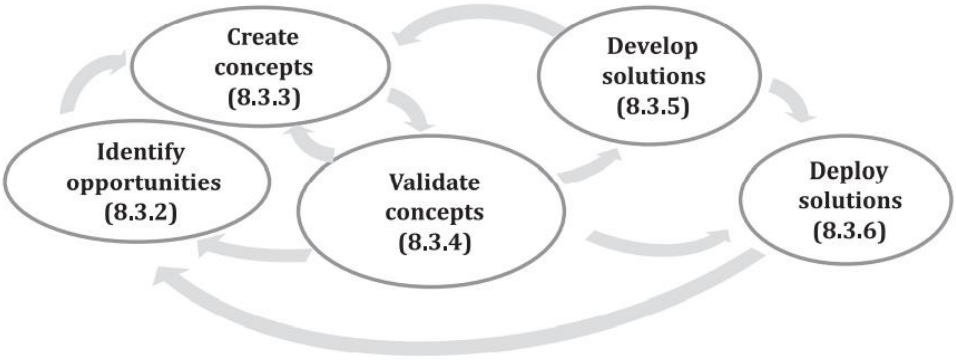

Figure 9: Innovation Process (ISO 56002:2021)

At the first stage, '*identify opportunities'*, variety of tools and methods can be used to create understanding of value to be realized, and to identify, define and prioritize opportunities. The purpose of the next stage, '*create concepts'*, is to transform identified opportunities to new ideas and potential solutions. Then, the standard describes how the organization should evaluate and validate the created concepts in the previous stage. The output of the stage '*validate concepts*', is validated concepts with acceptable levels of uncertainty. At the stage '*develop solution'*, the standard gives guidelines on developing a concept to a working solution and preparing it to be deployed. And finally, at the last stage '*deploy solutions*', the developed solutions are delivered to the users or customers. The organization should ensure the support to the solution and regularly monitor the adaption rates and feedback from users. The new knowledge captured from the deployment can help to improve solutions and trigger new opportunities.

Performance evaluation (Clause 9)

The clause 9 is the *CHECK* part of the PDCA cycle. It gives guidance on the types of innovation performance indicators.

The sub-clauses are:

- Monitoring, measurement, analysis, and evaluation
- Internal audit
- Management review

The first sub-clause gives instruction on how to monitor, measure, analyse and evaluate the innovation performance and the effectiveness of. The second sub/clause explains requirements for internal audits that should be conducted to control the performance of the innovation management system and its conformity to the defined requirements. And the third sub-clause gives the guidelines on how the top management should review the organization's innovation management system.

Improvement (Clause 10)

The last clause is the ACT part of PDCA cycle. The organization should have a structured approach for improving the innovation management system based on the performance evaluation results.

A deviation is identified as *"departure from an intended or expected direction, position, or objective"* and a nonconformity as *"non-fulfilment of a requirement*" (ISO 56000:2020). In the second sub-clause, the requirements relevant to the deviations and nonconformities as well as corrective actions are indicated. And finally, the last sub-clause emphasizes the importance of continuous improvement for different aspects of the innovation management system.

The sub-clauses of the clause 10 are:

- General
- Deviation, nonconformity, and corrective action
  Continual improvement

RESEARCH METHOD Chapter 2

This thesis includes both theoretical and empirical studies. The present chapter firstly, explains some general concepts withing the research domain. Afterwards, it presents the design and process of the research work. Additionally, it explains research approaches and methods that are used to create the knowledge. And finally, it discusses the validity of the research work.

Research

Janet Salmons (2011) describes the research as "inquiry in the service of knowledge creation". Blaxter, et al. (2010) in the book "How to research" define the research a systematic investigation to find answers to a problem. In the book "Introduction to Social Research: Quantitative and Qualitative", Punch (2014, p. 4) argues for the importance of the *research* and writes "… research is seen as the way of answering questions, solving problems and developing knowledge".

Blaxter, et al. (2010) try to inspirit the readers to think of research as a spiral through which you step on it and revisit the various stages of the process, but always with different and developed insight. They describe the research work by resembling it to swimming in the sea that can bring a combination of feelings, excitement, confusion, confidence in your aptitudes and skills and fear of mistake or fail (ibid). However, a researcher needs to be familiar with key aspects of the research process, ranging from getting started to writing up. Knowledge about research process clarifies the route and destination of the research journey. Knowledge and skills empower the researcher to keep motivation in tough situations and successfully pass through the stages of the research work (ibid).

Method and Methodology

To select a research method or methods among others, it is of high significance to consider advantages and disadvantages of each planned method as well as other alternative method that might be used (Blaxter et al., 2010). However, it is very important that the researcher, before selecting research methods, give enough consideration to the purpose and research questions because the way questions asked affects what needs to be done to answer them (Punch, 2014).

Dilemmas in research:

In the article "A Trojan Horse for positivism", Giddings and Grant (2007) argue about two persistent confusions in the realm of research. The first one is the misunderstanding over the difference between '*methodology'* and '*method'*. According to the authors, inability to differentiate between methodology and method can create confusions in thinking and practice. They state that *methodology* refers to the theoretical assumptions and values that underpin a particular research approach. "Methodology is a thinking tool that guides how a researcher frames her research question and how she decides on what methods and forms of data analysis to use". Giddings and Grant describe *methods* much more concrete and practical than methodology. Methods are defined as a doing tool for collecting and analyzing data.

Similarly, Blaxter, et al. (2010) draw attention to the key distinction between *methodology* and *method* and relate the term *method* to the tools for data collection or analysis. By this definition techniques such as questionaries and interviews are defined as methods. On the other side, the authors believe that the term *methodology* is a more philosophical concept and usually is related to the approach or paradigm that underpins the research. Regrading to the authors, interview as a research method can be conducted within two different approaches, a qualitative approach or paradigm and a quantitative paradigm. Interviews as a research method but within different approaches have different underlying purposes and will produce different knowledge.

It is of a high importance to have a good understanding of methodological issues, their impact on the type of produced data and what kinds of knowledge it is possible to produce (Blaxter, et al., 2010). According to the authors this issue is often neglected in small scale research, despite its significance. Furthermore, the methods that a researcher selects to proceed the research process are a key part of the research and it is important to understand the available alternatives and their strengths and weaknesses (ibid).

The second confusion is related to perceived difference in status between the terms '*qualitative'* and '*quantitative'* that are commonly used to explain the methods or methodologies of mixed methods research (Giddings & Grant, 2007). These concepts will be explained later in this chapter.

Configuring the Research Plan:

Before focusing on the tools and techniques for data collection, a researcher needs to consider some of the broader issues of research design and philosophy. Some questions are suggested by Blaxter, et al., (2010) to be answered to revise, reflect upon and reformulate research plans and reach decision. Following are some of those questions:

- *"What do you need or need to find out?"* (Blaxter, et al., 2010, p. 80).
  The answer to this question may immediately suggest a method or technique or it can lead to quantitative or qualitative directions (Blaxter, et al., 2010).

- *"What skills do you have?"* (Blaxter, et al., 2010, p. 82)
  Blaxter, et al. (2010) mention various everyday skills as key research resources. The researchers use such skills in a conscious, considered, and systematic fashion to collect, select, analyze and present data. A research work involves the professionalization of these everyday skills including Reading, Listening, Watching, choosing, questioning, summarizing, organizing, writing, presenting, reflecting, etc (ibid).

- *"Will your methodological preferences answer your questions?"* (Blaxter, et al., 2010, p. 82)
  Referring to the two previous questions, you now need to consider whether the everyday research skills which you intend to use are actually suited to the issues you are going to investigate (Blaxter, et al., 2010)

- *"How will your methods affect the answers you get?"* (Blaxter, et al., 2010, p. 83)
  The research questions determine the research approach and techniques and vice versa the methods that you use will affect the answers you get and knowledge you collect (Blaxter, et al., 2010)

Categorization within Research:

To make the discussions of methods and methodologies more understandable, Blaxter, et al., (2010) present a categorization of research families or general strategies, approaches and techniques.

Research families, or general strategies for doing research (Blaxter et al., 2010, p. 64)*:*

- Quantitative or Qualitative
- Deskwork or Fieldwork

Research approaches to designing research project (Blaxter et al., 2010, p. 64):

- Action research
- Case studies
- Experiments
- Surveys

Research techniques for collecting data (Blaxter et al., 2010, p. 184):

- Documents: Using written, online, archived and visual materials
- Interviews: Questioning or discussing issues with selected sample
- Observations: Collecting data through watching or engaging in activities
- Questionnaires: Gathering information through written questions
- Mixed methodologies: Combining approaches

Quantitative vs Qualitative Data:

As Punch writes in her book, data obtained in an *empirical* research are divided to two main types:

- "Quantitative data – which are data in the form of numbers (or measurements)" (Punch, 2014, p. 3)
- "Qualitative data – which are data not in the form of numbers (most of the time, though not always, this means words)" (Punch, 2014, p. 3)

Considering the definitions above, Punch presents two types of empirical research:

- "Quantitative research is empirical research where the data are in the form of numbers" (Punch, 2014, p. 3).
- "Qualitative research is empirical research where the data are not in the form of numbers" (Punch, 2014, p. 3).

Research process

Blaxter, et al., 2010 argue that the decision on how to proceed the research work depends on numerous factors and mainly on what the researcher is interested in finding out, on the other word the expected outcome of the research. In this research it is intended to investigate the implementation of a new standard. According to same authors, there are some other important practical concerns in making the methodological decisions, including the time limitations, the expected word length of the project, the researcher's research competence, the regulations of the department or school, examination board, what and whom the researcher have access to, and the researchers own preferences and inclinations.

The process of this thesis project is designed based on the stages that Prof. Franklin has defined in the book "Understanding Research : Coping with the Quantitative - Qualitative Divide" (Franklin, 2012, p. 57). Refer to Appendix 3 to see mentioned stages.

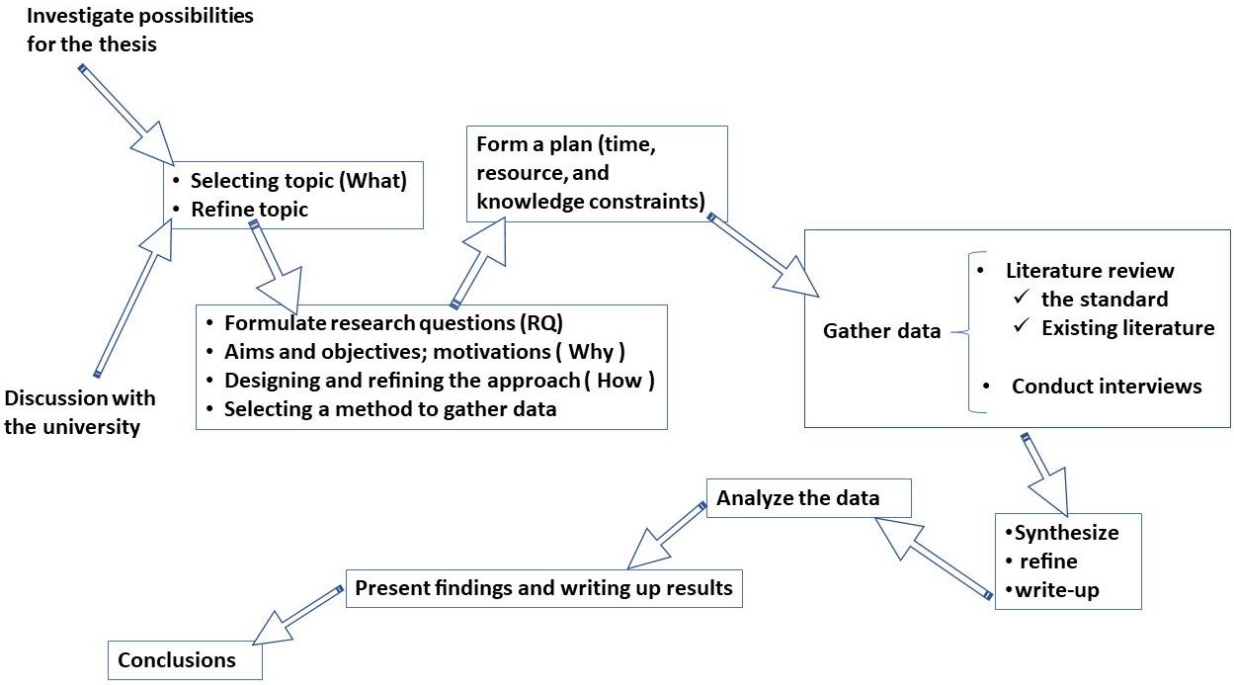

Figure 10: Research process for the present thesis (Author)

Data Collection

This section describes how data have been collected and used in this thesis.

As explained in the beginning of this chapter, the aim of performing a research is answering questions. To answer research questions, the researcher needs to collect data and information in one way or another. Blaxter et al. (2010) note regardless of methods or strategies, all research involves the collection and analysis of data.

In selecting the techniques for collecting data, often a combination of methods is used. One may use for example a set of interview or a dozen observation, but it is reasonable to complement them by some documentary analysis to facilitate exploring relevant literature or policy (Blaxter et al., 2010). Franklin (2013) explains mixed method as using more than one sort of data-gathering and analysis, usually including both quantitative and qualitative modes. Andrew and Halcomb (2009) argue that mixed methods can be studied in both methodology and method contexts. However, they limit the definition of mixed method to "The use of both qualitative and quantitative methods of data collection in a single study. For example, combining qualitative interviews and quantitative survey data collection" (ibid)

Collected data may vary significantly in their characteristics (Blaxter et al., 2010). The authors mention following examples for various types of data which can be considered:

- Data may be numerical, or just words. It can also be a combination of the two. Data does not necessarily need to be in the form of either numbers or words. Data can even consist of, for example, pictures or artefacts (Blaxter et al., 2010).

- Based on the origin, data can be original or secondary. Original data or information are those that never before collected. Secondary data are put together by someone else before, but they are rescued again by a new researcher probably in a new way (Blaxter et al., 2010).

Theoretical Data Collection

The literature study of this thesis has been conducted through broad research in books, scientific papers, academic literature, research publications, conferences proceedings and websites relevant to the notion of *innovation management in manufacturing*. Furthermore, the contents of the standards are used in collecting theoretical data. The main keywords to search literature are "innovation management", "process innovation", "manufacturing innovation" and "innovation capabilities". The search for documents is done through several channels such as: https://mdh.primo.exlibrisgroup.com and https://scholar.google.com. The books have been provided in hardcopies or read online through the library of Mälardalen University (https://www.mdh.se/bibliotek). Most of online books accessed through the websites: <https://ebookcentral.proquest.com> or <https://books.google.se>.

DOCUMENT:

Documents are important resources and an inseparable part of most of the research works. Documents that are written by others and form the base of the research, should be read, understood and critically analyzed (Blaxter et al., 2010).

In using document, it is of high importance to be aware of the extent to which texts present and make use of original data (Blaxter et al., 2010). Documents as a resource of research, can be *primary* or *secondary*. The *primary* sources mainly consist of original data. The secondary sources comment on and interpret data which has already been collected and possibly also analyzed, by somebody else. (ibid). In cases that original data are inaccessible or impossible to use, secondary data can be used as reference. As Blaxter et al. (2010, p. 188) note, "secondary

analysis can give fresh insights into data, and ready-made data sets or archives do provide extremely valuable and cost-efficient resources for researchers".

Data and information that are used in the theoretical section of this thesis are of the secondary nature.

Empirical Data Collection

Qualitative data are the base of the empirical section in this thesis. Generally, such data can be collected via for example interview, written questions, observation and meeting transcripts (Andrew & Halcomb, 2009).

To collect empirical data in performing this thesis, the method of *interview* is selected.

INTERVIEW:

Blaxter et al. (2010) explain interview as a method that involves questioning or discussing issues with people. "It can be a very useful technique for collecting data which would likely not be accessible using techniques such as observation or questionnaires".

In this thesis project, to collect empirical information, five interviews are performed with a combination of manufacturing companies regarding the organizational size, age and type of activity. Five cases related to five interviews are introduced briefly in the table 2. Information in the table is obtained through interviews, companies' websites or the website https://www.allabolag.se, related to years 2019 or 2020.

Since none of interviewed companies has started implementing ISO 56002 and interviewees were unfamiliar with the standard, all interviewees have been provided with a short introduction of the ISO 56000 family and the standard ISO 56002 individually. The content of this introduction is available in Appendix 4.

Cases	*Company Name*	*Number of employees*	*Turn over ~ (MSEK)*	*Founded in*	*ISO 9001 certified*	*Interviewee's position*
Case A	*anonymous*	*~ 80*	*130*	*Late 1800s*	*NO*	*CEO*
Case B	*SKF Mekan AB*	*~ 430*	*730*	*Late 1800s*	*YES*	*Production Developer*
Case C	*anonymous*	*~ 30*	*83*	*2001*	*YES*	*Production Manager*
Case D	*Volvo Construction Equipment in Braås*	*~ 800*	*Part of Volvo CE*	*1950s*	*YES*	*Project Manager*
Case E	*Eskilstuna ElektronikPartner*	*~ 50*	*100*	*1991*	*YES*	*Quality/Economy Manager*

Table 2: Brief introduction of interviewed companies

By performing each interview, firstly, the current situation of the organization in the context of innovation capabilities is investigated. Then, the interviewees have been questioned about the challenges that their production unit can confront in implementation of ISO 56002. Furthermore, they have answered questions about benefits that ISO 56002 can bring to their production organizations. And finally, the attitude of interviewees toward implementation of ISO 56002 in production processes is questioned. As explained in the chapter *'Introduction',* innovations within the domains of product or service are not included in the scope of this thesis. Thus, the interviews are limited to innovation within production processes.

Four of the interviews has been carried out online and one of them has been face-to-face. In the following some points about performed interviews are presented.

- Interviews conducted under 40-60 minutes including the introduction parts.
- Every Interview involved two individuals, the researcher and the respondent.
- Online interviews were done through using the application *TEAMS*.
- In all cases the contents of the interview were recorded and later transcribed by the author.
- The interviews followed a semi-structured format which is between tightly structured and discussion-formed interviews (Blaxter et al., 2010). The interviewer in cooperation with the respondent lead the interview forward in the context of research questions.
- The interviewees were informed about the topic of the interview and also had received a short introduction of ISO 56002, in advance to the interviews. The introduction can be found in Appendix 4.
- Interviews included an introduction of the company and continued by a review of the sub-clause 8.3 of ISO 56002, "*Innovation Processes*" - Available in Appendix 5. Afterwards, the research questions were discussed, by focusing on the current situation of the company in the domain of innovation, challenges, and motivations in implementing ISO 56002.
- The interviewees got a general introduction of the standards guidelines; and based on the interviewees' interest, some areas got highlighted. Some examples of challenges named to help interviewees to get a better understanding of the question. Example of challenges are available in Appendix 6.

Online Interview:

As the world is facing the pandemic Covid-19, the use of online meetings has become more common, to avoid spreading of the virus. However online meetings including interviews have many advantages that can make them popular in other times than pandemic situation. Andrew & Halcomb (2009) who believe technology enhances the traditional methods of data collection,

consider new innovative methods via electronic communication as an excellent opportunity for researchers to collect data from hard-to-reach groups.

Online meetings are cheap and can easily be recorded. With *TEAMS* application's features in recording the meetings (Microsoft Teams, n.d.), it is out of place to concern about the recording's technique or the quality of records. However, it is crucial to ensure the satisfaction of interviewees before recording the meeting. Blaxter et al. (2010) argues several advantages and disadvantages of recording the interview. Recordings the interview, enables the interviewer to only concentrate on the process of the interview, asking questions and listening to the responses. It also facilitates eye contact and non-verbal communication (ibid). Oppositely, recording may make the interviewee anxious about revealing confidential information. Furthermore, it takes a long time to transcribe and analyse recordings (ibid).

In comparison with other data collection methods, interviews are most based on communication. As Janet Salmons notes, "The interviewer must actively engage the interviewee to gain personal trust and build mutual respect to elicit information-rich responses" (Salmons, 2011, p. xvii). But in case of online interviews, there may be other concerns. According to Salmon, in performing online interviews, the interviewer must devise and learn new ways to build trust and create motivation for participants to share personal thoughts and experiences (ibid).

In performing this thesis project and before starting interviews, all interviewees got informed about receiving a copy of the report before assigning it to the university. In such case, interviewees would have the possibility to comment on the report and remove sensitive information. This is done to create trust within interviewees and encourage them to participate in discussions. As promised pieces of report relevant to each case, were sent to the interviewees to be approved by them before assignment.

Case studies:

As mentioned earlier, the case companies are different in size and it is visible in the table 2. Since the terms of *small* and *large* companies are used in this report, a short description of such terms is included here.

The criteria for defining the size of an enterprise differ from country to country. The European union categorizes enterprises based on either the number of employees or turnover or balance sheet total. Table 3 shows these categories.

Company category	**Staff headcount**	**Turnover**	or	**Balance sheet total**
Medium-sized	< 250	≤ € 50 m		≤ € 43 m
Small	< 50	≤ € 10 m		≤ € 10 m
Micro	< 10	≤ € 2 m		≤ € 2 m

Table 3: enterprises categories based on the size (European Commission, n.d.)

A short description of case studies and their production units is presented below. This follows a presentation of interviewees.

- *Case A:* The company has machinery processes with considerable demand for human work. They do not have standard products and customers can be prepared with variety of products considering material and size. As shown in the table 2, the company does not hold the certification of ISO 9001, since it not practical in this branch of industry. However, *KIWA and RISE* are their partners in doing audits.

✓ *Interviewee A:* The interviewee has worked over 22 years in a multinational company within the telecommunication industry, being responsible for various areas of activity. The following 10 years, he has worked as development manager for several units, within and outside Sweden. For three years, he worked in the Automotive industry with the responsibility for global product development as well as product management. The respondent works as CEO in the case A company.

- *Case B:* SKF Mekan is a part of SKF group and produces housing solutions and accessories to bearings. The factory consists of two main parts, foundry and machinery. It has manual and automated foundry lines, a large machinery plant and just very little assembly work.

✓ *Interviewee B:* The interviewee has been employed in the case B company, in over 20 years. For five years, he has worked as operator for modern machinery production lines. And for more than 15 years, he has worked with production development, responsible for optimizations of manufacturing units.

- *Case C:* The company produces innovative solutions consisting of hardware and software. The production is divided to electronic and mechanic sections. Raw materials are primarily purchased as standard parts or parts that are machined and prepared by suppliers. The production unit in the company mostly performs the assembly work.

✓ *Interviewee C:* Being involved in production, in around 35 years, his working life has started as machine operator in a large company. During several years he has worked as site manager for a small industrial company. He has been working in the company case A, as production manager, since more than 6 years ago.

- *Case D:* Volvo Construction Equipment, in Braås, produces Articulate haulers. Different parts of Articulate haulers that are produced in other sites, are assembled in Braås to produce the complete Articulate haulers. The site has a complex and large production site including machinery processes and assembly lines.

✓ *Interviewee D:* He has works in the organization since 2004, mainly with production technique and with the focus on production assembly. Within the last five years, he works as project manager and his responsibilities are about production's preparation. He is responsible for production aspects in product development projects to lead the product structures from design to production.

- *Case E:* Eskilstuna ElektronikPartner, is considered as a partner to its customer. Their business idea is that they should be as an electronic department for customers, so that the customers' firms do not need to possess such department. By employing innovative solutions, the company develops and manufactures customers' products. EEPAB generally,

does not have its own products. The company's production department consists of both modern machinery and assembly units.

- ✓ *Interviewee E:* After doing several general works, at the beginnings of 1990s, she started her first industrial carrier as operator for CNC machines. Based on her education in quality management, she helped the employing company to implement and get certificated for ISO 9001. Parallel to quality work, she has educated and worked with economy also. She has been responsible for quality/economy in another company, before starting her carrier in the company case E. Working for more than 15 years in the company case E, she works as quality manager, beside her contribution to the economy and HR departments.

Validity

Theoretical Study:

As mentioned previously, the theoretical part of this thesis is formed based on the content of books, academic literature, and research publications, etc. The referred research works have been published in international journals such as *Journal of Operations Management*, *Journal of Computer Integrated Manufacturing, etc*. or are written by well-known international experts. In using websites, it has been important to use only those that belong to the credible institutes such as ISO, SIS or other known organizations.

Empirical Study:

In order to enhance the validity of the research results, the selection of case studies is done based on following criteria:

- The nationality of company: Based on some advantages, all the selected cases are Swedish companies. The first reason is to minimize the influence of differences in working culture. In addition, this assures a certain level of quality resulted from the Swedish standards, legislation and working environments as a leading innovative country. Interviewees' convenience with the speaking language is another advantage of interviewing Swedish companies. Accessibility of Swedish companies also makes it reasonable to select cases among Swedish companies, particularly when the time is a matter of concern.
- Owning a production process: All studied cases are companies that produce goods and have production processes. All interviewees are involved in production processes and production of goods. All interviewees have long experience from Swedish industries and particularly have been involved in production processes. Some of the interviewees have experience from several production plants within different companies.
- Global footprint of the company: To avoid negative effects of having all cases from a single country, another case selection criterion is global cooperation of the companies. Three of five selected production plants are a part of a leading international company with production in several countries. In this way, selected companies full fill the global requirements and standards in addition to the local ones. Products from four companies

are exported and used in other countries. It ensures the engagement of the company in the global competitive market and in its turn, secures the validity of collected information.

- Size and age of the companies: Some may believe that the size or age of a firm affects the innovation process within the firm or the firm's ability to innovate (Coad et al., 2016; Forsman, 2011; Laforet, 2008; Reichstein & Salter, 2006). To include all factors that might affect the innovation capabilities, it is attempted to select interviewees from a variety of companies regarding the organizational size and age. Diversity in the companies' size and age, firstly facilitates the investigation of innovation capabilities concerning the firm's size and age. And secondly enables the author to generalize the common points and information obtained from interviews. And finally, it increases the validity of created knowledge.
- Diversity in the production processes and products: Companies that are the subject of this study, have totally different types of production processes and entirely different products. Case A has machinery processes on non-metal materials and demand for frequent internal transport. Case B, SKF Mekan produces housing solutions and accessories to bearings. It has a large machinery plant and just a little assembly work. Case C produces innovative solutions with a combination of hardware and software. It's production, to a large extent, consists of assembly lines and required machined or standard parts are prepared by suppliers. Case D, Volvo Construction Equipment in Braås, has a complex and large production site including machinery processes and assembly lines. Case E, Eskilstuna ElektronikPartner, is considered as a partner to its customer. It develops and manufactures innovative solutions based on the customers' request. The company's production department consists of both modern machinery and assembly units.

Data Analysis

As explained before, all interviews were recorded; and later, transcribed accurately by the author of the thesis. The prepared text was reviewed several times to get familiar with the collected empirical data.

Swanborn (2010) believes that the basic problem of data analysis is to reduce a huge amount of data in order to obtain an answer to the research question. Thus, the first step of data analysis in this thesis aims to capture important data – that are related to the research questions – and remove the extraneous parts. Talja (1999) explains "qualitative analysis is often started by analysing and counting the distribution of answers in a question by question manner". The researcher picks up sections of participants' discourse that provide the satisfactory answers to research questions, whereas the irrelevant parts of participants' discourse are ignored (ibid). After selecting the relevant parts of interviewees' answers and guided by the research questions, the data had to be split in parts (Swanborn, 2010). In the present thesis, the selected parts of interviews were categorized within the research questions: "current situation", "challenges" and "motivations". Categorizing the empirical data, regarding to the research questions, organizes data and prepares them to the analysis work.

To give a quick view of the collected empirical data, a data matrix was prepared that is shown in table 4. The table also facilitates finding the similarities and differences between various case studies.

In analysing data, “the crucial phase is, of course, the interpretation of the results and drawing conclusions” (Swanborn, 2010). To analyse data in this thesis, the viewpoints that were mentioned or emphasized by most of the interviewees were selected and discussed. Such viewpoints were interrelated with the theoretical framework to answer the research questions. In addition, the suggestions that were offered by interviewees were investigated and interrelated with the theoretical section. And based on them, a model was developed and recommended to solve a consensus challenge, related to one of the research questions.

RESULT (Empirics) Chapter 4

In this chapter, information collected from interviews is presented.

Current situation and attitudes in the innovation context:

Case A

The production part consists of an old machinery plant which is in focus to be more effective. By following nearly same process as suggested by IS 56002, they identify both what customers' need they have outside and what internal inefficiencies exist. And then they analyze how they can optimize the production processes and material flow. The analysis even results in a specification to be followed by suppliers. The company has started to implement LEAN manufacturing from some years ago and more innovative changes are planned. They are working to enhance process management and control on processes.

A new staff is employed with focus on process mapping and working methods' documentation. The products are produced based on the customers' need and innovation is not a serious issue in the field of products. But the innovation works that can be raised in the company are innovation in working methods, smarter material flow, how to stock the products in a more effective way, how to reduce and manage leftover material, how to increase traceability and repetitiveness, how to improve safety in the workplace and how to minimize environmental effects and work more sustainable. It is planned to work harder with such innovation areas.

In contrast with other companies, the company A is not ISO 9001certified, since it is not common in the branch that they work. However, they perform audits in cooperation with external partners RISE and Kiwa.

Case B

The company has been producing housings for bearings in over hundred years. The products have been developed and new machines and technologies have been supplied but the production methods, concepts and processes have been almost unchanged. However, a very innovative project is going on in the company currently and it will restructure the production processes and is expected to enhance flexibility and effectivity in the production. The new technology that is in the line with company's strategy for digitalization, will steer the manufacturing based on the customers' needs. The process of running the project is being documented to be used in the future.

In addition to productions units' responsibility for improvements, the department of *production development* takes care of improvements related to hardware, tools and machines. All production units have their daily meetings to bring up problems and collect ideas. The production process maps, and work method descriptions are available. Nevertheless, the innovation activities in the production do not follow any structured routines. By describing that some of ideas are unintentionally disregarded, the interviewee thinks a described innovation process can help to catch up all ideas.

"Sometimes it happens that some ideas and suggestions become ignored easily without really time to reflect or go through, or on some standardized way judge if it is right or not. That is maybe what which is missing".

The *suggestion-boxes* have been used before but not anymore.

Case C

During 2014-2016, the company has had innovative changes in production layout and processes to adapt the production rate to volume increase that the company faced. Identifying opportunities and applying improvements have always been in focus. Recently, they have run a *Kaizen event* by the help of some Kaizen coaches. The purpose of the Kaizen event was to optimize a part of production related to assembly of heavy products and improve the material flow during the assembly work.

After getting positive results, they run another project, a mini-Kaizen event, with participation of production manager, production personnel and an experienced guide. By focusing on the flexibility, they investigated the advantages and disadvantages of cell-production in mechanical assembly section. At that time, mechanical assembly carried out by people and in several production-cells. As a small company with few people working in the production, *flexibility* plays a key role to maintain the stable processes. They realized that line-production in comparison with cell-production increases the flexibility. By cell-production, absence of an employee could stop production of one type of products and affect the delivery to the customers. But in comparison, line-production creates more flexibility. They shifted to assembly line-productions consisting of consequent operations, verification, and packing. The company performs *personnel-rotation* to increase versatility and enhance flexibility.

As a small company, production manager has a good communication with employees and optimization is going on constantly. Additionally, employees get production-orders in the paper format, they can register problems or their suggestions in the order papers and leave it back to the management after accomplishing the assembly work. The manager reviews the comments before archiving them and can decide about any action needed.

Case D

The methodology model-based system engineering (MBCE) is partly used in Volvo-Braås, where the ideas initiate from considering existing needs and looking at possible solutions. There is a clear organization within production with groups, group leaders, group leaders' assistants, production technicians.

The company has established well-documented description of production processes and working routines. To deploy improvements, they have employed methods with documented description on how to use them. They include *risk analysis* and problem-solving methods such as *root cause analysis*. Descriptions that explain how to perform optimizations' processes are provided. Sometimes, they carry out activities directed by *Kaizen events*; they focus on a specific area and apply optimization as much as possible. There is a well-established support through daily control. Every morning during pulse meetings the employees can raise both deviations that they have had and features to be improved. The s*uggestion-boxes* have been used before but not anymore.

The company is executing a huge innovative project to produce a new product that demands innovative solutions in production methods. The process of product development is already well-described. But the innovation activities related to the production processes are mostly disconnected from process description. Since there is a high need in production to standardize innovation management, it is easier to find possibilities for implementation of standard in the production processes. Nevertheless, existing routines and descriptions for methods and routines can ease the implementation of standard even in the production processes.

CASE E

The company's structured approach toward the innovation is not confined to hard work with production processes and routines. Regarding to the interviewee, the innovation is a part of daily activities in the company, and they constantly work with it. However, she considers it difficult to clarify the border between improvements and innovation. She describes a little innovation example that created huge benefit. A different way of using a tool has saved time in the production. In EEPAB, they have a systematic approach toward innovation and have established a working method to stimulate and support innovation activities. They use some methods and tools to enhance the organization's innovation capabilities. Below some are explained.

Innovation Board: They have a large *innovation board* which is placed in the break room, to be seen by all employees. Its aim is to gather the ideas. An announcement on a subject is sent out there and employees can put their opinions and suggestions there; and if needed, they do brainstorming around it. They believe the innovation board is better than *suggestion box*, because all employees can see it and discus about it and additionally, they do not miss if something comes up. The procedure on how to work with this board is documented.

Sync board: In addition to innovation board, the company has a *sync board*. The optimization cases are presented by tags on the board. The board illustrates the status of each case and its position in the flow. It shows for example if it is in the management for analysing, if the case has become rejected or it is going forward, if it is decided to be applied instantly, or it is planned to be postponed. The planned time for implementation and responsible people to do it are shown.

Red Cards: Another example of idea initiation in the company is the use of *red cards*. The people who work in the production use the cards to write down problems or issues that are not working well in the process. The cards can also include *suggestions* to solve the observed problem. The red cards are collected and managed by the production management. These cards are considered as a normal part of work and not as an extra optimization work.

In the context of innovation, the organization is not hierarchal. The suggestions can come from anyone. Regardless of whose idea it is, all received ideas and suggestions are being analysed. The company has established a culture of openness that anybody in the organization can ask questions or come with suggestions. The interviewee explains that sometimes a suggestion can be rejected, and it may depend on a previous experience from a similar problem and knowing that the suggestion won't improve the situation. The suggestion can become an innovation, depending on what it means and which way the company choose to take, after analysing the suggestion. Some parts of suggestions are ordinary and simple ones that are introduced. And sometimes there are too many suggestions that it becomes impossible to do optimizations the whole time.

"We wish to be leading edge. We wish to be top company, so we try to find and catch up new things which show up and see if it can be something to develop us. We wish to become better continuously, it is our drive power".

Challenges in implementation of ISO 56002 and Solutions

Case A

According to the interviewee, difficulties in implementing the standard, depend on the maturity of the company in working with processes and documentation, i.e., where the organization is and where it should be started from.

"Difficulties, spontaneously, when implementing (the standard) depend on how mature the organization is, regarding to working with processes, how mature (the organization) is in documentation and have audit management on documentation, both for actual products and even processes. So, the level of maturity is a big challenge".

According to the interviewee the company may face several challenges in the implementation of ISO 56002. The company has not established proper documentation routines for example documenting working methods and production processes. The knowledge usually transfers verbally that causes vulnerability in the organization. He emphasizes that the culture of documentation should be improved in the organization.

The company has a high need to do a process mapping and document the production processes and work methods related to the processes. The interviewee notes that a process map facilitates very simple analyses in a basic level and have unbelievable developing effect of it. But the company is facing two difficulties to do process mapping. The first one, is that they do not have any standardized products. Their products are produced and delivered based on customers' need. Thus, each customer's order is unique, considering the combination of material and dimensions. And it makes every work-days special. The second challenge is that the production processes demand a lot of people's works and it can make the process mapping different from theoretical perspectives.

When he is asked about standardizing production processes in the company, he notes it essential that they should move toward it. They have already started implementation of LEAN from some years ago. But as he explains, it is not only providing physical tools, but also changing the culture of working. By defining the culture as *"the working methods that people have in the company to work with"*, he mentions the cultural change as a requirement for developing innovation management systems.

"And that is a culture change, that is not just to copy a system, but a culture change. And it is similar if one wants to work with some forms of ISO standard, for example 56000 innovation management system or which ISO system you can imagine. It is also a culture journey …".

He believes that when people do not know the advantages of implementing process or standardizing working methods, they do not show any interest for it.

"I think in many people's ear, when you say you want to implement processes or ISO systems, I think many become both scared and nervous and get almost negative attitude toward it".

He notes that although it can slightly vary from person to person, but generally speaking, operating a special machine for years, having same job for many years, doing same work steps in many years or having very regular working methods can reduce people's flexibility and worsen the openness to change. Thus, it makes the *change management* a central part in the organization.

"I think many who have worked here for a long time, from maybe 80s. 90s experience this very inflexible, they feel they lose their creativity and freedom. But in reality, the only thing we want to catch up is just to document what they have in their creativity and freedom".

To avoid such effects, they focus on the culture of *rotation of different workstations* and furthermore employ people who can work within a *team* and not just do a specific role. For example, the company are used to employ people for the production and the employee should help in the production, regardless of different departments in the production.

The interviewee stresses that they should go toward standardizing innovation management system and take the cultural journey, even though they have a little bit left before they can implement ISO 56002. According to him, involving the employees can become a challenge. All people are not interested in being involved. Some people may feel unsure, unsafe, and perhaps low self-esteem or low self-confidence. But regardless the reason, a competent leader can overcome this challenge. By referring to a successful personal experience, he suggests that leaders should work close to the employees, know employees and how they carry out the work, so that employees can feel the leaders as a part of their team. They can understand that the leader is familiar with their work and is involved. A leader that is interested in listening to the personnel and constantly tries to inform and communicate with them can improve the employees' engagement. He expresses his pleasure in overcoming this challenge in his organization.

The interviewee asserts that leadership has a critical role in creating a culture of openness to change. He argues that a stunning good leadership is a requirement for implementing innovation management system.

"The leadership is important, regardless which type of manager role you have, leadership and how you communicate and involve etc. is very important, I think".

Interviewee argues that to succeed in implementing the new system, it is important to describe why you do it i.e., the purpose of doing it and then try to involve the people. The key to progress is *involving*, *communicating*, and *informing* alternately the whole time. He also emphasizes the importance of freedom under responsibility to enhance the employees' creativity and innovation capability.

Case B

The engagement of management is a challenge that the company can face in the implementation of innovation management system. The respondent considers the engagement of leadership of such high importance that lacking it can become an obstacle in managing innovation works.

Lacking an innovation vision or an overall picture is another concern that prevents new ideas to be generated. Another issue is that normally optimization actions are decided by mangers. Instead, a group of competent, educated, and qualified people could exist to identify the needs, refine the ideas, learn new technological advances and work with future's projects. Consequently, he presents a positive attitude toward a department or a team that take care of innovation activities.

> *"Since you cannot have the ISO system without having the real parts that actually maintain the system and works with it".*

According to him missing competent people to work with standard, can be a serious challenge to maintain the innovation management system.

The interviewee mentions the daily issues as barriers that limit operators and technicians to generate optimization ideas. The stable production processes, that functions well, can unbind personnel's time, release their power and enable them to come up with ideas and suggestions.

> *"Often these optimization works are things that don't work well, and we raise them and try to find solutions. Actually, those are not (innovative) optimizations that needs to come with own ideas and do improvements".*

Continuously, the respondent points out to the culture and states that people often suppose if they buy a new equipment, the process is changed. But innovation is also about ways of thinking and culture. He says:

> *"The culture is a very large and important part of a company. And sometimes we do not have time to do exactly right but that is still good that we have started to leave those old working methods …".*

However, he believes the introduction of new machines and technologies in the production can impact the culture of working, since they demand their special requirements to work with.

To improve the personnel's engagement, the respondent emphasizes that if some innovative work is done, the result should be visualized and shown. It also is a reward to the innovators to see their ideas applied.

> "*to see own ideas to be implemented is a very large part of reward, that a co-worker can see that his/her idea is implemented and is in place".*

He emphasizes the importance of real follow ups that may be missed in the firms.

> *"If something is done, it should be visualized and be available so that the optimization can really be seen (...) I think the optimization should be raised and visualized. If a good result is achieved, it is important to raise it and show to*

people that this is what we are working with it. This optimization or this operation methods creates good results. You all see it".

According to him, showing the results gained through a management system informs the employees about the purposes and advantages of the system and consequently, it increases their engagement.

Case C

The innovative activities are running within the production processes, constantly. They identify opportunities, create concepts, evaluate them, and then develop solutions to optimize the production processes. But implementing the innovation management standard and creating routines and structures for innovative activities can be one step further ahead. Interviewee C point outs to the *clearness from management* as one of the most important issues in running an innovation management system in the production processes. He considers the role of management crucial to define the visions related to innovation activities and also to supply the required resources:

- The management should send out visions and goals to the organization. It should be clear from management what the management is expecting. Where shall we be in *short-term* and *long-term* future. Having the standard can make it compulsory.

- Management agrees to assign needed resources. Small companies have few employees, and all are assigned fully to their roles. Providing human resources can be a big challenge in implementing the standard. In some situations, the company needs to share resources with sister companies to compensate resource shortage.

In implementing new solutions in the production, it is important that the production employees are satisfied and agreed. At the start, when a change is going to be applied, all people have their own opinions and tendencies. But to apply changes all involved people should be content.

"If you have five employees, there are five different wills to start with. And you should funnel it so that all people feel comfortable with the new solution".

He explains why employees' satisfaction is of high importance:

"I think it is important to have production's personnel with you when doing changes. If they do not like, it won't become good. It is they who are sitting there in production and working the whole day. If they think it functions well, it becomes good for all".

However, he is content that when the number of employees increases, there would be other challenges in this context. He also agrees lessons learned from new innovative projects, usually do not get enough attention and are ignored to be documented.

Case D

Since the company already has established a process for product innovations, the interviewee does not expect considerable challenges for implementing a system to manage innovations in

the production processes. Nevertheless, there are some differences between innovations in product development and process development. In the context of production processes, for example, external customers do not exist, and it can make the innovation works both easier and more difficult. He is doubtful to consider the leadership's involvement as a challenge for the organization. However, he acknowledges the importance of culture in deploying changes, *"of course, all changes are challenging"*. He explains that the changes should be motivated properly to avoid sliding backwards to previous position.

The process of innovation in the company initiates from needs that exist. Thus, the needs and opportunities are the interviewee's center of attention. To take all existing needs into consideration at the same time, can cause complexity. To be effective in developing the new solution, it is of high importance to look at the main problem and not all problems at the same time. Probably, later it would be possible to provide a better solution that fulfills more requirements. The interviewee stresses the importance of *developing the solutions and concepts*.

> *"The first version of a solution probably doesn't cover all areas that you wish, but often you should work a little with the solution".*

In addition, "*having a clear map of needs and requirements"* limits the solution space and facilitates achieving the best solution.

The interviewee does not remark any great challenge that the company needs to struggle with, in implementation of ISO 56002. Nevertheless, he describes the biggest challenge related to the innovation.

> *"The biggest difficulty is to find the big innovations and opportunities and it demands to think out of the box".*

Case E

The interviewee who has long experience of implementing other ISO standards, considers it difficult to talk about challenges before reading the standard ISO 56002, completely. She believes the culture won't be a problem or challenge for their organization in implementation of standard. The company holds several ISO certifications and regarding to her, employees are used to the introduction of new standards.

> *"And all people have become open to change. They have easy for further changes. If people know why we do a change and why we are going to introduce a new standard, it is used to be no problem".*

The company's cultural journey to *change openness* has started when the company commenced working with LEAN concepts and features in 2005. At the start, there has been high resistance toward changes. She explains they have managed to change the employees' posture from *"What is it that we should do?" to "Wow! something new! Where is it coming from?"* or they wonder *"What does it lead to?"*. Through this cultural journey, the attitude of reluctancy toward changes is altered to curiosity and interest. She notes the personnel are more interested in changes in comparison to past. The reason is that they know and trust that the changes often lead to a positive result. She explains:

"But during that journey, it has become much simpler; it has become easier to work. People do not need to look for things as before; and they trust that it often becomes better afterwards".

After reviewing the interviewer's examples of challenges, such as the 'leaderships involvement', 'defining routines' and 'developing documentation', she recognizes none of them as being a difficulty or problem for their company. However, in the process of implementing the standard, when it comes to detailed features, for example, some points that they should figure out how to apply, it can become a matter of challenge. In general, she does not expect any problem to implement ISO 56002.

Motivations for implementation of ISO 56002

Case A

The interviewee starts his argument by mentioning that innovation is not just related to products, but to every part of the supply chain. And the innovation management standard does not only create benefits for product development but also for process and effectivization.

The interviewee argues that by standardization one can ensure the quality through the whole work.

"*You know that you don't miss anything in the way. So, it is actually prerequisite to have control on the repetitive work so that you don't forget anything*".

Capturing *lessons learned* is an important point mentioned in ISO 56002, the interviewee states. According to his experience from different companies, lessons learned are often disregarded. People pay high attention to find solutions and deliver them quickly to customers. They often ignore doing analysis if the solution created benefits for the customers or how the process worked.

"We should not just work with product concept, but also with how the process was to come there, to product solution".

The standardization of processes, enables the firm to do same thing repetitively. It is of high importance to have traceability, control on processes and being able to repetitively do same thing again; and it is what ISO process management is about. It is especially important when the organization grows and faces an increase in the number of processes.

Although the respondent has a very positive positioning toward ISO 56002, but he thinks his organization needs to acquire some preparation before implementing such standard.

Case B

According to the interviewees experience, standardization of innovation activities is the one that the company needs currently. An overall view over the whole process of innovation work is missing. Additionally, through an innovation management system, one can capture good ideas.

"That we do often, is that depending on the situation, one solves the current problem and I do not see that we really have a view of the whole. …There are things that one can do but we do not have the (innovation) managing system, so they do not get realized".

He thinks there are huge possibilities in the company for standardization of innovation activities and mainly get the managing group to understand this way of thinking. The standard ISO 56002 demands the management to define *short-term* and *long-term* goals and plans. This will ease handling innovation activities for people who work with production development. The interviewee considers the implementation of ISO 56002 as an investment for the future and notes although the daily practical issues occupy most of the time, but if one likes to go forward, should make the resources available to do it.

Although all production units have their daily meetings to follow up problems and collect ideas, the interviewee thinks that a described innovation process can help to catch up all ideas.

"Sometimes it happens that some ideas and suggestions become ignored easily without really time to reflect or go through, or on some standardized way being judged if it is right or not. That is maybe what which is missing".

Case C

In addition to general optimizations in the production processes, introducing new products or demand changes require new solutions in the production. Following a defined process ensures not to miss any part. With referring to Kaizen event that contains points and process descriptions, the interviewee considers checklists useful to perform an optimization work. Standardizing innovation management prevents actions to be missed.

"… You don't miss anything. It is about all from well-working production to sustainability concerns".

As an example, when performing the assembly work in the company, some used materials have plastic bags that should be sorted as plastic waste. Without a described process, it is easy to miss such pints in designing new solutions.

The standard demands the managers to specify short-term and long-term goals and visions. And it clarifies for employees how to run innovative changes. Furthermore, Lessons learned are often missed when most of the projects are done quickly. Having a tool or routine to catch them up can be useful.

The interviewee has a very positive attitude toward implementing an innovation management system and following processes.

Case D

Usually, when a problem crops up, the cause of the problem appears almost clear. Almost always you can do root cause analysis and clarify the problem's situation. Nevertheless, to solve the problem and take all of root causes into consideration, is a point that one can miss some

parts. By standardizing the innovation activities and problem-solving processes, this can be avoided.

The respondent believes the new standard of ISO 56002, can be mostly useful in their production section that has a higher need to manage innovation activities.

Case E

The interviewee acknowledges the points of standard as very useful checklist. She points out to the remarkable functions of checklists in the company and notes checklists as very valuable tools to ensure that all points are considered, and nothings are missed. Furthermore, having a structured approach toward innovation, clarifies the picture of a process from the start to the end. A systematic innovation management system not only clarifies the goals, but also already from the beginnings shows the right track to follow. And in the case of fails, it is easier to regain and continue. She has a positive positioning toward structured documentation for innovation work.

The company actively works with innovation features and they are planning to include innovation aspects in the company's management system. The interviewee has an optimistic attitude toward implementation of ISO 56002. Generally, she does not consider any problem in implementing the standard ISO 56002 in the organization and says:

> *"Generally, I think it can even be good to introduce this standard and it can have positive impacts when it is done".*

The interviewee who has long experience of implanting the standard ISO 9001 and currently has established an operation system by integrating several standards, thinks it probably won't be a problem to integrate ISO 56002 with company's current standards. And the reason is that ISO 56002 complies with the ISO's common structure.

ANALYSIS

In this chapter, based on the content of the standard ISO 56002, the collected data from prior research and empirical findings, an analysis will be performed. With the research questions in focus, consensus viewpoints will be discussed, and important standpoints will be investigated. The table 4 shows a summary of the interviews' content in the context of research questions.

	CASE A	CASE B	CASE C	CASE D	CASE E
Idea collection	Direct contact	Morning meeting	Direct contact	Morning meeting	Innovation board
			feedback to Pro. orders		Red cards
Current situation	Implementing LEAN, working with production processes, documentation & optimization	processes documented	Cell pro. till Line pro.	Problem solving methods	innovation management Inn. board Sync board Red cards Semi-documented
		innovation in process and technology	Layout design	Kaizen Event	
			Kaizen Event	MB system engineering	
Challenge	Organization's immaturity in working with processes, documentation etc.	Culture & Involving employees	Clearness from management about vision, goals & expectations	To find out the main Innovation and think out of the box.	The challenge may appear when working with detailed parts.
		Competent resources			
	Culture & Involving employees	Missing an overall picture of future's goals & vision	personnel's consensus on working methods	To prioritize the existing needs and focus on the main	
	Lacking standard products	Being busy with current situation	resources		
Motivations	traceability	Overall Vision	not miss requirements	capture all root causes in developing solution	not miss points
	control				clear picture of processes
	repetitivity	long term goals	long term goals		
	lessons learned	short term goals	short term goals		clear goals
	Ensure the process quality	Capture ideas	Clear Vision		clear track to goal
			Lessons learned		

Table 4: summary of empirical study

In performing the present thesis project, many literatures in the realm of innovation were studied. A massive agreement can be understood from the literatures about the advantages and significance of the innovation (e.g., OECD, 2018; Wind & Rhodes, 2017; OECD, 2013, 2010; Sveiby, et al., 2012; Bessant & Rush, 2009; Bullinger, 2008). Such consensus can also be perceived among interviewees that contribute to the empirical part of the present research. In conducting the interviews, no doubt was recognized regarding the importance of innovation. Following such confidence, creating an innovation management system through the standard ISO 56002 sounds to be interesting for interviewees.

As it is explained before, innovation in production processes can be triggered by a variety of factors such as new customer requirements, emerging technologies, materials, processes and equipment (Romero, D. et al., 2017) or digitalisation and sustainability (Karlsson, 2019a). Innovation can create a lot of benefits. For example, it can help to improve customers' satisfaction through reducing cost and time or enhancing quality (Schallmo, et al., 2018). Additionally, by innovative solutions in production processes, manufacturing firms can produce their products in smarter, more flexible, agile and sustainable ways (Romero, D. et al., 2017).

Considering the empirical study, all case companies are involved with some type of innovative activities in their production units. Case A is mapping the production processes to facilitate identifying innovation opportunities. Case B is running a big project to significantly improve some of the production processes. The company case C has recently implemented new solutions in the manufacturing processes to accommodate the increase in market demand as well as to improve the material flow and flexibility in production. Case D is running a huge project introducing a new product with its innovative production methods. And finally, case E, as the interviewee mentions, is involved with innovation activities constantly and on daily basis.

Although all case companies are involved with innovation activities, but as it is explained in the empirical studies, the companies demonstrate different level of innovation management capabilities. They also have very different approaches and policies regarding handling new ideas and managing innovation activities. The case A, as an old medium sized company, has been used to work traditionally, lacking documentation for its processes or working methods. Based on the management's decision, the company has just started working with processes effectively to find optimization opportunities. In contrast to case A, the company E not only actively works with innovation processes, but also has established a strategy to support innovation activities, through systematically collecting innovation initiatives, new ideas and suggestions; and subsequently analysing and using them to develop new solutions. It is the only case study that has developed routines to guide ideas from origin to value adding solutions.

As the interviewee A mentions, the challenges that a company can face in standardizing innovation management or implementing the standard ISO 56002, is highly dependent on the maturity level of the company in working with processes. It complies with what literatures highlight. Bessant and Tidd (2015) observe innovation as a sequence of activities and suggest to treat and manage it as a process. Other literatures confirm the role of processes in management systems. "Processes are the backbones of modern management system standards" (Kohl, 2020, p. 10) and "effective innovation management relies on iterative processes" (Hyland & Karlsson, 2021).

Additionally, ISO 56000:2020 (p. 16) names the *proficiency in processes* as an innovation capability. Thus, the higher maturity in working with processes, the less difficulties in implementing the standard of innovation management system. The companies that have a

system approach in working with processes and specially innovation processes, will probably confront less difficulties in developing an innovation management system. However, the interviewee A considers *establishing a culture of documentation* as a prerequisite in working with processes.

The standard ISO 56002, through its guidelines, helps organizations to configure the innovation processes (sub-clause 8.3). Implementing the standard ensures the quality of the innovation processes, enables repeating the same process and improves traceability and control over the innovation processes (interviewee A). *Not missing requirements of the innovation process* (interviewee C) and *capturing all root causes in developing solution* (interviewee D) are other benefits that motivates production units to standardize innovation management.

In the clause 8.2, ISO 56002 gives instructions to manage the innovation initiatives. Although all innovation initiatives aim to innovation, but it is not all of them that result in innovation (ISO 56000:2020; ISO 56002:2019). The standard states that "an initiative can be proposed by anyone in the organization" (ISO 56002:2019, p.17). Considering the case companies, innovation initiatives and suggestions can be generated by anyone in the companies, as required by the standard. But most of the companies lack a structured approach toward collecting, evaluating, prioritizing, and managing all initiatives. As stated by most of the interviewees, the consequence can be that some of initiatives are ignored without being evaluated or be evaluated by incompetent people. Although managing initiatives is a challenge in implementation of ISO 56002, but the standard's instructions on how to manage each innovation initiative – from origin to deployed solution – can motivate firms to use such guidelines. *Capture all initiatives and suggestions without missing any of them*, is an advantage frequently mentioned by interviewees.

It is generally accepted that culture is a prerequisite for any innovative approach (Löhr, 2016). Culture is one of the eight principles in ISO 56002. The standard draws attention to create a culture that supports innovation activities. Both the theoretical (Brettel, et al., 2015; Engelen, et al., 2014; Naranjo-Valencia, et al., 2011; Martins & Terblanche, 2003, Obenchain, 2002) and empirical studies, of this thesis, acknowledge the importance of culture in developing innovation management system. Regarding to the empirical study, all interviewees are consensus about the impact of the culture in developing a structured approach toward innovation management. The interviewee B observes cultural issues important for implementing ISO 56002, since "*the culture is a very large and important part of a company"*. Interviewee A considers the cultural change as a requirement for developing innovation management systems, "*that is not just to copy a system, but a culture change".*

One significant part of cultural issues is related to the employees' attitude toward change as well as their involvement in performing innovation practices. Several research literatures affirm the employees' involvement as an indicating factor in the firms' innovation performance (Linke & Zerfass, 2011; Naranjo-Valencia, et al., 2011; Denison, et al., 2004; Fey & Denison, 2003; Denison & Mishra, 1995; Monge, et al., 1992). Although in all case companies, innovation initiatives can be proposed by anyone in the organization - as it is required by ISO 56002 - but all people are not interested in being involved (interviewee A). Involving the employees is commonly accepted by interviewees to be a challenge in implementation of ISO 56002 in production processes. Even the interviewee E, who observes no problem regarding the culture in their organization, does not refuse the role of culture in conducting innovation activities. According to her the organization has faced such problem earlier in implementing other systems such as LEAN. But gradually by introducing new systems and standards and observing their positive results in the organization, the opposition to change is replaced by curiosity. People

who intend to contribute time and effort to the development of innovative ideas or to carry out innovation activities are indicating factors in standardizing innovation management in production sector.

All respondents have suggestions to improve the culture of organization so that it supports the innovation activities. They present solutions to enhance the people's involvement and reduce resistance to change. For example, according to the interviewee A, the key to involve people is to inform and communicate with them. Consequently, he highlights the important role of the leaders who should work close to the employees. An involved leader makes the employees involved (interviewee A). A competent leader listens to employees, *informs* them and *communicates* constantly. Many researchers such as Linke & Zerfass (2011) and Martins & Terblanche (2003) highlight the impact of communication in the innovation performance. And ISO 56002:2019 states "Communication can be done to create awareness, increase people engagement, …".

The interviewee B shed light on the result of innovation activities that should be shown and visualized for all. The interviewee C, who have few employees in the production unit, tries to get all employees agreed, in case of changes. He funnels opinions to come to a common agreement. Satisfied people are more likely to create a good outcome (interviewee C). The interviewee D believes that motivating changes and explaining the purposes decrease the resistance toward changes and enhance involvement. The interviewee E who asserts the organization has overcome the culture problem, emphasizes that all ideas are welcomed in the organization and go through the process of analysing. Fair evaluation of ideas is also confirmed by Amabile (1995) to positively affect the innovations performance. The interviewee E also states when people know why changes are applying and trust that changes create good results, they will not oppose.

The table 5 illustrates these suggestions that are presented by five interviewees, to enhance people's involvement.

	Suggested solution to cope with cultural difficulties
CASE A	Inform people about the advantages of implementing changes. The leader should be involved in the work. He/she should listen, *inform*, and *communicate* with employees constantly to make them involved.
CASE B	The benefits gained through innovation activities or innovation management system should be shown and visualized for all employees so that they can understand the advantages and purposes.
CASE C	The agreement of all employees in the small organization is important. The respondent gets all opinions and funnels them to achieve a common agreement.
CASE D	Motivating changes and explaining the purposes of performing changes reduce resistance toward them.
CASE E	Informing about purpose of change, creating trust about the benefits of the change, respecting all ideas and suggestions, and treating them equally are the solutions.

table 5: suggestions to the culture challenge

Referring to the table 5, the most consensus solution, to increase people's engagement in innovation activities, is to create trust among employees toward the advantages of changes. By informing people bout the purpose of activities, their tendency to contribute to the innovation activities will increase. This is confirmed by previous research. Linke & Zerfass (2011) argue that when employees are faced with change, initially they react with suspicion and low motivation. But after discovering the innovation, they achieve a better understanding of the new, observe the need for change and open up to it.

In this regard, a model is developed and recommended by the Author of this paper. It can be found in the recommendation part which comes later.

Regarding to ISO 56002, people are one of the resources that support the innovation management system. The effective implementation of ISO 56002 requires competencies who execute the innovation processes (ISO 56002:2019). Moreover, the organizations should consider forming teams with a diversity of people to enhance the collective competence (ibid). The relationship between competency and innovation performance has been investigated by prior research (Hero, et al., 2017). Mir, et al. (2016) refer to competence as a major element of *innovation capability*. But access to the required competencies can be a challenge for some companies. This is acknowledged by interviewee B who observes the lack of competent people as a potential difficulty in maintaining the innovation management system. Additionally, as the interviewee C mentions, in some enterprises especially in small companies, people resources can be a serious challenge, since the human resources are very limited in small organization. However, the companies can find some solutions such as sharing resources with sister companies, if applicable (interviewee C).

Leadership is a domain that ISO 56002, the prior research (e.g., Hughes, 2018; Ryan & tipu, 2013; Gumusluoğlu & Ilsev, 2009) and the interviewees – in this thesis project – have paid high attention to it. The whole clause 5 in the standard ISO 56002 is dedicated to *Leadership*. And both theoretical studies and interviewees validate leadership as a key variable that can enhance or hinder innovation in workplace. It means, the leadership can have either positive or negative impact on the innovation management's effectiveness. In one side, leadership's inadequacy can be a hinder to reach the innovation objectives and in the other side, a competent leadership can contribute to great achievements. In addition to many other contributing channels, through defining *innovation vision* (Reid, et al., 2015) and fostering a *supportive culture* (e.g., Linke & Zerfass, 2011), leadership can have great impact on innovation management performance.

Some interviewees consider missing an overall innovation vision for the future as a barrier in performing innovative activities. They think through communicating their expectations and indicating *short-term* and *long-term* innovation goals, top management can facilitate managing innovation activities within their organizations (interviewees B and C). By articulating an exciting and strong innovation vision for the future, the leaders can raise the performance expectations, change the organization's tendency toward change and positively influence innovation (Reid, 2015; Gumusluoğlu & Ilsev, 2009).

The standard ISO 56002 requires the leadership to establish, implement and maintain an innovation vision that describes the desired future state (ISO 56002:2019, p. 6). It is expected that the challenge of lacking innovation vision would be mitigated by implementing the innovation management standard. And this is one of the reasons that some interviewees have a positive positioning toward the standard.

The role of top management in developing an innovation management system is not confined to defining and executing the vision, policy, strategy, and objectives. In addition to many other responsibilities that ISO 56002 specifies for leadership, top management are responsible to foster a culture supporting innovation activities. They should engage, direct, and support persons to contribute to the effectiveness of the innovation management system (ISO 56002:2019, p. 6). Linke & Zerfass (2011) and Dawson (2010) emphasize the role of a leader in building a consistent, supportive organizational culture. By establishing the culture of freedom under individual responsibility, leaders can encourage the people's creativity and capability to innovate (interviewee A). Autonomy or freedom in conducting tasks that gives the sense of individual ownership and control over work, improves innovation performance (Amabile & Conti, 1999).

The involvement of leadership is a determining factor in the success or failure of the innovation practices (Ryan & Tipu, 2013). This is in line with what interviewee A notes about the role of leadership in developing innovation management system. He considers a crucial role for the leadership in both employees' engagement and fostering a culture of openness to change. He believes management's involvement results in employees' involvement.

The standard ISO 56002 provides leadership with guidelines on how to participate to build and maintain an effective innovation management system. It requires leadership to actively be engaged in innovation activities. And this is one of the major benefits that the standard brings to the organizations.

Countless resources (e.g., Ologbo & Nor, 2015; Crespi & Zuniga, 2012; Kamasak & Bulutlar, 2010; Koch & Strotmann, 2008; Storey & Kelly, 2002; Calantone et al., 2002; Tsai, 2001; Edquist, 1997) remain no doubt about the key role of knowledge and learnings in organizations' innovation performance. Knowledge as the fuel of innovation (Merrill, 2019), have got a lot of attention in ISO 56002. Although the importance of learnings is widely agreed by interviewees, but according to some of them, lessons learned do not get enough attention and are often ignored without being documented to build a knowledge basis for future use. Even within some large companies – that routines to document lessons learned are defined – people in the effect of the projects' rapid pace, do not take it seriously. ISO 56002 provides organizations with guidelines to "establish an approach for the management of knowledge for the effective implementation of its innovation management system" (ISO 56002:2019, p. 11).

Regardless of the companies' type, size, age and the level of the innovation capabilities, all respondents have a positive positioning toward innovation management system. As mentioned by Hyland and Karlsson (2021), implementing ISO 56002 not only creates a common language international and withing the organization, but also assists the organizations to promote their innovation capabilities. The interviewees consider it useful to manage innovation processes in a structured and systematic way and think it can create benefits in their organizations. These benefits are driving factors and motivations to implement ISO 56002.

Recommendation:

There is a huge consensus among both seminal and recent researchers about the impact of employees' involvement in the success of innovation activities. Motivated individuals who like to contribute time and effort to the development of innovative ideas and intend to participate in innovation activities are considered as a key factor in innovation performance. (e.g., Linke & Zerfass, 2011; Naranjo-Valencia, et al., 2011; Denison, et al., 2004; Fey & Denison, 2003; Denison & Mishra, 1995; Monge, et al., 1992).

Findings from empirical study in this thesis, are in line with the prior studies. All interviewees affirm the role of people's involvement in implementation ISO 56002 in production processes. And they try to give their suggestion on how to cope with this challenge in implementing ISO 56002 in production organizations.

ISO 56002:2019 mentions *engaged and empowered people in the organization* as one of the potential benefits of implementing an innovation management system. The standard gives guidelines on how to keep people engaged. According to the standard, the organization should provide an environment that encourages *feedback*, *suggestions*, and *participation* (ibid). In evaluating innovation performance, ISO 56002 gives some indicators including: number or ratio of employees involved, number of ideas and innovation initiatives as well as engagement level.

By this overall consensus, there is no doubt about the importance of people's engagement in implementing ISO 56002 in production sector. Therefore, the model in the figure 11 is developed and recommended by the Author of this thesis. The purpose the model is to "*enhance people's involvement"* in performing innovation activities within an organization. Through following the model's principles, organizations can strengthen the people's engagement in developing an innovation management system.

As explained before in this thesis, an innovation starts from *innovation initiatives*. Also, it is discussed to engage all organization's employees in creating innovation initiatives. The number of initiatives is one of the indicating factors in evaluating innovation's performance (ISO 56002:2019) and it reveals the importance of involvement level in developing innovation management system.

This model suggests that all people in the organization should contribute to generate innovation initiatives. Initiatives can come from everyone in the organization. And all initiatives that fulfil defined requirement should go through a fair judgement channel, regardless of who has suggested it.

According to the guidelines of ISO 56002, some initiatives manage to enter the innovation process. To lead innovation initiatives through the *innovation process*, and transform them to innovation value, people with the right knowledge and competence should be assigned. Through following the guidelines of sub-clause 8.3 (see figure 9) in ISO 56002, and based on the collected innovation initiatives, the group of competent people create the best solution. After deploying the new innovative solution and achieving the intended outcome, the positive results should be visualized for all people. It is very important to follow up the outcome and highlight its positive function or effect. The visualization should be available and clear for all employees. It is not only a part of reward for innovators to see their solution in place, but also a way to build trust toward innovation activities.

As argued previously, when employees face a change, initially they react with suspicion and low motivation. But after discovering the innovation, they get a better understanding of the new, observe the need for change and become open to future changes (Linke & Zerfass, 2011).

As discussed widely before, the improved involvement of the employees and their participation in innovation, in turn, will increase the effectiveness of innovation management system. It also means coping with one the challenges in implementing ISO 56002 in production processes.

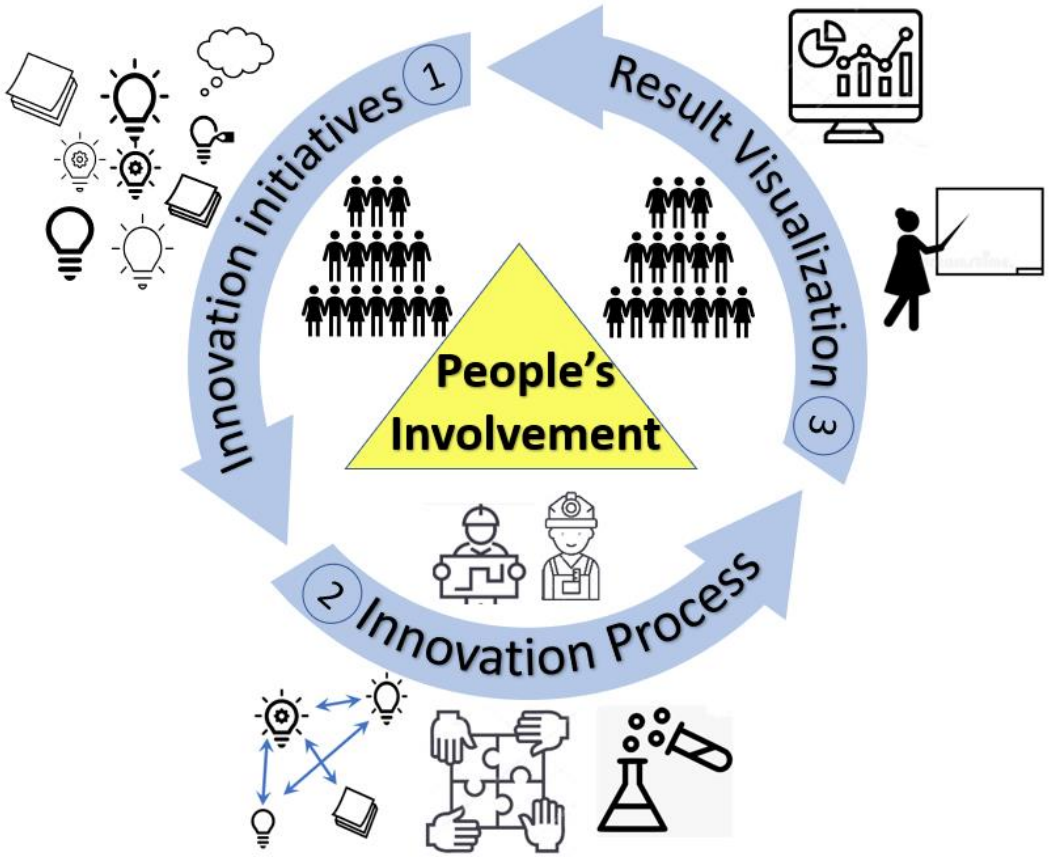

Figure 11: Involvement of people in innovation activities

CONCLUSIONS

The purpose of performing this thesis project was to identify potential motivations and challenges when implementing the innovation management standard, ISO 56002 in production processes. In addition to studying prior related literature, five interviews with five Swedish industrial companies are conducted. The theoretical information together with findings from empirical research are analysed to present the research result.

The standard of innovation management system can create benefits to the production units. According to the findings of the present thesis, some motivations to implement ISO 56002 in production processes are *ensuring the quality of innovation processes*, *creating a clear picture of the innovation process*, *helping to consider all important requirements*, and *enhancing the leadership's involvement in innovation activities.* Even for those companies that innovation is already included in their management system, standardizing innovation management, through ISO 56002, can help the organization to promote the innovation management system and related strategies.

However, production units may confront various challenges. *Cultural issues*, *immaturity in working with processes*, *devoting all resources to the current concerns* and *inadequate leadership's engagement* are some of them.

None of the interviewed companies in this thesis has commenced the implementation of ISO 56002. Although an ongoing project investigates the systematic innovation management in companies that are using guidelines of ISO 56002 (Hyland & Karlsson, 2021), but there is no evidence of any research with focus on implementation of ISO 56002 in production processes. Future empirical studies, through interview with companies that have applied guidelines of ISO 56002 in their production processes, can inspect the applicability of the standard from different perspectives and shed light on new features of the standard's applicability in the production processes.

Furthermore, in doing the empirical part of this thesis, the guidelines of ISO 56002 are considered generally; and based on the interviewees' interest, some concepts have been highlighted. Additionally, this thesis is a small project and has not have the opportunity to explore all aspects of ISO 56002 in production processes. As a recently developed standard, ISO 56002 has many new features that can be unfolded individually, through more detailed and deep study. Future research can aim to analyse implementation of such features in production processes. For example, production processes capabilities for implementing ISO 56002 and the impact of each clause/sub-clause of the standard in production processes can be inspected.

The applicability, impact and possibly the development of the *involvement model*, suggested by the present thesis, can also be the subject of future research.

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Appendix 1:
uniform basic High Level Structure (Hinsch, 2019, p. 4)

Overview
4 Context of the organization
4.1 Understanding the organization and its context
4.2 Understanding the needs and expectations of interested parties
4.3 Defining the scope of the quality management system
4.4 XXX [Requirements of the respective] management system
5 Leadership
5.1 Leadership and commitment
5.2 Policy
5.3 Organizational roles, responsibilities and authorities
6 Planning
6.1 Actions to address risks and opportunities
6.2 XXX [Requirements of the respective management system] Objectives and planning to achieve them
7 Resources
7.1 Resources
7.2 Competence
7.3 Awareness
7.4 Communication
7.5 Documented information
8 Operation
8.1 Operational planning and control XXX [Requirements of the respective management system]
9 Performance evaluation
9.1 Monitoring, measurement, analysis and evaluation
9.2 Internal audit
9.3 Management review
10 Improvement
10.1 General
10.2 Nonconformity and corrective action

Appendix 2:
Chapter structure of ISO 56002:2019 & ISO 9001:2015

ISO 56002:2019(en) Innovation management —

Innovation management system — Guidanc

ISO 9001:2015(en) Quality management systems —

Requirements

Appendix 3:
The main stages in a research project (Franklin, 2012, p. 57)

BOX 3.1 THE MAIN STAGES IN A RESEARCH PROJECT

Enter: first decisions and commitments

Stage 1

- Selecting a topic (*What*)
- Formulating a research question (RQ)/hypothesis (H)
- Aims and objectives; motivations (*Why*)
- Designing and refining the approach (*How*)
- Conduct review of available literature
- Articulating a conceptual framework – 'theory'
- Selecting the appropriate method/s to gather data – 'method'
- Presenting a work-plan (*Research outline/proposal*)
- Plan to carry out research within time, resource, and knowledge constraints
- Outlines how to gather data and relates it to conceptual framework and RQ/hypothesis
- Consider and deal with ethical and/or practical limitation to data-gathering.

Stage 2

- Gather the data
- Design, organize, carry-out original/empirical research component
- Literature review: synthesize, refine, and write-up
- Analyse the data
- Present findings and writing up results
- Conclusions (*research paper/dissertation/thesis*; seminars, conferences).

Exit: draw things to a close and disseminate

Appendix 4
Introduction to ISO 56000 series of standards, sent to interviewees in advance to interviews.

ISO 56002

Innovation management system

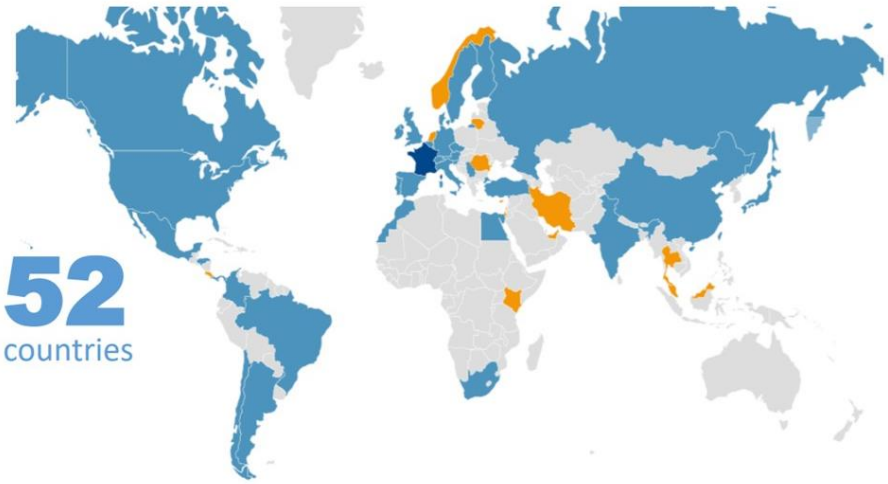
Guidance

International Innovation Management standardization

ISO 56000 family of standards:

- ***ISO 56000*** *Innovation management – Fundamentals and vocabulary*
- ***ISO 56001*** Innovation management —Requirements
- ***ISO 56002*** Innovation management —Guidance
- ***ISO 56003*** Innovation management — Tools and methods for innovation partnership — Guidance
- ***ISO TR 56004*** Innovation management assessment — Guidance
- ***ISO 56005 …*** further guidance on tools and methods to support the implementation of an innovation management system.

Participation



Reference: <Towards an international framework for innovation management (innovationmanagementsystem.com)>

ISO 9001 vs ISO 56002

ISO 9001:2015(en) Quality management systems — I

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Introduction
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2 Normative references
3 Terms and definitions
4 Context of the organization
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4.2 Understanding the needs and expectations of interested parties
4.3 Determining the scope of the quality management system
4.4 Quality management system and its processes
5 Leadership
5.1 Leadership and commitment
5.2 Policy
5.3 Organizational roles, responsibilities and authorities
6 Planning
6.1 Actions to address risks and opportunities
6.2 Quality objectives and planning to achieve them
6.3 Planning of changes
7 Support
7.1 Resources
7.2 Competence
7.3 Awareness
7.4 Communication
7.5 Documented information
8 Operation
8.1 Operational planning and control
8.2 Requirements for products and services
8.3 Design and development of products and services
8.4 Control of externally provided processes, products and services
8.5 Production and service provision
8.6 Release of products and services
8.7 Control of nonconforming outputs
9 Performance evaluation
9.1 Monitoring, measurement, analysis and evaluation
9.2 Internal audit
9.3 Management review
10 Improvement
10.1 General
10.2 Nonconformity and corrective action
10.3 Continual improvement

ISO 56002:2019(en) Innovation management — Innovation mana

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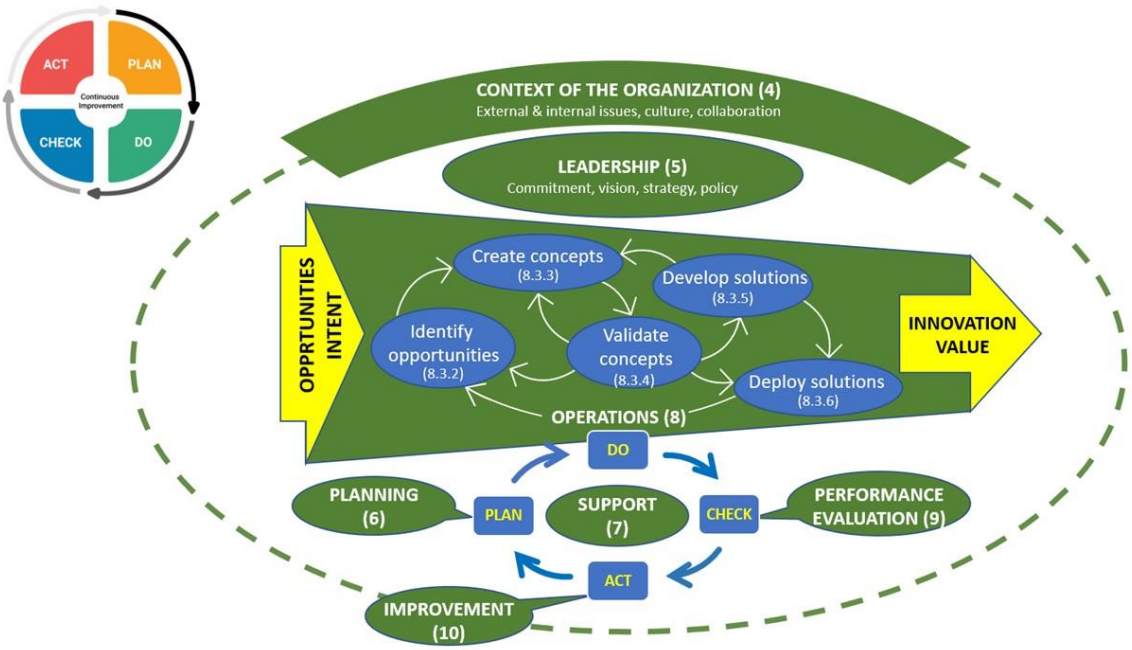
5.2 Innovation policy
5.3 Organizational roles, responsibilities, and authorities
6 Planning
6.1 Actions to address opportunities and risks
6.2 Innovation objectives and planning to achieve them
6.3 Organizational structures
6.4 Innovation portfolios
7 Support
7.1 Resources
7.2 Competence
7.3 Awareness
7.4 Communication
7.5 Documented information
7.6 Tools and methods
7.7 Strategic intelligence management
7.8 Intellectual property management
8 Operation
8.1 Operational planning and control
8.2 Innovation initiatives
8.3 Innovation processes
9 Performance evaluation
9.1 Monitoring, measurement, analysis, and evaluation
9.2 Internal audit
9.3 Management review
10 Improvement
10.1 General
10.2 Deviation, nonconformity, and corrective action
10.3 Continual improvement

ISO 56002 Innovation management —Guidance

- ✓ Common language
- ✓ Credible and common framework

ISO 56002

1. Scope
2. Normative references
3. Terms and definition
4. Context of organisation
5. Leadership
6. Planning
7. Support
8. Operation
9. Performance evaluation
10. Improvement



4. Context, *Understand the organization and its context*

- *identify external & internal issues impacting production process*
- *Identify opportunities, needs, expectations of interested parties related to production*
- *Determine the scope of innovation management system within production processes, interaction with other management systems*
- *Establish the innovation management system, promote a culture to support innovation activities: openness, curiosity, user focus, encouraging feedback and suggestions, learnings, experimentation, creativity, change and challenging current assumptions*

5. Leadership, *(Top Management & Production Management)*

- *analyse forces that acting on the organization and after evaluating their impacts, set direction to the organization.*
- *Establish innovation vision, strategy, policy and objectives*
- *Adapting and integrating standard into existing structures and processes*
- *Ensure that support and resources are available*
- *Establishing a culture supporting innovation activities*

6. Planning, *Plan to achieve innovation objectives*

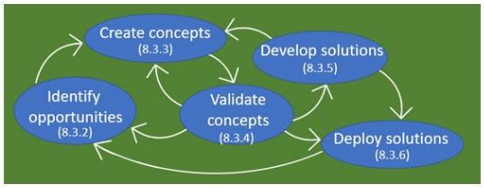
- *Plan actions to address opportunities, uncertainties & risks associated with opportunities*
- *Plan how to integrate and implement actions into processes, evaluate effectiveness*

7. Support, *Provide needed resources*

- *Resources: People, Time, Knowledge, Finance, Infrastructure, Competence*
- *Competence: determine necessary competences, identify existing competence and identify gaps, take action to provide competence*
- *Decumented information determined by standard and organization*
- *Tools and methods: determine, provide and maintain the necessary tools and methods including guides, instructions, templates, softwars etc.*

8. Operation, *Plan- Do- Check- Act*

- *Operational planning and control: Establish criteria for innovation initiatives and processes, control initiatives in acc. With criteria, control planned changes and review the consequence of unintended changes and make relevant action.*
- *Innovation Initiatives: continuously review objectives, constrains, expected results and deliverables of initiatives, determine indicators, establish decision making structures*
- *Innovation Process*



9. Performance evaluation

- *Monitoring, measurement, analysis and evaluation: what, how, when & who?*
- *Internal audit at planned intervals to examine if the innovation management system conforms to requirements and effectively implemented and maintained.*
- *Management review: Top management should review the organization's innovation management system at planned intervals.*

10. Improvement

The organization should continually improve the suitability, adequacy, effectiveness and efficiency of the innovation management system.

The organization should determine and select opportunities for improvement and implement any necessary actions and changes to the innovation management system, considering performance evaluation results. The organization should consider actions and changes to:

a) maintain or enhance strengths;

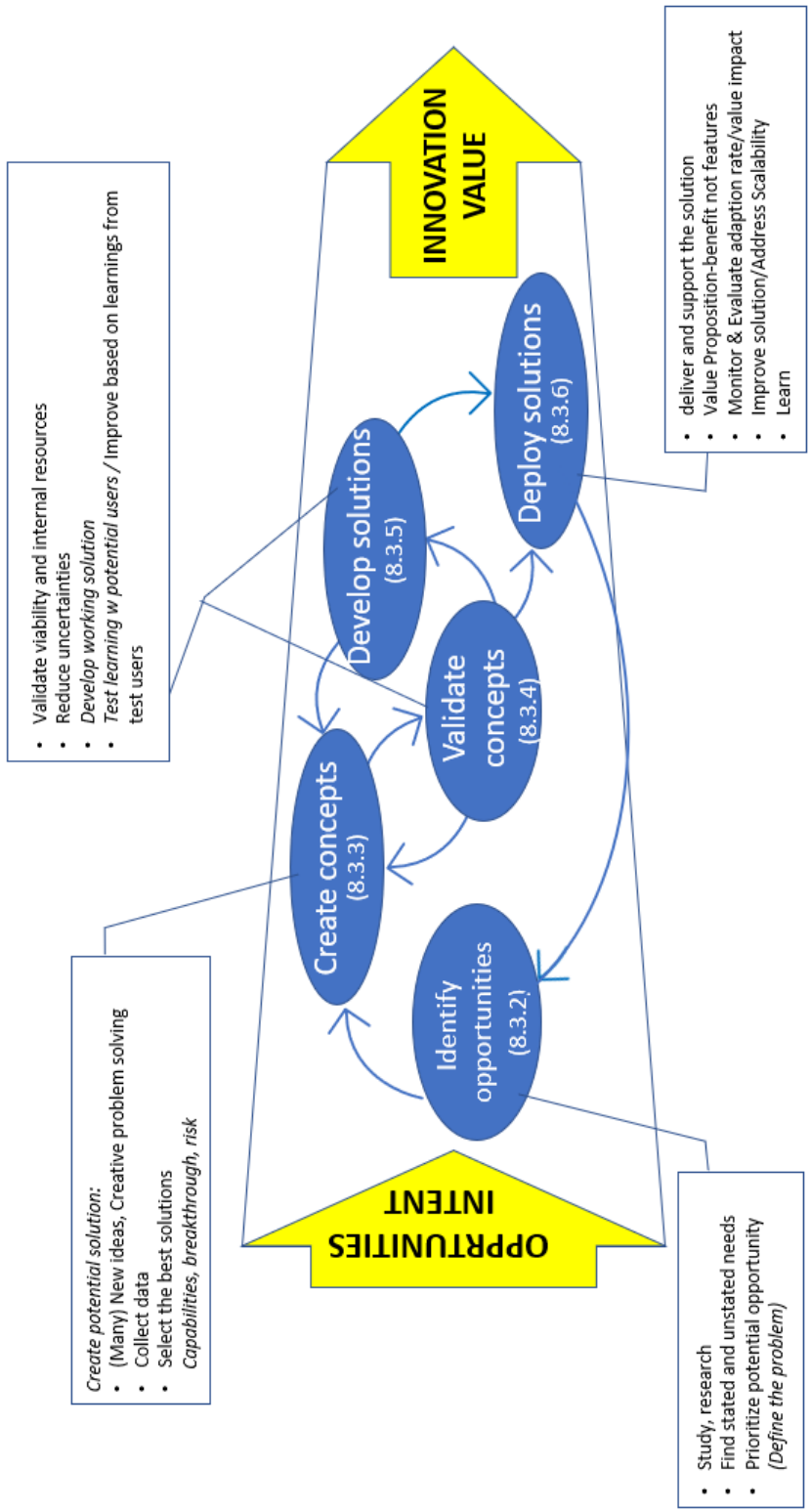
b) address weaknesses and gaps;

c) correct, prevent, or reduce deviations and nonconformities

"Introduktion till innovationsstandarden ISO 56000"

https://www.youtube.com/watch?v=DH1qgUATFmU

Appendix 5:
Introduction to sub-clause 8.3 *Innovation Process*, presented in the beginning of the interviews.



Appendix 6

Proposed challenge-examples during interviews