UNIVERSIDADE DO VALE DO RIO DOS SINOS - UNISINOS
UNIDADE ACADÊMICA DE PESQUISA E PÓS-GRADUAÇÃO
PROGRAMA DE PÓS-GRADUAÇÃO EM ADMINISTRAÇÃO
NÍVEL DOUTORADO

LUCIANA MAINES DA SILVA

THE INFLUENCE OF DYNAMIC CAPABILITIES ON THE INCLUSION OF STAKEHOLDERS IN THE RESPONSIBLE INNOVATION PROCESS:

the case of healthcare technology companies

Porto Alegre
2020

LUCIANA MAINES DA SILVA

THE INFLUENCE OF DYNAMIC CAPABILITIES ON THE INCLUSION OF STAKEHOLDERS IN THE RESPONSIBLE INNOVATION PROCESS:

the case of healthcare technology companies

Tese apresentada como requisito parcial para obtenção do título de Doutor em Administração, pelo Programa de Pós-Graduação em Administração da Universidade do Vale do Rio dos Sinos - UNISINOS

Orientadora: Profª. Drª. Claudia Cristina Bitencourt
Co-orientadora: Profª. Drª. Kadigia Faccin

Porto Alegre

2020

S586i Silva, Luciana Maines da.
The influence of dynamic capabilities on the inclusion of stakeholders in the responsible innovation process : the case of healthcare technology companies / por Luciana Maines da Silva. – 2020.
234 f. : il. ; 30 cm.

Tese (doutorado) — Universidade do Vale do Rio dos Sinos, Programa de Pós-Graduação em Administração, Porto Alegre, RS, 2020.
Orientadora: Dra. Claudia Cristina Bitencourt.
Co-orientadora: Dra. Kadigia Faccin.

1. Inovação responsável. 2. Capacidades dinâmicas. 3. Stakeholder. 4. Inclusão. 5. Saúde. I. Título.
CDU: 658.011.8

Catalogação na Publicação (CIP):
Bibliotecário Alessandro Dietrich - CRB 10/2338

LUCIANA MAINES DA SILVA

THE INFLUENCE OF DYNAMIC CAPABILITIES ON THE INCLUSION OF STAKEHOLDERS IN THE RESPONSIBLE INNOVATION PROCESS:
the case of healthcare technology companies

Tese apresentada como requisito parcial para a obtenção do título de Doutor em Administração, pelo Programa de Pós-Graduação em Administração da Universidade do Vale do Rio dos Sinos - UNISINOS

Aprovado em (dia) (mês) (ano)

BANCA EXAMINADORA

Dra. Tatiana Aleksandrovna Iakovleva – Stavanger University

Dr. Sandro José Rigo – Universidade do Vale do Rio dos Sinos - UNISINOS

Dr. Alsones Balestrin – Universidade do Vale do Rio dos Sinos - UNISINOS

Dr. Ivan Lapuente Garrido – Universidade do Vale do Rio dos Sinos - UNISINOS

To my parents, Clo and Nena, for their example of strength and encouragement and support in all stages of my life.

I love you!

ACKNOWLEDGEMENTS

Responsible innovations are developed from the contribution of several people – stakeholders – that enable the generation of new knowledge. Similarly, for the construction of a thesis, many people contribute and encourage.

First, I would like to thank the interviewees of the companies under study. Thank you, Simon, Christian, Manfred, Michel, Gregor, Martin, Gianmarco, Rausch, Phung, Vanessa, Stefan, Steffen, and Thomas, from Siemens. A special thanks to Sigrun for welcoming me and organizing the agenda of the interviews. I was honored to be able to learn more about this great company, with the history and legacy that, for decades, contribute to a better world.

I also would like to thank to Torbjorn, Petter, Tor, Frederik, Eric, Katalin, Janaína, Cláudio, and Sarah, from Laerdal. Thank you so much for devoting your time and sharing knowledge and experiences with me. I am deeply grateful for the opportunity to meet a company with such a meaningful story and such a beautiful vision. I'm a fan and disseminator of your work.

To Unisinos, in the figure of our dear rector, Father Marcelo, for being a great supporter of research, through his speech and, mainly, his actions. I am very proud to be a lecturer of a institution, which respects the human being and values the quality of teaching.

To PPGA professors, especially those with whom I had the pleasure of attending classes, for all learning inside and outside the classroom. To professors Norberto Hoppen and Douglas Wegner, for showing us how beautiful is research and science. I also thank the professors who evaluated the theoretical essay and composed the qualification board – Diego Marconato, Daniel Puffal, and Ane Linden. I thank the PPGA secretariat team for all support, especially to Ana Zilles, who, since my master's degree, takes care of and accompanies each of us as unique. To Cristiano "CAC" Costa, for putting me in contact with Siemens and Rose Lagemann, for welcoming me and presenting the Unisinos laboratory that use Laerdal equipment.

My thanks to the managers and team of UAPPG, especially the "Lato team girls" for the support, patience, and understanding at all stages of the doctorate.

To Silvio Bitencourt, by theoretical discussions on "porous edges," ecosystems of innovation and innovation management.

Especially, Dorotea “Doro” Frank Kersch, for her laughs and her high spirits. Thank you for all the encouragement and for giving me all the support during the visiting period at Norway. I admire you and I am very proud to work with you.

Ju Suzin, thank you for your every hour partnership. We support each other several times, and work with you makes everything more fun. Undoubtedly this partnership has turned into a great friendship.

To my advisor, Cláudia Cristina Bitencourt (Claudinha), who chose me and hugged me. I confess that words are missing to describe how your way of working, and all your knowledge inspired and encouraged me. What I most heard from you was "But it's terrific, see?" and "You have a super thesis." You turned the process lighter.

In the middle of this journey, Kadigia Faccin became part of it. First as a member of the qualifying board and then as co-advisor. In the “spaghetti of our relationships”, I learned and learn a lot from you — a super partner of research and travel. I'm sure I have more than advisors. I have friends which I'm going to take in my heart. Thank you both!

To doctoral colleagues, classroom discussions, and academic, technical, and sometimes "psychological" support throughout this journey. Ana, Bel, Tati, I loved our "teen" nights at Hotel 10. Alexander, thank you for the partnership, together with Jefferson, in a different line of research, but that makes us even more qualified. I wish us all success!!!

To CAPES, for financial support for the visiting period at the University of Stavanger.

To Professor Tatiana Iakovleva, for the reception and guidance, even before the visiting period at Stavanger University, and for inviting me to participate in the project that culminated in the book. Her follow-up made me, without a doubt, a better researcher, and I am very proud of the partnership that was born from there. Let it belong!!!

To Professor John Bessant, for his time and contribution in the discussion about the connection between dynamic capabilities and responsible innovation, as well as for the reflections on the participation of the companies under study.

To Elisa Thomas, my cicerone in Stavanger. Super research partner. Thank you for welcoming from the beginning, and helping me with small details such as buying the bus ticket or choosing the best neighborhood to live in. I won't forget our polyglot lunches, afternoon teas with cake, and city tours on weekends.

To my friends, especially the people of “ZS”, for never giving up inviting me, even though you knew I would deny it almost always. I'm coming back!

To Elisa Priori, for the latest review of the work and academic conversations over the years.

To my parents, Clo and Nena, for always encouraging us and supporting studying and chase our dreams. Mainly because they are an example, throughout my life, of honesty, respect, and love. I'm very proud to be your daughter. This thesis is for you!

My little sister, already a Ph.D., Paula, for inspiration, support, partnership in articles, and academic conversations. I take this opportunity to apologize to the three of you for my almost total absence in those four years. I love you!

Finally, my special thanks to my greatest supporter. Thank you for all the breakfasts, lunches, and dinners. For celebrating the small achievements and stages of the doctorate. For accompanying me on the world trips to data collection or congresses. For being the shoulder in the hours of tiredness. For understanding my absence on weekends and being around when I needed to. X, I love you! Now I'm going up again in the back of the motorbike. Take me to the road!

"I want to give the audience a song they can perform."

(Brian May, Queen guitarist)

ABSTRACT

The traditional development of innovation often generates unknown impacts. The search for responsible innovation establishes the management of (external) stakeholders' interests as a way to minimize uncertainty and maintain or develop a competitive advantage. Also, there is a concern with ethical, social, and environmental aspects. The inclusion of stakeholders during the responsible innovation process enables the integration of new and significant knowledge. For inclusion to be leverage, dynamic capabilities are required. This thesis analyzed how dynamic capabilities leverage the inclusion of stakeholders in the innovation process. Two equipment developer companies from the healthcare sector, recognized worldwide, were analyzed. The sector was chosen by the potential to provide high-quality solutions that offer better results and reliability, improving productivity and service to patients. The analysis of the cases pointed to specific processes and routines for the inclusion of stakeholders, which constitutes the microfoundations of dynamic capabilities. The particular processes and routines are cocreation, memory creation, strategic partnerships, active participation in events, systematic observation of product use, encouraging training and qualification of users, and the establishment of multiple communication channels. From the microfoundations, generic and specific dynamic capabilities were identified, which leverage the inclusion. The comparative analysis of the cases pointed to four propositions: (1) The inclusion of stakeholders occurs throughout the responsible innovation process, favored by the Stage-gate model; (2) the inclusion of stakeholders in the responsible innovation process requires particular processes and routines; (3) the generic dynamic capabilities of *sensing, seizing* and *transforming*, and the specific dynamic capabilities, relational and Integrative knowledge, based on particular processes and routines, leverage the inclusion of stakeholders in the process of responsible innovation; and (4) specific dynamic capabilities contribute to greater responsible innovation maturity. Theoretical contributions stand out as the approximation of the theoretical lens of dynamic capabilities to the context of responsible innovation. Specifically, about dynamic capabilities, the possibility of operationalization is demonstrated, from its microfoundations. The concept of generic dynamic capabilities is developed – which leverage various processes, and specific dynamic capabilities – that leverage a given

process. Empirical advances are mainly due to detailing the inclusion process, considered to be one of the governance aspects of responsible innovation. Another increase is to demonstrate to entrepreneurs and managers the case of global companies in the healthcare sector, recognized for responsibility in innovation. A responsible innovation governance model was also developed, inspired by the Canvas model, which contributes to companies evaluating and seeking responsible innovation development.

Keywords: Responsible innovation. Dynamic Capabilities. Stakeholder. Inclusion. Healthcare.

RESUMO

O desenvolvimento tradicional da inovação gera impactos muitas vezes desconhecidos. A busca pela inovação responsável estabelece o gerenciamento dos interesses de stakeholders (externos) como uma maneira de minimizar a incerteza e manter, ou estabelecer, vantagem competitiva. Além disso, há uma preocupação com aspectos éticos, sociais e ambientais. A inclusão de stakeholders durante o processo de inovação responsável possibilita a integração de novos e significativos conhecimentos. Para que a inclusão seja potencializada, são necessárias capacidades dinâmicas. A presente tese analisou como as capacidades dinâmicas potencializam a inclusão de stakeholders no processo de inovação. Foram analisados dois estudos de caso, de empresas desenvolvedoras de equipamentos para o setor de saúde, reconhecidas mundialmente. O setor foi escolhido pelo potencial em fornecer soluções de alta qualidade, que proporcionem melhores resultados e confiabilidade, melhorando a produtividade e o serviço prestado aos pacientes. A análise dos casos apontou para processos e rotinas específicos para a inclusão de *stakeholders.* que constituem microfundamentos de capacidades dinâmicas. Os processos e rotinas específicos são: cocriação, criação de memória, parcerias estratégicas, participação ativa em eventos, observação sistemática do uso de produtos, estímulo ao treinamento e capacitação de usuários, e o estabelecimento de múltiplos canais de comunicação. A partir dos microfundamentos, foram identificadas as capacidades dinâmicas, genéricas e específicas, que potencializam a inclusão. A análise comparativa dos casos apontou para quatro proposições: (1) A inclusão de *stakeholders* ocorre ao longo do processo de inovação responsável, favorecida pelo modelo Stage-gate; (2) A inclusão de stakeholders no processo de inovação responsável requer particulares processos e rotinas; (3) As capacidades dinâmicas genéricas de *sensing, seizing e transforming*, e as capacidades dinâmicas específicas Relacional e Integrativa de Conhecimento, a partir de processos e rotinas específicos, potencializam a inclusão de *stakeholders,* no processo de inovação responsável; e (4) capacidades dinâmicas específicas contribuem para uma maior maturidade de IR. Destacam-se como contribuições teóricas a aproximação da lente teórica das capacidades dinâmicas ao contexto de inovação responsável. Especificamente sobre capacidades dinâmicas, se demonstra a possibilidade de operacionalização, a partir de seus microfundamentos. Também é desenvolvido o conceito de capacidades

dinâmicas genéricas – que potencializam diversos processos, e capacidades dinâmicas específicas – que potencializam um determinado processo. O avanço empírico se dá, principalmente, através do detalhamento do processo de inclusão, considerado um dos aspectos de governança da inovação responsável. Outro avanço é demonstrar para novos empreendedores e gestores o caso de empresas globais, do setor de saúde, reconhecidas pela responsabilidade na inovação. Também foi desenvolvido um modelo de governança da inovação responsável, inspirado no modelo Canvas, que contribui para que empresas se auto avaliem e busquem o desenvolvimento responsável de inovações.

Palavras-chave: Inovação responsável. Capacidades Dinâmicas. *Stakeholder*. Inclusão. Saúde.

LIST OF FIGURES

LIST OF TABLES

LIST OF ABREVIATIONS

AAP	American Academy of Pediatrics
AHA	American Heart Association
ALARA	As low as reasonably achievable
ASD	Autism spectrum disorder
BHF	British Heart Foundation
CSC	Customer Service Center
CMOS	Complementary metal-oxide-semiconductor
CPR	Cardiopulmonary resuscitation
CVA	Cerebrovascular accident
DC	Dynamic capabilities
DNP	Development of new products
ERP	Enterprise resource planning
ESU	Energy storage unit
FAU	Friedrich-Alexander University
IC	Integrative capability
IKC	Integrative knowledge capability
KM	Knowledge management
MVP	Minimum viable product
NGO	Non-governmental organization
NLN	National Leaghe for Nursing
NRP	Newborn resuscitation program
OR	Operation room
QCPR	Quality cardiopulmonary resuscitation
R&D	Research and development
RBV	Resource-based view
RI	Responsible innovation
RQI	Resuscitation quality improvement
RRI	Responsible research and innovation
SAFER	Stavanger Acute Medicine Foundation for Education and Research
SDG	Sustainable development goals
SUN	Simulation user network

TIS	Technological innovation system
UFRGS	Universidade Federal do Rio Grande do Sul
UNISINOS	Universidade do Vale do Rio dos Sinos

CONTENTS

1 INTRODUCTION

> If we can create value to the society at large, and do our job well, satisfactory economic results will follow – and allow us to build a stronger company with time.
> (Åsmund S. Laerdal[1])

Innovation brings with it the search for economic development (SCHUMPETER, 1912), which also requires attention to the environmental, social, and ethical impacts it can generate. In the environmental context, the innovation of new sources of heat and energy, developed through biofuels, for example, raises some questions. The most recurrent and discussed are related to the use of land and other natural resources, such as water, for biomass production, to the detriment of food production (SHORTALL; RAMAN; MILLAR, 2015). In the social and ethical context, health has some examples of innovation that generated disastrous results. A 2018 documentary, The Bleeding Edge (translated in Portuguese as *Operação Enganosa*), presents cases such as a permanent device for birth control, from Bayer, and a chrome-cobalt hip prosthesis that brought irreversible damage to the health of patients who used it (OPERAÇÃO ENGANOSA, 2018). Due to the significant repercussions of the documentary, Bayer removed the birth control device from the American market, suffering economic losses, accumulated to those sustained by the account of the legal proceedings of patients who used the device (KIEFER, 2018).

These few examples demonstrate that despite the legitimate interest in the development of innovations aimed at the common good, their impact may be unknown. This uncertainty results in an increasingly uncertain business environment.

Managing the interests of the stakeholders is one of the ways to minimize uncertainty, in addition to maximizing the performance of companies (WELCOMER et al., 2003). Stakeholders are any group or individual who may affect or be affected by the fulfillment, or not, of the objectives defined by the organization (FREEMAN, 1984; KRETZER, 2010).

---

[1] Laerdal Medical founder.

By strengthening the relationship with stakeholders, significant competitive advantages can be obtained through trust, reputation, and innovation (RODRIGUEZ; RICART; SANCHEZ, 2002). Based on this approximation, it is analyzed the relationship between the business and society, from the point of view of sustainable development, which emphasizes values such as participation, inclusion, and mutual dependence (WHEELER; COLBERT; FREEMAN, 2003).

The relationship with stakeholders is connected to the responsible research and innovation (RRI) phenomenon, or simply, responsible innovation (RI), which considers the ethical, social, and environmental contexts of innovation (HEMPHILL,2014). More recently, literature has fragmented the term “responsible innovation,” connected primarily to companies’ contexts, and “responsible research and innovation,” aimed at research and public policies (OFTEDAL; FOSS; IAKOVLEVA, 2019). From this dichotomy and aligned with the objective of this research, the context is exclusively related to RI.

Stakeholder participation in this process is considered essential for expanding visions and purposes through processes of dialogue, engagement, and debate, inviting and listening to broader perspectives of audiences, as well as several stakeholders (OWEN et al., 2013; STAHL, 2013). Under this lens, the participation of researchers, research organizations, research ethics committees and their members is demanded, as well as users of research and innovation, civil society at different levels with political decision-making powers, professionals, legislators, educational organizations, and public bodies (STAHL, 2013).

From an organizational perspective, the inclusion of stakeholders in the innovation process requires aligning stakeholder interests with the objective of long-term value creation. To this end, organizations must develop, apply, and maintain the necessary management skills to address the concerns and needs of stakeholders over time (AYUSO; RODRÍGUEZ; RICART, 2006). Participation must have a strategic character for the organization, mobilizing resources (human, physical organizational), creating processes or modifying current ones, and stipulating a new organizational dynamic for the appropriation of knowledge that will be generated. In this context, dynamic capabilities (DCs) can contribute to leverage RI from the inclusion of stakeholders.

A company that responsibly develops innovation is oriented by four key elements (governance dimensions): anticipation, inclusion, responsiveness, and reflexivity (VAN OUDHEUSDEN, 2014). The inclusion of stakeholders is one of the most researched aspects. However, the full inclusion of society (for example, local communities and citizens) is little explored (LUBBERINK et al., 2017). This observation reinforces the fact that organizations mainly involve stakeholders who share values, or similar stakeholders, motivated to align their interests with a shared goal of innovation.

Empirical evidence is still scarce (BLOK; HOFFMANS; WUBBEN, 2015). For the inclusion of multiple stakeholders, even if with different interests, to be effective in the context of innovation, especially with regard to costs and processes, the inclusion process needs to be institutionalized. Only when institutionalized, inclusion becomes a new organizational capacity (PANDZA; ELLWOOD, 2013; SCHUMACHER; WASIELESKI, 2013).

Owen at al. (2013) doubted whether there were (at the time of development of their studies) examples of systematic RI structure, and that was institutionally incorporated into the operation. A recent study of Silva at al. (2019) confirms Blok at al.' (2015) findings, who identified that most RI studies focus on research and academic development, pointing out a gap in studies developed by organizations of the private sector. Blok at al. (2015) still highlight that in the current studies, the limitations for the engagement of stakeholders in the RI process in these organizations are not considered and can also slow down the process due to inclusion (OFTEDAL; FOSS; IAKOVLEVA, 2019).

Dynamic contexts such as innovation require definition and management resources through capabilities as well as dynamics (TEECE; PISANO; SHUEN, 1997). These capabilities expand the company's competitive advantage through internal resources and their relationship with the external environment (LEONARD-BARTON, 1992; TEECE; PISANO; SHUEN, 1997).

It is from this gap that the present thesis is presented, which maintains that the inclusion of stakeholders in a responsible innovation process requires dynamic capabilities (DCs).

The original concept of DCs was coined by Teece, Pisano, and Shuen (1997, p. 516), who consider them as the "the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments."

Integrating, building, and reconfiguring refer to the nature (or types) of DCs: *sensing* of opportunities and threats; *seizing* of opportunities detected; and, ultimately, remodeling of processes and resources, through *transforming*.

The development of innovation requires that companies simultaneously integrate internal and external information and knowledge of employees, customers, competitors, and the media to improve their knowledge base performance and innovation performance (LIN; CHE; TING, 2012). The external flow of knowledge needs to be assimilated and integrated into unique processes of knowledge and organizational innovation (MARTÍN-DE CASTRO, 2015). Therefore, additional dynamic capabilities to *sensing, seizing* and *transforming* must be developed by the companies.

Absorptive capability (AC), understood as the company's capability to acquire, assimilate, and apply knowledge for commercial purposes (COHEN; LEVINTHAL, 1990; ZHARA; GEORGE, 2002), stands out in studies on the integration of this external knowledge (WEST; BOGERS, 2014). However, some studies suggest that AC reduces the need for collaboration (BARGE-GIL, 2010), as it points out that remote collaboration is more effective (DE JONG; FREEL, 2010; LAURSEN; SALTER, 2006).

Through the AC, the knowledge of stakeholders can be generated far from the innovation process, rendering their participation “invisible.” Despite the recognition of the importance of AC, especially in the context of responsible innovation (LUBBERINK et al., 2017), the inclusion of stakeholders provides greater proximity throughout the process, requiring specific dynamic capabilities.

Based on a case study in two companies that developed healthcare equipment, triangulation of data, collected through interviews, document analysis, and non-participant observation, was performed. Both companies are globally recognized in their expertise areas.

The results of the thesis highlight the **Relational** and **Integrative of Knowledge** DCs that – together with *sensing*, *seizing*, and *transforming* – leverage the inclusion of stakeholders in the RI process.

More specifically, the findings suggest, on one hand, that the capabilities of *sensing, seizing* and *transforming* are considered **generic capabilities**, once they are allusive to any process (in dynamic environments) (TEECE, 2007). On the other hand,

Relational and Knowledge Integration DCs are considered **specific capabilities** for the inclusion of stakeholders in the context of RI.

1.1 DEFINITION AND SCOPE OF THE RESEARCH PROBLEM

RI is preliminarily related to responsible research, which most recently entered the agenda of studies in the area of management and business (OWEN; MACNAGHTEN; STILGOE, 2012; ROBINSON, 2009; STILGOE; OWEN; MACNAGHTEN, 2013). The main studies address RI from the perspective of governance (STILGOE; OWEN; MACNAGHTEN, 2013) and public policies (OWEN; MACNAGHTEN; STILGOE, 2012).

The term Responsible Research and Innovation (RRI) appeared in 2002, in the 6th EU Framework Program for Research and Technological Development (FP6), from a set of EU actions to finance and promote research (EUROPEAN COMISSION, 2008). In the document, responsibility is linked to ethical issues (creating networks between existing bodies and activities, fostering dialogue in a global context, raising awareness, training and ethics research about science and technology), and the uncertainty, risk, and principle of precaution (analysis and best practices). However, processes and tools were already in use before that, such as the actions of the French philosopher Michel Serres who, around 1972, invited other philosophers to work together with scientists and engineers in technical and scientific development (BURGET; BARDONE; PEDASTE, 2017). However, responsibility for innovation is still little explored, being restricted to only a few studies, such as that of Aloise (2017), which analyzes the ethical parameters of organizations about sustainability and environmental innovations.

Responsibility in research and innovation is motivated by the global concern for the planet, its natural resources, and a fair and inclusive society (UN, 2015). This concerns governments, which can act through policies and regulations, even if they are still in the development stage (SCHERER; PALAZZO; BAUMANN, 2006). It also concerns the private sector, aligning the demands of research and development (R&D) with society's values, needs, and expectations (BURGET et al., 2017).

The concept of RRI is related to responsible development. It is a consequence of previous discussions about the ethical, legal, and social implications of research and research integrity (OWEN et al., 2012):

> Responsible Research and Innovation is a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view on the (ethical) acceptability, sustainability and societal desirability of the innovation process and its products (in order to allow a proper embedding of scientific and technological advances in our society). (VON SCHOMBERG, 2012, p. 280).

In fact, RRI aims to shape, maintain, develop, coordinate and align existing and innovative processes, actors and responsibilities related to innovation and research, to seek desirable and acceptable research results (STAHL, 2013). It, therefore, consists of developing new products and services that combine growth, performance, and responsibility. This responsibility is directed at customers and users, as well as the whole ecosystem (PAVIE; CARTHY, 2015).

Despite the ethical, social, and environmental context in which RI is inserted (HEMPHILL, 2014), the process of innovation development follows the stages of traditional technological innovation. Because it is a complex process, product/service development requires the management of several factors at different stages. In general, it starts from the generation of the concept (sketch design) until the product launch (on the market), passing through design and testing (TIDD; BESSANT, 2014). For Tidd and Bessant (2014), the management of the innovation process involves “the integration of sets of knowledge across organizational, functional and disciplinary boundaries” (TIDD; BESSANT, 2014, p. 471). The Stage-gate and Agile-Stage-gate models (COOPER, 2008; 2016) provide, in addition to the scope stages, construction of the business case, development, testing and validation, and launch. The models also present decision points (gates), which represent the moments where the process can be interrupted or moved onto the next stage. Both models considered the participation of the client/user throughout the process and were observed in the analyzed cases (Siemens: stage-gate; and Laerdal: Agile-stage-gate).

The participation of different external stakeholders can stimulate the generation of new knowledge, which must be integrated into the innovation process. This participation is one of the main assumptions of RI, which aims to expand visions, purposes, issues, and dilemmas for a collective deliberation through processes of

dialogue, engagement, and debate (OWEN et al., 2013). This participation intends to develop greater democratic responsibility in the innovation life cycle (EDEN; JIROTKA; STAHL, 2013). Assistance can be aimed at achieving normative, instrumental, or substantive objectives (SYKES; MACNAGHTEN, 2013), either in the early stages of development (BURGET; BARDONE; PEDASTE, 2017) or when innovation has already been developed and is on the market (OWEN et al., 2013; STILGOE; OWEN; MACNAGHTEN, 2013).

External stakeholders are considered social and political actors who play a fundamental role in the credibility and acceptance of business activities (AYUSO; RODRÍGUEZ; RICART., 2006). The inclusion process investigated in this thesis considered only external stakeholders, who will be called, from now on, stakeholders.

How this participation is conducted does not follow a standard path and may vary according to the nature and flow of information between those responsible for the inclusion process and the participants. According to this flow, the effectiveness of this process can be determined by how efficiently complete and relevant information is obtained from all appropriate sources, transferred to (and processed by) those responsible and combined (when necessary) to generate a response or reconfiguration of the model initially proposed (ROWE; FREWER, 2005).

Obtaining, transferring, and combining information obtained through stakeholder participation refers to the (dynamic) capabilities that the company develops, through organizational processes – microfoundations – based on reorganization and evolution over time (ROBINSON, 2009; TEECE, 2007; TEECE; PISANO; SHUEN, 1997).

Microfoundations refer to:

> distinct skills, processes, procedures, organizational structures, decision rules, and disciplines—which undergird enterprise-level sensing, seizing, and reconfiguring capabilities are difficult to develop and deploy. (TEECE, 2007, p. 1319).

Several studies indicate that stakeholder participation occurs only when innovation is already on the market, serving as a basis for changes, whether in the product developed (for example, assisted technology for patients with dementia) (DECKER et al., 2017) or in an innovation paradigm (for example, biofuel production) (SHORTALL; RAMAN; MILLAR, 2015).

Late inclusion (in the latter stages) may reflect a management problem within organizations, which are unable to direct resources and establish processes for systematic stakeholder participation. For participation to take place in the different stages of new product development (NPD), or the innovation process, it is necessary to develop processes and routines, leveraged by specific DCs.

DCs encourage the company to learn new approaches and abandon old ones through new knowledge components, such as new technologies, new markets, and regulatory and environmental conditions (BESSANT, 2013). But this learning depends on an interactive, inclusive, and open process of adaptive learning based on DCs, which can be expensive and without guarantees of success (SCHROEDER et al., 2016).

Despite this restriction, there are cases of successful companies, such as Siemens and Laerdal, recognized companies in the healthcare sector, who have strong relationships with stakeholders, in addition to anticipating, reflecting, and responding to their actions. Both companies have developed dynamic capabilities that leverage the inclusion of stakeholders in the innovation process and represent the case studies of this thesis.

The healthcare sector has encouraged companies and researchers to develop innovations based on the participation of the patient or user. The importance of this can be highlighted by investment in the sector: Many countries have spent around 10% of their gross domestic product (GDP), and this situation will worsen due to the aging of the population, rising prices, and increasing complexity of technology in health (BESSANT et al., 2017). It becomes more critical to know that between 20% and 40% of health spending is wasted due to inefficiency (WHO, 2010).

On the other side, technological evolution has allowed significant advances in the area, either through the use of artificial intelligence to improve the quality of diagnostics or through the use of nanotechnologies (PAUTLER; BRENNER, 2010; WATSON, 2017). Newer initiatives work on digitizing healthcare, which encompasses several distinct technologies, including decision support systems that use algorithms derived from clinical mining data sets, mobile healthcare apps, connected biometric sensors, telemedicine, and personal electronic health records. Digitization, in 2017, was already worth the US $25 billion globally, with the potential to reduce healthcare

costs by about the US $7 billion per year in the United States alone (DUGGAL; BRINDLE; BAGENAL, 2018).

Patient empowerment in the health context was the subject of a book, organized by Iakovleva, Oftedal, and Bessant (IAKOVLEVA; OFTEDAL; BESSANT, 2019), which present examples of this inclusion. The study by Mulloth and Williams (2019) is noteworthy, as it analyzed how the health systems of a university medical center can take advantage of the benefits of health technologies in a responsible manner to better manage patients and improve their results using patient-enabled tools. Thomas and Silva (2019) analyzed how companies manage knowledge in the process of including stakeholders.

Although several studies highlight the importance of including stakeholders (CHESBROUGH, 2003; LIS & SUDOLSKA, 2015; DE ANA et al., 2013; BESSANT et al., 2017), including those that address the co-creation process, none describes explicitly and deeply the process of including stakeholders during the innovation process (SILVA, 2019).

Therefore, based on the premises of the need to include stakeholders throughout the innovation process and the development of established organizational processes that contribute to a better use of the knowledge generated from such inclusion (TEECE; PISANO; SHUEN, 1997; ROBINSON, 2009; TEECE, 2007; STILGOE et al., 2013; OWEN et al., 2013), this study seeks to answer the question: **How do dynamic capabilities leverage the inclusion of stakeholders in the responsible innovation process?** In answering this question, the thesis seeks to deepen the contribution to specific dynamic capabilities developed by companies recognized for the development of responsible innovations.

1.2 OBJECTIVES

This section presents the main and specific objectives of this research.

1.2.1 Main Objective

Analyze how dynamic capabilities leverage the inclusion of stakeholders in the responsible innovation process.

1.2.2 Specific Objectives

The specific objectives that guide this thesis are:

a) To relate the stages of the innovation process to the Stage-gate model;

b) To identify the stage (s) of the innovation process where stakeholders are included;

c) To identify and describe the processes and routines that support the inclusion practices of the stakeholders involved in the innovation process; and

d) To identify and analyze the dynamic capabilities that leverage the inclusion of stakeholders.

1.3 JUSTIFICATION

This study is justified by its theoretical and empirical contributions, as described below.

1.3.1 Theoretical contributions

This thesis advances scholarship in this field by linking the theoretical lens of dynamic capabilities to the phenomenon of RI, since only a limited number of studies that make this connection exist. The connexon between DC and RI Is established from the creation, or identification, of processes and routines. From there, dynamic capabilities belonging to the organization are developed, which leverages the RI process systematically and continuously. Managers assume a more central role as intentional agents that mitigate between external changes and the reconfiguration of internal capabilities (PANDZA; ELLWOOD, 2013). The development of dynamic capabilities influences the performance in the dimensions of responsiveness and anticipation (VAN de POEL; ASVELD; FLIPSE; KLAASSEN; SCHOLTEN; YAGHMAEI, 2017).

In addition to the intentionality and anticipation in responding to demands, the dynamic **relational and integrative knowledge** capabilities refer to how the investigated companies – Siemens and Laerdal – are able to select, relate, and collect information, absorb and transform their innovation process, and, finally, offer value to stakeholders and society, through quality products and services geared to the

customer/user. The incentive and creation of procedures for learning, sharing, and integrating knowledge are critical for business performance and a dynamic resource base (TEECE, 2007).

This thesis also advances in the theory of dynamic capabilities, through the operationalization of dynamic capabilities within the context of responsible innovation, in response to criticisms of the model proposed by Teece, Pisano, and Shuen (1997), that the model is generic and that there is a difficulty of tangibility. Authors such as Priem and Butler (2001) and Williamson (1999) consider DCs to be tautological and non-operational, describing them as “routines for learning routines” (EISENHARDT; MARTIN, 2000).

Finally, a categorization of the microfoundations that support, and leverage generic and specific dynamic capabilities was developed to promote the inclusion of stakeholders throughout the RI process.

1.3.2 Empirical contributions

In addition to the theoretical advancements, this study brings empirical contributions related to responsible innovation and the development of DCs.

Although recent, the subject of RI is relevant, especially in the national context. In Brazil, investments in innovation increased significantly, despite the recent economic crisis, also pointing to an increase in the participation of suppliers and customers in the development process (IBGE, 2016). It contributes empirically through the result of the analysis of cases of global companies, recognized for their products and responsibility for innovation.

The details of the stakeholder inclusion process, one of the pillars of RI, can serve as an inspiration, or model for entrepreneurs and organizations interested in developing new products. The identification of specific processes and routines for the inclusion of stakeholders at each stage of the innovation process contributes to companies that seek to build their particular dynamic capabilities.

A model of the dimensions of governance was also developed, inspired by the Canvas model, which can help companies assess whether they meet the aspects of anticipation, reflexivity, inclusion, and responsiveness – the basis for the development of responsible innovation.

Finally, it demonstrates the importance of the healthcare sector and how the development of new processes and routines can contribute to the generation and expansion of the impact of innovations in this area, which can reduce costs and increase gains in scale in the service.

1.4 THESIS STRUCTURE

In this first chapter, the topic is introduced, and the research problem, objectives, justification, and expected contributions are presented. The terminologies and concepts that underlie the present thesis are highlighted in Table 1, which will guide the following chapters.

Table 1 - Terminologies and guiding concepts of the thesis

Terminologies	**Concepts**	**References**
Responsible Innovation (RI)	Responsible Research and Innovation is a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view on the (ethical) acceptability, sustainability and societal desirability of the innovation process and its products (in order to allow a proper embedding of scientific and technological advances in our society).	Von Schomberg (2012, p. 280)
Dynamic Capabilities (DC)	The firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments.	Teece, Pisano and Shuen (1997, p. 516)
DCs Microfoundations	Distinct skills, processes, procedures, organizational structures, decision rules, and disciplines—which undergird enterprise-level sensing, seizing, and reconfiguring capabilities are difficult to develop and deploy.	Teece (2007, p. 1319)
Innovation process (based on *Stage-gate* model)	Plan to manage the new product development process (NPD) to improve effectiveness and efficiency.	Cooper (2008, p. 214)
Stakeholder (external)	Any group or individual that may affect or be affected by the fulfillment, or not, of the objectives defined by the organization.	Freeman (1984) Kretzer (2010)

Source: by the author.

Subsequently, the second chapter presents the theoretical basis used in the research. The third chapter describes the methodology used. The theoretical foundations of the method are described, as well as the stages of data collection and analysis. The fourth chapter presents the description and analysis of the cases. The fifth chapter presents a comparative analysis of the cases, as well as a discussion on the dynamic capabilities that enhance the inclusion of stakeholders in the RI process. Finally, the sixth chapter presents the final considerations of the thesis, highlighting the conclusions and theoretical and empirical contributions, in addition to the limitations of the study and suggestions for future research.

2 THEORETICAL FOUNDATION

This chapter presents the theoretical foundation that supports this thesis. Content on innovation and the phenomenon of responsible innovation are addressed, as well as the theoretical lens of dynamic capabilities. Finally, the aim is to establish a connection between the themes, dynamic capabilities and responsible innovation, as well as the DC microfoundations developed for the inclusion of stakeholders in the RI process.

2.1 INNOVATION

The search for innovation is not recent, having as a precursor the studies of Schumpeter (1912), who considered that the economic development would only happen through new combinations. These combinations could occur through the production of new goods, an original production method, a new market, a new source of income, or even through the establishment of a new organization.

It was based on Schumpeter (1912) that the contemporary accepted concept of innovation was designed, presented in the Oslo Manual (OECD, 1997, p. 55), which provides that

> an innovation is a new or improved product or business process (or combination thereof) that differs significantly from the firm's previous products or business processes and that has been introduced on the market or brought into use by the firm.

The development of innovation is a non-linear process. It is characterized by the learning processes of actors about artifacts and participants (ROBINSON, 2009).

These actors recognize the need for a clear regulatory framework as a tool for making strategic decisions (D'SILVA; ROBINSON; SHELLEY-EGAN, 2012). Many of these decisions concern the governance of the process, which refers to how society participates, or not, in the innovation process and what social and environmental impact it can generate. These aspects are intrinsically related to the concept of responsible innovation.

RI is guided by technological innovations, which are based on technology-based inventions, to achieve commercial success. In this context, the companies' strategy is to develop new products for new market segments, seeking to generate sustainable

economic growth (GARCIA; CALANTONE, 2002; O'CONNOR, 1998; TEECE et al., 1996).

This innovation can be radical when it incorporates a new technology that results in new market infrastructure (O'CONNOR, 1998). It can also be moderately innovative when they consist of new lines for the company, but which are not new to the market, as well as new items in existing product lines for the company (KLEINSCHMIDT; COOPER, 1991). Still, it can represent an incremental innovation, which involves adaptation, refinement, and improvement of existing products or in production and delivery systems (SONG; MONTOYA-WEISS, 1998).

Regardless of the type of innovation (radical, moderate, or incremental), the primary purpose is the generation of technological development, which has some fundamental characteristics (TEECE et al. 1996), briefly described below:

- Uncertainty: changes in technologies and markets (TIDD, 2001);

- Path dependence: the historical sequences in which certain events change patterns (MAHONEY, 2000);

- Cumulative nature: technological progress is built on what happened before;

- Irreversibility: Since it requires specialized investments, it is not possible for a specific technology, defined through a particular trajectory, to compete with older technologies.

- Technological interrelationship: it relates to several subsystems;

- Tacit knowledge - the development of technology must be based on organizational routines (NELSON; WINTER, 1982) since they are the essence of technological, organizational capability;

- Inappropriate - property rights associated with technical knowledge are often ambiguous and temporary.

Such characteristics influence the organizational structure, the innovation management processes (TIDD, 2001), as well as the stages of innovation development.

2.1.1 Innovation Development Process

The development of innovation is not a singular event, but a series of connected activities. It can be described as a process and involves responding to a context-

dependent need or opportunity. It also comprises a creative effort that results in the introduction of a novelty, which will be modified in the future (TROTT, 2012).

Over time, several models of innovation development have been designed based on different approaches (Table 2).

Table 2 - Innovation development models

Model	Characteristic	Process Flow	Author (s)
Departmental-stage model	Series of movements in and out of each department.	Orderly and logical process	Robertson (1974)
Activity-stage model	Complex network of communication paths that link the various stages.	Orderly and logical process	Rothwell e Robertson (1973); Baker e McTavish (1976)
Decision-stage model	Number of options available and lack of information on which to base decisions.	Orderly and logical process	Cooper e More (1979)
Conversion process model	"System" in terms of inputs and outputs.	Non-plannable and non-rational process	Shon (1967); Twiss (1980)
Response model	Stages involved in developing a company "response" to some external or internal stimulus.	Non-plannable and non-rational process	Becker e Whisler (1967)

Source: Adapted from Saren (1984).

Despite the diversity of approaches, there is no “best model.” There is one that best matches the requested proposal (SAREN, 1984). Each of them looks at the innovation process from a unique perspective, with the methods developed through an orderly and logical flow prevailing.

Over the years, generations of innovation models have emerged. Tidd (2006), presents the key factors of each one of them (Table 3):

Table 3 - Generations of innovation models

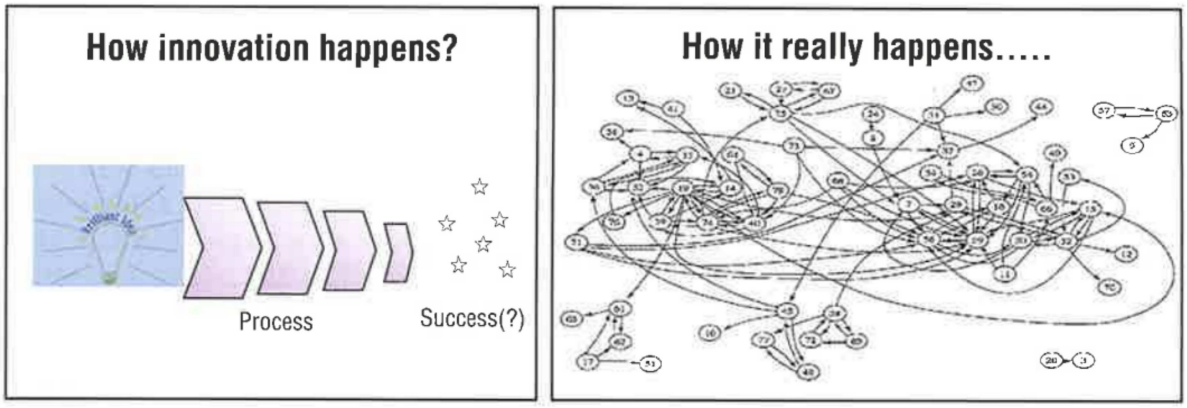
Generation	Key factors
First and Second	linear models need to pull and push technology
Third	interaction between different elements and feedback loops (coupling model)
Fourth	the parallel line model, the integration within the company, upstream with the main

	suppliers and downstream with the customers
Fifth	extensive network and systems integration, flexible and personalized response, continuous innovation

Source: Tidd (2006).

More recently, it is clear that there is a trend towards less linear models, as proposed by Berkhout, Hartmann, and Trott (2010), who have a multidisciplinary view of the change process (and its interactions), in the context of open innovation, where they are connected behavioral sciences and engineering, as well as natural sciences and the market. From the Schon model (1967) to the most current ones, innovation does not occur linearly within the company. Bessant and Tidd (2007) represent the process very well, through the so-called “spaghetti” of innovation (Figure 1).

Figure 1 - Innovation spaghetti model

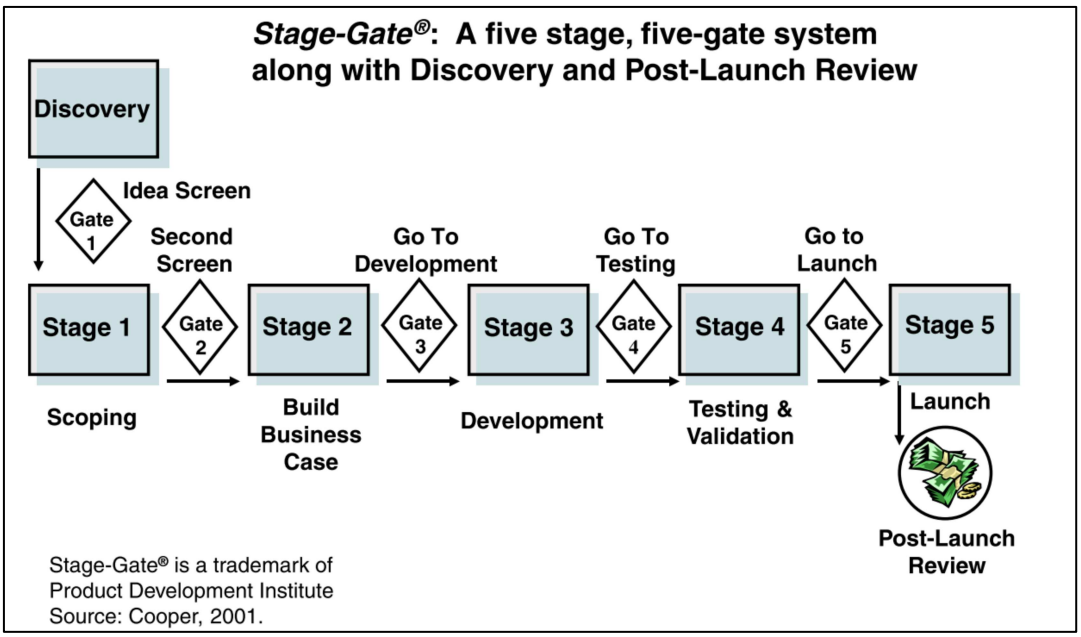


Source: Bessant e Tidd (2007, p. 291).

Despite the inconstancy and real non-linearity of the flow, more recent studies present the innovation process in a structured way (FOUAD; TOURABI; LAKHNATI, 2018), obeying the stages of new product development (NPD).

From the perspective of NPD, the process requires clear stages ranging from the preliminary idea to its launch on the market. One of the leading models, previously presented, was proposed by Tidd and Bessant (2014), who describes it in four stages: outline design, detailed design, testing, and launch. Cooper (2008) proposes a more comprehensive model named Stage-gate, which considers five stages: the scope, the construction of the business case, the development, testing and validation, and, finally, the launch. Discovery (or idea generation) and post-launch review are presented in the model but are not considered stages of the process (Figure 2).

Figure 2 - Stage-gate model



Source: Cooper (2008).

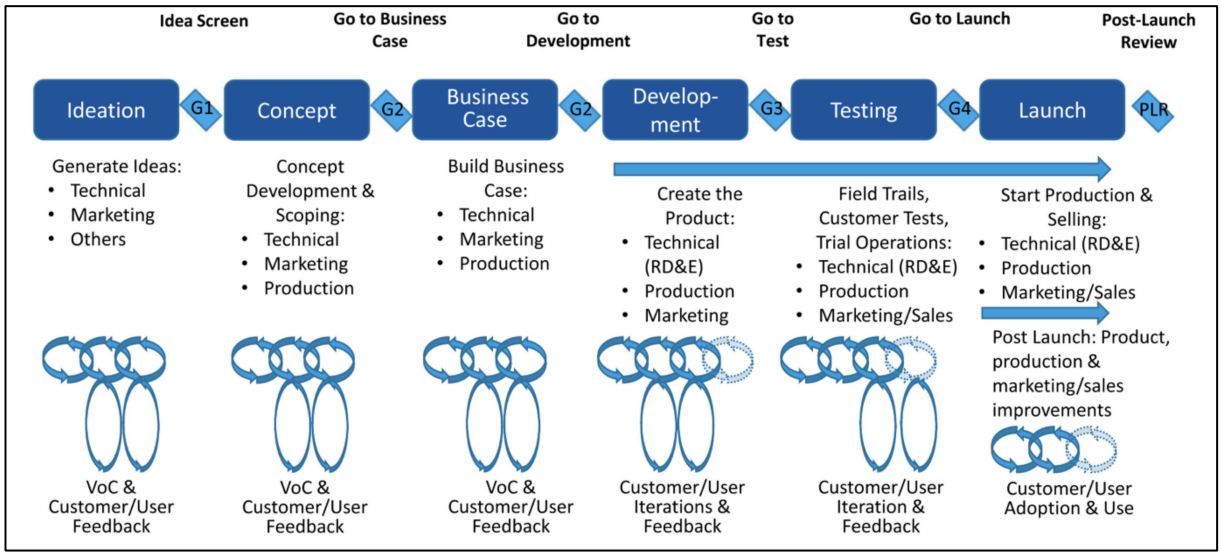
The model considers the stages common to the development of new products, which are composed of a group of activities, complemented by decision points (gates), or control points. The decision points also represent the moments when the process can be interrupted (go/kill strategy).

Following the proposition of the Stage-gate, which is when each stage ends with pre-defined milestones that must be reached to move on to the next stage of the development process, Schaarschmidt and Kilian (2014) present a framework with five stages: discovery, concept, development, testing, and marketing.

In addition, the NPD process is also subject to questioning (lack of empirical data) raised by some authors about its effectiveness in obtaining significant innovations. On one hand, four groups of NDP activities - strategic planning, market analysis, technical development, and product marketing - are decisive for the success of new products, regardless of whether they are radical or incremental innovations. But these activities can have different roles in each type of innovation (SONG; MONTOYA-WEISS, 1998). On the other hand, the organizational structure also plays a fundamental role in the kind of innovation that will be developed. Several companies have the same structure for radical or incremental NPD processes, despite the better performance in companies that have an inter-functional structure for radical innovations (DE VISSER, 2010).

More recently, Cooper (2016) proposed a hybrid model, used primarily in software companies and later adapted for the industry. Agile-stage-gate (Figure 3) combines the Stage-gate macro-planning process and agile methods, which "empathize with individuals over processes, working software over complete documentation, collaboration over contracts, and flexibility over planning." (COOPER; SOMMER, 2016, p. 168).

Figure 3 - Agile-stage-gate model

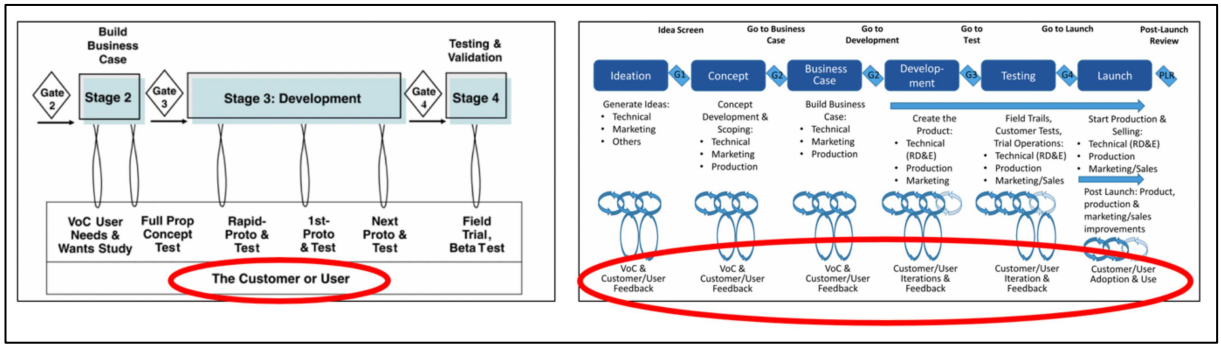


Source: Cooper; Sommer (2016).

The main advantages of the model relate to the development of the right product, through a prototype in the early stages (Sprint), quickly obtaining feedback from customers. Through this anticipation, uncertainty is minimized, accelerating development. The model also favors focused teams with improved communication (COOPER, 2016). Perhaps the most significant benefit is spiraling (build-test-feedback-review interactions), which makes the system more adaptive.

Both the Stage-gate and the Agile-stage-gate models highlight the importance of customer/user participation throughout its stages, as shown in Figure 4.

Figure 4 - Importance of the client / user in the Stage-gate e Agile-Stage-gate models



Source: Cooper (2008); Cooper; Sommer (2016).

The importance of customer/user participation refers to the inclusion dimension of the RI, which has its process guided by the more linear NPD models, which ended up becoming predominant (TROTT, 2012).

2.2 RESPONSIBLE INNOVATION

Responsible innovation evokes a collective duty of care: a commitment to rethinking the purposes and impacts of change, as well as the reflection on how to make your pathways sensitive to uncertainty (MEJLGAARD; BLOCH, 2012). This responsibility suggests, first, rethinking what you want from innovation and then how to make it raw in the face of uncertainty. When recognizing the role of change in the collective future, it is necessary to assess what kind of future is sought. It must be a much bigger project in ambition than the delivery of short-term policies (OWEN; MACNAGHTEN; STILGOE, 2012).

RI is gaining importance for its connection with the search for solutions to significant challenges, which can guarantee sustainable development through a fairer society, achieved through the integration of multiple stakeholders, such as governments, the private sector, and civil society, at the local, national and global levels (NUNES; LEE; O'RIORDAN, 2016). Such challenges refer to a higher perspective and quality of life (HINDE, 2008).

The most used concept is proposed by Von Schomberg (2012) (presented in the Introduction chapter, p. 23). Stahl (2013), in turn, introduced a new concept, which, according to him, is consistent and comprises the definitions most cited at the moment,

recognizing, however, the history of activities related to RI. For Stahl (2013, p. 1), responsible innovation is

> a higher-level responsibility or meta-responsibility that aims to shape, maintain, develop, coordinate and align existing and novel research and innovation-related processes, actors and responsibilities with a view to ensuring desirable and acceptable research outcomes.

Wickson and Carew (2014) point to the difference in terminology, orientation, depth of description and emphasis on concepts. However, the authors perceived specific shared characteristics that can be identified as fundamental to the emerging concept:

(1) Focus on meeting significant socio-ecological needs and challenges;

(2) Commitment to actively involve different stakeholders with the aim of better decision making and mutual learning;

(3) Dedicated attempt to anticipate potential problems, evaluate available alternatives and reflect on the underlying values, assumptions, and beliefs; and

(4) Willingness among all participants to act and adapt according to these ideas.

It is noticed that the concept of responsible innovation goes beyond the traditional definition of innovation when considering the ethical, social, and environmental context in which traditional innovation operates (HEMPHILL, 2014). Predominantly, the concepts refer to adaptive and anticipatory governance of research and innovation (OWEN; GOLDBERG, 2010). Anticipatory governance motivates the reflection of scientists, engineers, policymakers, and other audiences about their role in new technologies (GUSTON, 2014).

When considering innovation as a process, RI denotes an orientation towards anticipation, reflexivity, inclusion, and responsiveness (VAN OUDHEUSDEN, 2014). These four dimensions imply collective and continuous commitment (STILGOE; OWEN; MACNAGHTEN, 2013).

Anticipation describes and analyzes the impacts - economic, social, environmental, or others - that are intended and potentially unintended that may arise and is supported by methodologies that include forecasting, assessing technologies, and developing scenarios (OWEN et al., 2013). These impacts occur in environments of rapid technological change, where one seeks to anticipate the effect of innovation

before its dissemination and to incorporate the evaluation in regular R&D activities instead of reacting after the fact (DEMERS-PAYETTE; LEHOUX; DAUDELIN, 2016).

The **reflection** considers the underlying purposes, motivations and potential impacts of what is known (including areas of regulation, ethical review or other forms of governance that may exist) and what is not known (associated uncertainties, risks, areas of ignorance, assumptions, issues, and dilemmas) (OWEN et al., 2013). At the individual level, reflexivity requires that actors involved in technological development can recognize and articulate their knowledge, values, and beliefs, as well as those of others (DEMERS-PAYETTE; LEHOUX; DAUDELIN, 2016).

Inclusion, also called **deliberation**, refers to the decrease in the authority of specialists, with the addition of new voices in the governance of science and innovation as part of a search for legitimation. It is defined as the exchange of views between stakeholders, commonly agreed based on shared criteria for information and evaluation, and that support the decision-making of stakeholders on the innovation process and its results (LUBBERINK et al., 2017). Inclusion enables new visions, purposes, questions and dilemmas to broad and collective deliberation through means of dialogue, engagement and debate, inviting and listening to broader perspectives of audiences and diverse stakeholders and revolves around a search for social legitimacy for projects of innovation (DEMERS-PAYETTE; LEHOUX; DAUDELIN, 2016). This allows the introduction of a wide range of perspectives to reformulate issues and the identification of areas of potential challenge (OWEN et al., 2013). And there are several motivations for greater participation in the social assessment of science and technology (SYKES; MACNAGHTEN, 2013). The normative motivation understands that dialogue is the right way for the reasons for democracy, equity, equality, and justice. Instrumental motivation considers that discussion provides social intelligence to fulfill the fundamental political objectives in advance, such as building trust or avoiding an adverse public reaction. Substantive motivation arises when political choices can be legitimately co-produced with audiences, incorporating authentic diversity of knowledge, values, and social meanings in a practical way. Citizens are engaged as subjects and not as objects (STIRLING, 2008).

Finally, **responsiveness** means that responsible innovation requires an ability to change shape or direction in response to stakeholder and public values and changing circumstances. The response capability is, therefore, to make inevitable

adjustments in the innovation trajectories as they progress and mobilize the expectations of all involved (DEMERS-PAYETTE; LEHOUX; DAUDELIN, 2016). This must be an adaptive, inclusive, and open learning process (OWEN et al., 2013).

Table 4 presents, in a summarized form, each of the dimensions.

Table 4 – Dimensions of RI governance

Dimension	Critical questions and decision components	Description	Guiding questions for companies	Indicative techniques and approaches
Anticipation	Who can be affected in the future? (Result)	It seeks to answer the question: “What if?”. Consider contingency, what is known, what is probable, what is plausible and what is possible.	Are there possible ways of using the technology and possible impacts (risks and benefits) of the technology anticipated by the company and integrated with the research and innovation process and other relevant business processes in the company?	Forecasting, Technological Assessment, Horizon Scanning, Scenario Planning, Vision Assessment, Prospective Studies, Life Cycle Assessment, and Socio-Literary Techniques.
Reflexion	What are you working on? (Opportunity) Why are you working on this? (Considerations)	Rethinking prevailing conceptions about the moral division of labor within science and innovation.	Does the company reflect on its impacts on society, its purposes, motivations and values, and are the purposes and values integrated into the research and innovation process and other relevant business processes in the company?	Multidisciplinary collaboration and training, Definition of fundamental values, Social and ethical scientists incorporated in laboratories, Evaluation of ethical technology, Codes of conduct, and Suspension of activities
Inclusion	Who are you working with on this? (Alternatives)	Seek legitimacy by reducing the authority of experts, by including new voices in the governance of science and innovation.	Does the company engage in dialogues with relevant stakeholders and are the insights from such dialogues integrated into the research and innovation process and other relevant	Stakeholder engagement strategies, Stakeholder dialogues, Public dialogues, Consensus conferences, Juries and citizen panels, Focus groups, Science shops, Deliberative

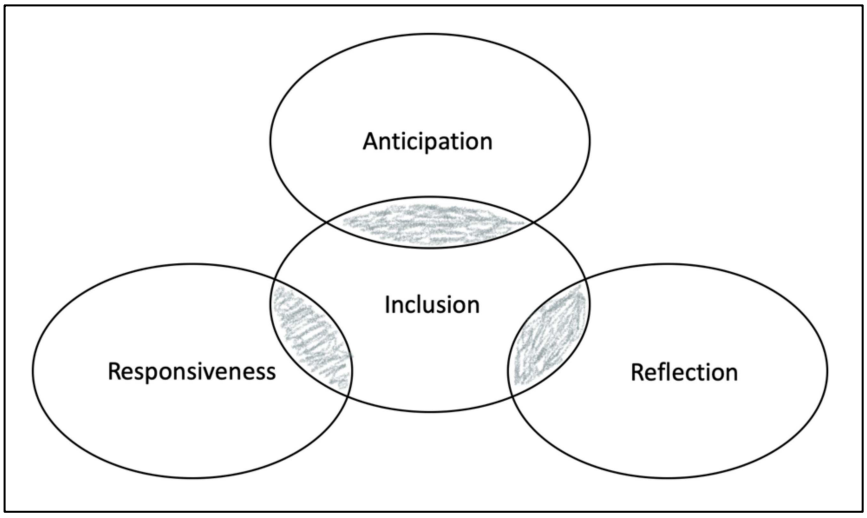
			business processes in the company?	(stakeholder) mapping, Deliberative research, Lay members of expert bodies, User-centered design, and Open innovation
Responsiveness	How could you approach it differently? (Alternatives)	Consider how innovation systems can be shaped to be as responsive as possible.	Does the research and innovation process respond to social needs? Is the research and innovation process organized in such a way that it can respond to new insights and developments (including surprises)?	Constitution of major challenges and thematic research programs, Regulation, Standards, Monitoring, Gradual scaling, Adaptive risk management, Living labs and social experimentation, Flexible and adaptable design, Open access and other transparency mechanisms, Niche management, Value-sensitive (sustainable) design, Stage-gates for suspension of activities, and alternative intellectual property regimes

Source: adapted by the author, based on Owen et al. (2013), Stilgoe; Owen; Macnaghten (2013) and Van de Poel et al. (2017).

One of the highlighted aspects about responsible innovation is the continuous participation of different actors, emphasized mainly by the dimension of inclusion, and which seeks to engage stakeholders already in the early stages of innovation (BURGET; BARDONE; PEDASTE, 2017).

When describing the governance dimensions of RI, Owen et al. (2013) and Stilgoe, Owen and Macnaghten (2013) supposedly describe dimensions that are developed internally (anticipation, reflexivity, and responsiveness) and that which requires a more significant external relationship (inclusion). When analyzing each aspect in greater depth, mainly through the techniques and indicative approaches, one realizes that the dimensions are more integrated (VAN DE POEL et al., 2017). Inclusion stands out, being the main link of RI (Figure 5), being the guiding dimension of this study, without disregarding the others.

Figure 5 - Inclusion as the main link of RI



Source: by the author.

The relation of anticipation and inclusion occurs when considering that the company does not have all the information about the impact that innovation can generate. When seeking this information, through dialogue with specialists, researchers, or members of associations, for example, managers and innovators will have a more comprehensive view of the consequences of the product or service.

Ethics is the central aspect of reflexivity. In this case, inclusion can occur through dialogue with social and ethical scientists. Your contribution will assist the

company in establishing its own moral and ethical precepts but aligned adequately with society's expectations.

Responsiveness aims to shape innovation systems so that they are as sensitive as possible. When testing these models, the collaboration of future users or even ordinary citizens can bring new questions or certainties about the impact of innovation.

As RI governance does not proceed procedurally, and specific actions will be loaded with one or more dimensions, having inclusion as an established process, organized through routines, will generate the necessary knowledge that will feed the other dimensions, in due time. It is the different voices that will enable the company to predict the impact effectively (anticipation), reflect (reflexivity), and make the necessary adjustments (responsiveness) in the development of innovation.

2.2.1 The inclusion dimension in the context of Responsible Innovation

Seeking social legitimacy for innovation requires the inclusion of stakeholders that enable new visions, purposes, questions, and dilemmas for broad and collective deliberation through processes of dialogue, engagement and debate, inviting and listening to broader perspectives of different audiences (DEMERS- PAYETTE; LEHOUX; DAUDELIN, 2016). Involving stakeholders makes the decision-making process more open and participatory, more focused on sustainable development (NUNES; LEE; O'RIORDAN, 2016).

From the seminal article on governance (STILGOE; OWEN; MACNAGHTEN, 2013), several studies advanced the discussion. They highlighted the inclusion capabilities, management practices in the engagement of stakeholders, and the identification of stakeholders. Besides, the difficulties in the inclusion process are highlighted, as well as the critical points. Table 5 summarizes these findings.

Table 5 - Studies about stakeholder inclusion

Study object	Main findings	Reference
Inclusion capability	Existence of two simple capabilities - dialogue with stakeholders and integration of stakeholder knowledge - to generate innovations according to the needs of stakeholders.	Ayuso; Rodríguez; Ricart (2006)

Management practices in stakeholder engagement	Transparency, interaction, practices, responsiveness and co-responsibility	Blok; Hoffmans; Wubben (2015)
Types and diversity of stakeholders	Multi-stakeholder involvement	Von Schomberg (2013); Van De Poel; Asveld; Flipse; Klaassen; Scholten; Yaghmaei (2017); Ligardo-Herrera; Gómez-Navarro; Inigo; Blok (2018)
Difficulties	Stakeholders have different views and interests on ethical and social aspects in innovative practices	Blok, Hoffmans, Wubben (2015)
	Cynicism and disenfranchisement of current deliberations on account of past experiences, with more powerful stakeholders	Parkhill et al. (2013)
	Aspirations and trajectory not always aligned with IR	Thapa, Iakovleva and Foss (2018)
	Selective opening of product information	Blok, Hoffmans, Wubben (2015)
	Not perceived co-responsibility	Blok, Hoffmans and Wubben (2015)
	Conflict of interest groups	Taddeo (2016)
	Information asymmetry - for example, knowledge of what is ethical and environmentally responsible	Blok, Hoffmans, Wubben (2015); Blok 2016; Moratis 2018
Critical points	Maintenance of power over the process (product / service)	Lubberink et al. (2017)
	Consumption of time and other resources - additional costs for inclusion	Russo Spena; De Chiara (2012); Wagner (2009); Stuermer; Spaeth; Von Krogh (2009); Ligardo-Herrera et al. (2018)
	How to create spaces and educate stakeholders for participation	Ligardo-Herrera et al. (2018)
	Compromises the agility of the innovation process	Ligardo-Herrera et al. (2018)
	The company's view on patents changes - they cannot be developed since the beginning of the innovation process	Spinello (2003); Blok, Hoffmans, Wubben (2015)

	Relationship between secrecy x transparency	Balka; ; Raasch; Herstatt (2014)
	Appropriate inclusion - correct selection of multi-stakeholders	Tapha, Iakovleva and Foss (2018)

Source: by the author.

In summary, the current literature suggests the participation of different stakeholders with different points of view. Companies are required to develop this process, the skills of dialogue and integration of the knowledge of stakeholders, to ensure transparency, interaction, and co-responsibility, responding to the needs and desires of stakeholders. However, the process is not simple, since some factors impact both the innovation process (for example, delays, the confidentiality of the information) and the company itself (for example, consumption of time and resources, correct selection of stakeholders). And even with the right selection of multi-stakeholders, companies suffer from information asymmetry, conflicts between interest groups, different visions, and objectives.

The main objective of inclusion is to diminish the authority of specialists, with the addition of new voices in the governance of science and innovation as part of a search for legitimacy. As mentioned before, inclusion is defined as the exchange of views between stakeholders (LUBBERINK et al., 2017). This allows the introduction of a wide range of perspectives to reformulate issues and identify potential areas of contention (OWEN et al., 2013).

Reflecting not only on the need for participation, but also on how this participation occurs, essential factors are pointed out, such as the opportunity for stakeholders to participate, or not, in research or innovation, the role of participants and the power of relationships during participation (AYUSO; RODRÍGUEZ; RICART, 2006). The opportunity refers to the choice to participate, considering that research and innovation should bring benefits to all stakeholders (LIGARDO-HERRERA et al., 2018). In many cases, some participants do not feel free to participate, especially since the topic can provoke ethical discussions such as nanotechnology, biotechnology, among others (AYUSO; RODRÍGUEZ; RICART, 2006). Inclusion must be sensitive to the culture and the particular needs of the participants (DI GIULIO; GROVES; MONTEIRO; TADDEI, 2016).

Another criticism of inclusion is the failure of organizations to recognize the diversity of audiences and institutions that can participate in the process of innovation and governance of science, technology, and innovation (RIBEIRO; BENGTSSON; BENNEWORTH; BÜHRER; CASTRO-MARTÍNEZ; HANSEN; ... ; SHAPIRA, 2018). They should also be aware of how inclusion happens. Sometimes, it is necessary to create spaces and educate the stakeholder on the topic (LIGARDO-HERRERA et al., 2018).

Also, excessive inclusion is discussed, which can compromise the integrity of the common good (SPINELLO, 2003), as well as informational asymmetry (BLOK; HOFFMANS; WUBBEN 2015). The result of this poor management is the absence of a decision or an ineffective decision (TE KULVE; RIP, 2011). We also highlight the fundamental philosophical differences that the actors and stakeholders have (micro-level); within organizational structures of innovation systems (meso-level); and related to broader political, economic, cultural, and social contexts (macro-level) (KUZMA; ROBERTS, 2018).

The main exercise is to develop criteria to assess the quality of the dialogue, which can be: intensity - how the initial members of the public are consulted and how much attention is paid to the composition of the discussion group; openness - how diverse the group is and who is represented; and quality - the severity and continuity of the discussion (CALLON; LASCOUMES; BARTHE, 2009). Vaquero Martín, Reinhardt and Gurtner (2016) highlight the identification of stakeholders, the interaction with stakeholders, and the integration of inputs in the innovation process.

The inclusion of stakeholders does not necessarily follow a pattern and may vary according to the nature and flow of information between those responsible for the exercises and the participants. Despite the evident importance of stakeholder involvement in the innovation process, some aspects of inclusion are still not sufficiently studied. In the context of RI, no studies are describing the agents in organizations or projects, responsible for the inclusion of stakeholders. Recent studies identify the need to detect these agents, who will be responsible for the dialogue and the integration of the knowledge generated in the company's processes (STILGOE; OWEN; MACNAGHTEN, 2013; SILVA et al., 2019). The integration of dialogue and knowledge is part of a necessary process that begins with the choice of who should participate. This process can be called "orchestration," which means managerial action

on resources (HELFAT et al., 2009; SIRMON et al., 2011). This raises the following question: Who are the agents who orchestrate the inclusion of stakeholders?

Besides, product/service development is a complex process that requires the management of several factors in different ones (HELFAT et al., 2009). In general, it moves from the concept of product marketing (introduction to the market) to the design and testing of the project (HELFAT et al., 2009). More sophisticated processes can be understood using the Agile Stage-gate model (COOPER, 2016). The benefits of the model are faster product launch, better response to user needs, better communication, and team morale (COOPER, 2016). As previously noted (p. 40), Agile Stage-gate considers six stages: ideation, concept, business case, development, testing, and launch. The model considers the common stages to the development of new products, composed of a group of activities complemented by decision points (gates) or control points. Decision points can serve as opportunities for inclusion, offering moments in which the process can be continued or stopped (go/kill strategy). In RI, inclusion must occur in the initial stages of innovation (BURGET; BARDONE; PEDASTE, 2017), but, although some theoretical articles deal with the dimension of inclusion (OWEN; MACNAGHTEN; STILGOE, 2012; BURGET; BARDONE; PEDASTE, 2017) (among others), none of them explores the theme of the innovation process. This leads to the next question: when stakeholders participate, at what stage in the innovation process does this happen?

As already mentioned, innovation can take many forms, summarized in four dimensions of change: product innovation (change in products/services offered by a company), process innovation (change in the way products/services are provided or presented to the consumer), position innovation (change in the context in which products/services are introduced in the market) and paradigm innovation (change in the underlying mental models that guide the company's actions) (BESSANT; TIDD, 2007; TADDEO, 2016). Although it is related to all types of innovation, RI research does not highlight the dimensions of change. Thus, the third question is raised: how does stakeholder involvement contribute to innovation - and what kind of innovation?

Finally, it is discussed who are the stakeholders involved in the RI. The next section will deepen the discussion, highlighting that many studies list people who should be considered as stakeholders but do not take into account the context of responsible innovation. The main objective of selecting stakeholders lies in choosing

who will contribute, but also those who will be impacted while the literature on innovation management emphasizes the inclusion of users and customers, the literature on RI advocates a broader composition of economic and non-economic stakeholders (which will be presented below). A persistent debate concerns adequate inclusion (THAPA; IAKOVLEVA; FOSS, 2018), difficulties related to conflicts of interest (TADDEO, 2016), fear of loss of power over the process (LUBBERINK et al., 2017) and fear of the relationship between secrecy and transparency (BALKA; RAASCH; HERSTATT, 2014), in addition to operational aspects such as the consumption of time and other resources (LIGARDO-HERRERA et al., 2018).

Dealing with these difficulties requires companies to have specific dynamic capabilities. The fourth and last question is presented: who are the stakeholders who should participate in the RI process?

The stakeholder inclusion process is extrapolated by Silva et al. (2019) when proposing the analysis of 3W1H of inclusion. The authors assume that the addition of stakeholders is not based on a standard and that it varies according to the nature and flow of information between process managers and participants. Preliminarily, the inclusion dimension determines **who**, **how** and at what stage of the innovation process (**when**) participation will take place (BLOK; LEMMENS, 2015), with a gap in the identification of **who** the agents are that orchestrate stakeholder participation. Following this discussion, who are the stakeholders?

2.2.2 Stakeholders in the context of Responsible Innovation

When considering that stakeholders are any group or individual that can affect or be affected by the organization (FREEMAN, 1984), the literature presents several classifications.

Stakeholders can be classified as internal or external groups (FREEMAN, 1994; GURZAWSKA; ; MÄKINEN; BREY, 2017); at the same time, they can be classified as economic or non-economic actors (BLOK; HOFFMANS, WUBBEN, 2015). Internal stakeholders relate to the group that has direct contact with the organization, an essential group that includes owners, customers, employees, and suppliers. The outside group is composed of social and political actors who play a fundamental role in the credibility and acceptance of business activities, including governments, competitors, consumer advocates, environmentalists, special interest groups, and the

media. Here non-governmental organizations (NGOs) and their activists, citizens, governments, and competition appear (AYUSO; RODRÍGUEZ; RICART, 2006).

Extending this debate, RI suggests the participation of individual researchers, research organizations, research ethics committees and their members, users of research and innovation, civil society at different levels with political decision-making power, professional bodies, legislators, educational organizations and public bodies (STAHL, 2013). Besides, employees, users, supply chain stakeholders, and external research institutes (universities and research centers) make significant contributions (VAN DE POEL et al., 2017; GURZAWSKA; MÄKINEN; BREY, 2017). Other classifications are suggested by Blok, Hoffmans and Wubben (2015), who consider economic stakeholders (such as employees and suppliers) and non-economic stakeholders (such as NGOs and research institutes). Also, Von Schomberg (2013) proposes the involvement of multiple stakeholders, bringing together actors from industry, civil society, and research.

There is special attention to the user in the context of RI. By focusing the innovation process on the user, usability and utility are guaranteed, in addition to providing a more extensive range of social and individual benefits (POLITIS; ROBB; YAKKUNDI; DILLENBURGER; HERBERTSON; CHARLESWORTH; GOODMAN, 2017). The connection with users as a source of innovation has a more significant role than the consumer (BESSANT; TIDD, 2007). However, companies often fail to benefit sufficiently from user integration. This failure is attributed to the limited absorptive capacity, concerns about intellectual property, or the "not-invented-here" syndrome (SCHAARSCHMIDT; KILIAN, 2014) and also in the conversion of the initial interest into a significant long-term co-creation activity (BESSANT; TIDD, 2007).

In the context of RI in healthcare, in addition to stakeholders already mentioned, the patient, his family, and healthcare professionals (medical doctors, caregivers, nurses, among others) are listed. Table 6, below, summarizes the stakeholders involved in healthcare and well-being research.

Table 6 - Stakeholders involved in RI healthcare

Stakeholder	**Context in which it is included**	**References**
Patients	- Use of robots in therapy for children with Autistic Spectrum Disorder (ASD)	Coeckelbergh et al., 2016;

	- Assistive technologies for people with dementia - Health system challenges that can be solved through technological innovation - Development of serious games for patients with Autistic Spectrum Disorder (ASD)	Demers-Payette; Lehoux; Daudelin, 2016; Decker et al., 2017; Politis et al., 2017; Treadwell et al., 2017
Patients family	- Use of robots in therapy for children with Autistic Spectrum Disorder (ASD) - Assistive technologies for people with dementia - Assistive technology for people with sickle cell disease	Coeckelbergh et al., 2016; Decker et al., 2017; Treadwell et al., 2017
Caregivers and health professionals (medical doctors, nurses)	- Use of robots in therapy for children with Autistic Spectrum Disorder (ASD) - Assistive technologies for people with dementia - Health system challenges that can be solved through technological innovation - Assistive technology for people with sickle cell disease	Coeckelbergh et al., 2016; Demers-Payette; Lehoux; Daudelin, 2016; Decker et al., 2017; Treadwell et al., 2017
Lay people	- Assisted technologies for aging populations	Bechtold; Capari; Gudowsky, 2017
Society representatives (associations, business organizations, NGOs)	- Health system challenges that can be solved through technological innovation - Use of robots in therapy for children with Autistic Spectrum Disorder (ASD) - Assisted technology for people with sickle cell disease	Demers-Payette; Lehoux; Daudelin, 2016; Coeckelbergh et al., 2016; Treadwell et al., 2017
Research funding agencies	- Development of public health policies	Silva et al., 2018
Technology Developers	- Assisted technologies for people with dementia - Health system challenges that can be solved through technological innovation - Development of public health policies	Demers-Payette; Lehoux; Daudelin, 2016; Decker et al., 2017; Silva et al., 2018
Investors	- Development of public health policies	Silva et al., 2018
Genetic laboratories	- Use of precision medicine in genetic testing in an emerging country	Balasopoulou et al., 2017
Academic institutions	- Assisted technologies for aging populations - Use of robots in therapy for children with Autistic Spectrum Disorder (ASD)	Coeckelbergh et al., 2016; Bechtold; Capari; Gudowsky, 2017

Experts	- Assisted technologies for aging populations - Action Plan for Mobilization and Mutual Learning in food and health innovation	Gemen et al., 2015; Bechtold; Capari; Gudowsky, 2017
Innovation managers (universities, health organizations, biomedicine companies)	- Health system challenges that can be solved through technological innovation - Assisted technology for people with sickle cell disease	TreadwelL et al., 2017; Demers-Payette; Lehoux; Daudelin, 2016
Government agencies (political and economic entities, policy makers)	- Use of precision medicine in genetic testing in an emerging country - Assisted technologies for aging populations - Action Plan for Mobilization and Mutual Learning in food and health innovation	Gemen et al., 2015; Balasopoulou et al., 2017; Bechtold; Capari; Gudowsky, 2017

Source: by the author.

As well as user-centered innovation, the inclusion of patients and family members aims to develop innovation seeking to meet the needs of the primary user. Regarding the patient, despite the criticisms considering the quality of inclusion, stand out the work of Politis et al. (2017) and Coeckelbergh et al. (2016), who worked with children and adults with Autistic Spectrum Disorder (ASD) and Decker et al. (2017), who worked with patients with dementia. The studies emphasized the limitations of the participants, but also the contribution they brought. Politis et al. (2017) presented the development of serious games that were developed for (and with the participation of) people with ASD.

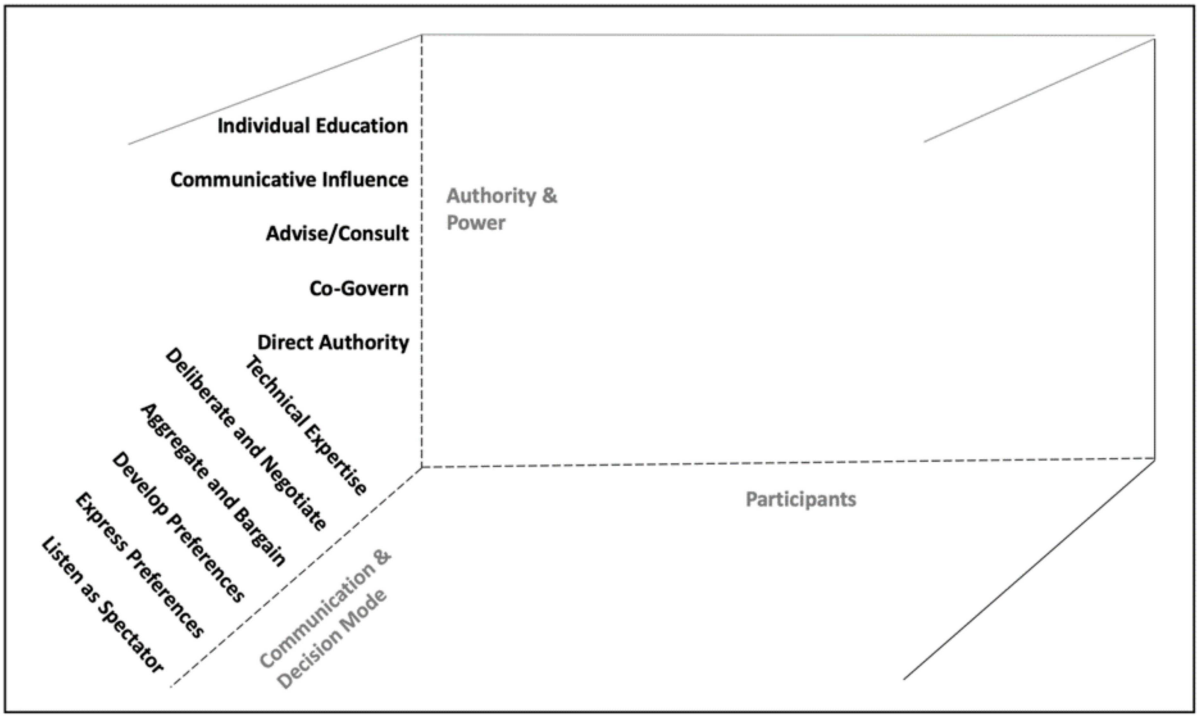
In addition to the difficulty in working with patients who have different cognitive characteristics, the organization and coordination of roles based on participation are considered complex and diffuse, due to the political bias, to persuade other people to some form of action (YENICIOGLU; SUERDEM, 2015), which can influence innovation policy (DE BAKKER et al., 2014). The challenge is caused by different, often contradictory, interests, goals, priorities, and demands (AYUSO; RODRÍGUEZ; RICART, 2006).

This bias is pointed out by Lubberink et al. (2017), who identified that most empirical studies that investigated the inclusion of stakeholders highlighted that organizations mainly involve stakeholders who share values or similar stakeholders who are motivated to align their interests with a shared goal of innovation. Little is said about stakeholders with conflicting values or stakeholders who opposed innovation.

In this same way, limiting the dialogue with stakeholders, other factors interfere with self-interest, political processes, power imbalances, and even a lack of voice (BLOK, 2014). The different ways can influence this limitation that the various stakeholders influence the organization (FRIEDMAN; MILES, 2002). Despite these difficulties, the perception of alignment of the most recent studies is clear and one of the characteristics shared by the concepts of RI, highlighted by Wickson and Carew (2014), concerning the commitment to actively involve a series of stakeholders with the objective of better decision making and mutual learning.

Another critical aspect of stakeholder participation in the identification of the form and degree of their participation. Inspired by Fung's democratic cube (2006), Figure 6 shows the degree of the participants' modes of communication and decision.

Figure 6 - Forms and degrees of stakeholder participation in the RI process



Source: adapted by the author from Fung (2006).

When considering stakeholders, their selection for participation is established according to the degree of contribution. While in the public context, engagement occurs due to a deficiency in the authorized set of decision-makers - usually elected representatives or administrative employees (FUNG, 2006), in the context of RI, this participation occurs intending to increase the commitment and contribution of stakeholders. In this way, the performance of the innovation network is enhanced,

which represents an organizational solution for the innovation of products and services, since they integrate different organizational skills favorable to a common goal (PYKA; SCHARNHORST, 2009). This commitment can be achieved through the creation and maintenance of relationships that satisfy these parts (LUBBERINK et al., 2017).

Their participation can take place less intensely, like that of a spectator up to the highest degree of intensity, when engagement happens due to their technical expertise. And his degree of authority and power represents the level of knowledge he has, which can be that of someone who needs to be educated on the topic, even one who has extensive knowledge and influences the process (FUNG, 2006). The power that individual stakeholders exercise over others can trigger cynicism and disenfranchisement to current deliberations. This reaction stems mainly from previous experiences of formal consultations, in which they felt that their concerns were usurped by the agendas of what they considered to be the most powerful actors (for example, governments, experts, and stakeholders) (PARKHILL et al., 2013).

This thesis argues that the inclusion of stakeholders in the RI process requires specific DCs. Therefore, it is necessary to explore the detection and apprehension capabilities of the generated knowledge through the integration of multiple stakeholders, as well as the reconfiguration of the product from this new knowledge generated. Detecting, apprehending, and reconfiguring are recognized as the nature of dynamic capabilities (TEECE, 2007). These capabilities can be developed only through the organization's internal processes, based on disposition, reorganization, and evolution over time (TEECE; PISANO; SHUEN, 1997).

2.3 DYNAMIC CAPABILITIES

Even in times when the business environment was not as agile and sophisticated as it is nowadays, researchers in the field of strategy always have sought to answer how companies developed and maintained a competitive advantage over their competitors. For a long time, the strategic vision was that companies in the same sector were identical in terms of relevant strategic resources (PORTER, 1981). In this context, only a few companies achieved sustainable competitive advantage and superior economic performance.

Competitive advantage is generated, fundamentally, from the value that the company can generate for customers, and that exceeds the cost of that generation (PORTER, 1985). Competitive advantage must be sustainable, developed through the implementation of a value creation strategy, which is not being implemented simultaneously by any current or potential competitor, and that these competitors are not able to copy the benefits of that strategy (e.g., for a relative period of time) (BARNEY, 1991).

The understanding that company's resources and capabilities were responsible for the competitive advantage arose from the studies of Wernerfelt (1984) and Barney (1991), inspired by Penrose (2006/1959) who considered that the combination, or recombination, of productive resources, enabled the company to adapt to new market conditions. Thus, the Resource Based View (RBV) was created, which considers that resources and capabilities controlled by the company are responsible for sustainable competitive advantage. In short, from the RBV, obtaining and maintaining a competitive advantage is based on the assumption that the company's resources must be heterogeneous and fixed. They cannot be easily transferred from one company to another (BARNEY, 1991).

However, in dynamic business environments, sustainable competitive advantage requires more than assets that are difficult to replicate. The constant development of innovations has as its primary objective the generation and maintenance of competitive advantage (BARNEY, 1991; TEECE; PISANO; SHUEN, 1997). This highly dynamic context presupposes that the definition and management of resources require capabilities that are also dynamic (TEECE; PISANO; SHUEN, 1997).

The term “dynamic capabilities,” coined by Teece, Pisano, and Shuen (1997), refers to organizational capabilities and can be conceptualized as the “ability to integrate, build and reconfigure internal and external competencies, to deal with rapidly changing environments” (TEECE; PISANO; SHUEN, 1997, p. 516). Going beyond RBV, the theoretical lens of DCs answers why some companies obtain a competitive advantage in dynamic and unpredictable changes environments (EISENHARDT; MARTIN, 2000). Also, DCs assume that the expansion of this advantage occurs through resources and internal capabilities and the way they relate to the external environment (LEONARD-BARTON, 1992; TEECE; PISANO; SHUEN, 1997). In brief,

the theoretical lens of DCs is not restricted to the company's internal environment but also maintains an external connection.

The concept of DC is linked to a high-speed environment, where the processes are simple, highly experimental, and fragile, generating unpredictable results (EISENHARDT; MARTIN, 2000). Differently, in moderately dynamic environments, the focus is on processes and routines (EISENHARDT; MARTIN, 2000), and the dynamic capabilities in these environments are reflected in high-level methods (or groups of habits) that generate new processes, products and/or services, designing and implementing viable business models (WINTER, 2000; 2003; TEECE, 2007). It is these routines that “enables an enterprise to direct its activities towards producing goods and services in high demand (or likely to be in high order soon).” (TEECE; LEIH, 2016, p. 7).

The duality between environments (dynamic or moderately dynamic), reinforces what Arndt and Pierce (2017) called “the two schools of DCs”. On one hand, Teece, Pisano and Shuen (1997), argue that company must be able to change its resource portfolio through innovation. To do so, they must use “a combination of Schumpeterian innovation and higher-order routines” (ARNDT; PIERCE, 2017, p. 4). In this way, the company develops and maintains competitive advantage, focusing on its strategic elements. On the other hand, Eisenhardt and Martin (2000) address "best practices," concentrate on imitation and operational concerns, to the detriment of innovation and strategic differentiation. For Peteraf, Di Stefano and Verona (2013), the “no-conversation" between articles can be attributed to the social structure of the academic community. The authors reflect that another factor is the fact that the field is simultaneously constructed by two different groups of authors, each with their worldview about the construct and its functions.

When analyzing the two “schools”, it is clear that both focus on the role of organizational routines, about management processes and organizational processes, and portray the structure of dynamic capabilities as an extension of the RBV. It is also perceived as complementarity in the studies since Eisenhardt, and Martin's (2000) discussion about the alliance, product development, and decision making as specific types of dynamic capabilities enhances the more general debate by Teece, Pisano and Shuen (1997). However, there is a point of divergence between them, since they have opposite views on the central question of whether dynamic capabilities have the

potential to explain sustainable competitive advantage in rapidly changing environments.

In response to this duality, the concept of “dynamic packages” (emphasis added) arises. The focus of Teece, Pisano and Shuen (1997) is in complex routines and organizational mechanisms, and Einsenhardt and Martin (2000) are in simple routines and managerial arrangements. Both levels of analysis and both types of devices are essential, and both work within the company, either sequentially or simultaneously. Understanding dynamic capabilities require viewing the complete image and exploring “dynamic packages” as a whole (PETERAF; DI STEFANO; VERONA, 2013).

Contrarily, for Winter (2003), it is a mistake to link DCs to the notion of generalized effectiveness, using generic formulas to obtain a competitive advantage. For the author, investing in DCs is a partial protection against the obsolescence of existing capabilities, and can generate a relatively sustainable competitive advantage.

Even with different points of view, the importance of dynamic capabilities, which goes beyond the competitive edge, cannot be ignored. The importance lies in focus on the process by which the company develops and recreates its competences, which is conditioned to its past choices and the dynamism of the environment (TEECE; PISANO; SHUEN, 1997). In this way, the company is permanently and systematically revisiting its capabilities, meeting not only its competitive needs but also attentive to the needs of the market, including stakeholders.

Many criticisms fall on the theoretical lens of DCs. Aspects such as doubts about DCs as generating competitive advantage, difficult identification of DC processes, their terminology, tautology, and research methods are pointed out in several studies (for example, WINTER, 2003; TONDOLO; BITTENCOURT, 2014; LINDEN; BITENCOURT; NETO, 2019). The criticisms can be summarized about the difficulty of operationalizing and making tangible the DCs.

The study by Meirelles and Camargo (2014) contributes to the identification of dynamic capabilities. From the analysis of DC definitions, the authors identified three elements:

- Set of behaviors, capabilities, and skills;
- Processes and routines;
- Learning mechanisms and knowledge governance.

Both Teece (2007) and Eisenhardt and Martin (2000) highlighted that routines and processes could be considered microfoundations of DC. Eisenhardt and Martin (2000) understand that best practices (specific methods and processes) can be understood as a dynamic capability. Differently, Teece (2007) sees them as ordinary capabilities. A routine (or group of them) can only be considered a dynamic capability if it has the capability to detect (sensing), apprehend (seizing) and transform (transforming) (TEECE, 2007). Such capabilities are recognized by the author as the nature of dynamic capabilities.

2.3.1 Nature of Dynamic Capabilities

As already shown, the concept of DC concerns the integration, construction and, reconfiguration of competences (TEECE; PISANO; SHUEN, 1997). This concept already explains what Teece (2007) proposes as the nature of DCs.

2.3.1.1 Sensing

Sensing *refers* to the ability to detect. To perceive and identify threats, opportunities, and problems (TEECE, 2007). It is an activity of exploration, creation, learning, and interpretation. To do so, it is necessary to monitor, research and explore markets and technologies, to develop research and to monitor the needs of customers, but also the evolution of the market and the sector, as well as suppliers and competitors. Perception and attention are at the base of the *sensing* capability (HELFAT; MARTIN, 2015; HELFAT; PETERAF, 2015). Prior knowledge, expectations, and beliefs guide mental perception activity (DONG; GARBUIO; LOVALLO, 2016). Perception is composed of activities or mental processes, which detect opportunities through the recognition of emerging patterns in the (external) environment (BARON, 2006). Attention is the “state of focused awareness on a subset of available perceptual information.” (DONG; GARBUIO; LOVALLO, 2016, p. 102). New opportunities can be detected through formal and informal work relationships, in different networks within and between companies, obtaining the most diverse information (HELFAT; MARTIN, 2015). One of the critical elements of competitive advantage, which contributes to the development of DCs is the network of relationships (PELAEZ et al., 2008).

It is the detection capability that establishes a connection with the external environment. Despite criticism of RBV and, consequently, of DCs about its purely inside look at the company, it is the ability to detect that establishes the link with the market.

2.3.1.2 Seizing

Seizing refers to the ability to apprehend. To explore the detected opportunities *(sensing)* (TEECE, 2007). This apprehension is made through new products, processes, or services, which will require investments in development and commercialization activities. But the success of the business depends both on the selection of technology and (and perhaps mainly) on organizational innovation. On its business model, which will define its marketing strategy and investment priorities. The use of opportunities depends, in part, on the effectiveness of the managers' cognitive abilities, based on problem solving and reasoning, which support the design of the business model, as well as the ability to make substantial strategic investments (HELFAT; PETERAF, 2015). Cognitive skills contribute for managers to pay attention to the prevention of errors and prejudices that may harm new configurations of resource allocation (DONG; GARBUIO; LOVALLO, 2016).

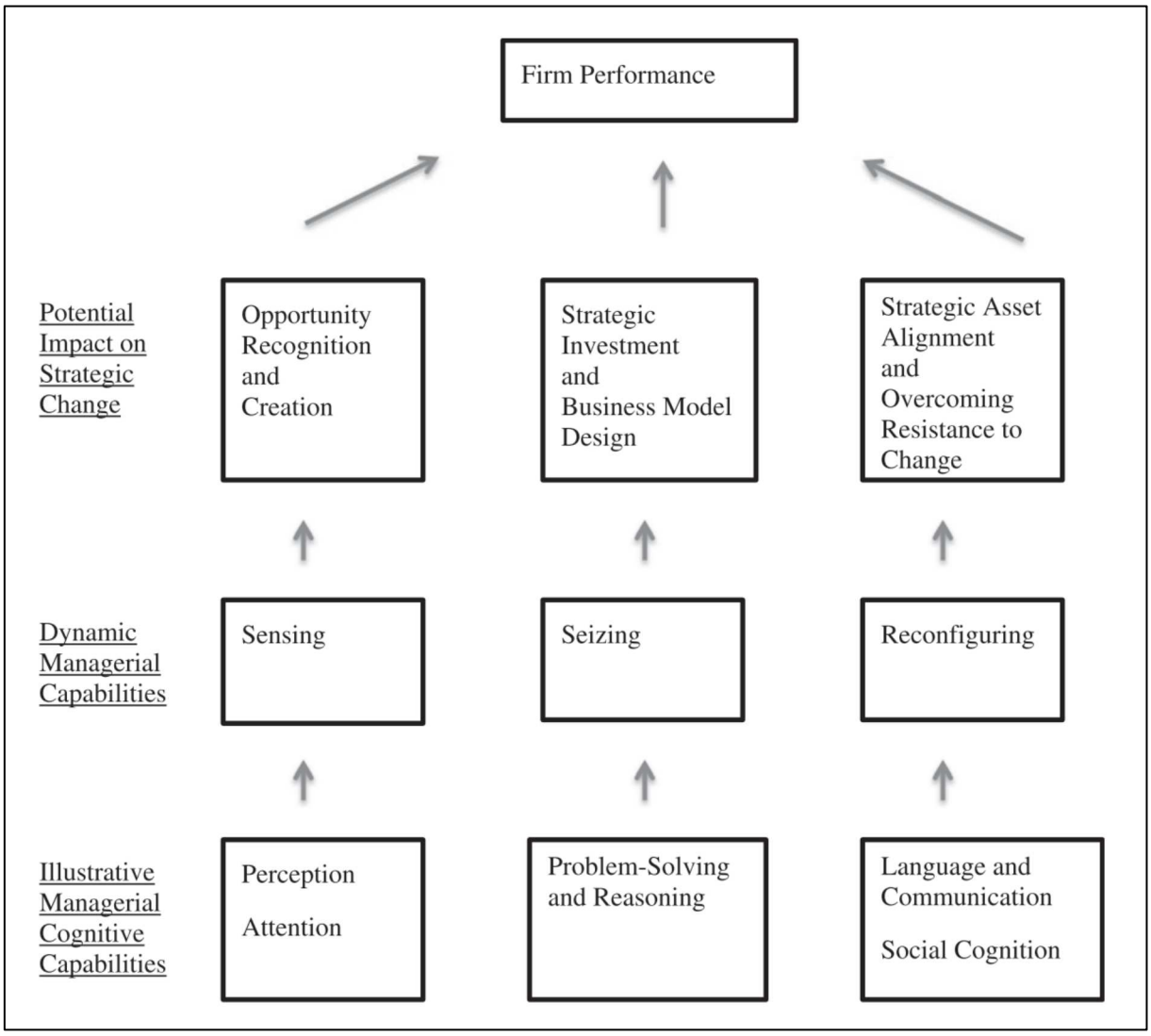
2.3.1.3 Transforming

Transforming means the ability to reconfigure - reshape processes and resources through reconfiguration. Reconfiguration is necessary for the company to continue evolving, avoiding unfavorable trajectories. For that, routines are developed, which promotes operational efficiency (TEECE, 2007). Reconfiguration supports the company's growth and profitability, improving, combining and reconfiguring its organizational assets (resources and capabilities), through cognitive language and communication capabilities, and social cognition (HELFAT; PETERAF, 2015). But reconfiguration only achieves its objective when combined with a propensity to make market-oriented decisions (BARRETO, 2010).

Based on the capabilities of *sensing, seizing, and transforming*, companies can develop DCs that play a fundamental role in their performance, generating a potential impact on strategic change (Figure 7).

Specific cognitive capabilities influence, or support, *sensing, seizing, and transforming* capabilities, creating a potential impact on strategic change. The cognitive abilities of perception and attention contribute to sensing, which impacts the recognition and creation of opportunities. The cognitive skills of problem solving, and reasoning contribute to seizing, which has implications on strategic investment and the design of the business model. Finally, the cognitive abilities of language and communication, and social cognition, contribute to *transforming*, impacting the strategic alignment of assets and overcoming resistance to change.

Figure 7 - Managerial cognitive skills and the nature of DC



Source: Helfat; Peteraf (2015, p. 837).

It is the processes and routines that provide the organizational structure and articulation for the construction of the company's DCs. Such processes and habits can be considered DC microfoundations.

2.3.2 Microfoundations

Despite the importance of understanding organizational phenomena from their macrofoundations, several social scientists like Simmel (1971) and Weber (1949) believe that a fruitful construction of theory emerges from how social structures originate and evolve, through its microfoundations. For Coleman (1990), macro-level explanations cannot occur through other macrophenomena, since potential lower levels were not observed, consequently not generating alternative reports. The author suggests that micro-level mechanisms are the causes of macrophenomena and that explanations involving the micro-level are more stable, fundamental, and general than answers at the macro level. Ultimately, all of these reasons boil down to microfoundations that generate a new essential perception.

Felin; Foss; Heimeriks; Madsen (2012) define microfoundations as a theoretical explanation, supported by empirical examination, of a phenomenon, and perceive them as (p. 22)

> actions and interactions of lower level organizational members understand how firm-level performance emerge from the interaction of these members, and how relations between macro variables are mediated by micro actions and interactions.

Aligned with this concept, Barney and Felin (2013) highlight the importance of the individual and his social relationships within organizations. For the authors, the collective “things” of the organization - structure, culture, institution, organization, market - are the result of the individual and his interactions. The authors emphasize that the microfoundations *sine qua non* is aggregation. Advancing further in this discussion, questions about how to identify who has the correct information and how to aggregate dispersed information emerged when discussing the aggregation of data and organizational knowledge (NICKERSON; ZENGER, 2004; JEPPESEN; LAKHANI, 2010; AFUAH; TUCCI, 2012).

Foss and Pedersen (2016) highlighted that research on microfoundations has focused on routines, social capital, and dynamic capabilities. For the authors, the microfoundations lead to the understanding of dynamic capabilities, about managerial cognition as well as the motivational antecedents of competitive advantage based on human capital, and that from there emerge the routines that drive performance.

2.3.2.1 Microfoundations of Dynamic Capabilities

The microfoundations of dynamic capabilities assumed greater importance from the search for factors that facilitate strategic change (HELFAT; PETERAF, 2015). The skills, processes, procedures, organizational structures, decision rules, and distinct disciplines that support detection, apprehension, and reconfiguration (*sensing, seizing and transforming*) capabilities are considered microfoundations (TEECE; PISANO; SHUEN, 1997).

For new resource configurations, in addition to specific strategies, certain organizational processes or routines are required (EISENHARDT; MARTIN, 2000/1997). Such processes and routines are still one of the ways to store and access knowledge, in addition to contributing to minimizing conflict situations within the organization (NELSON; WINTER, 2002).

However, such processes and routines are challenging to develop and implement, requiring entrepreneurial skills. These companies not only adapt to business ecosystems but also shape them through innovation and collaboration with other companies, entities, and institutions (stakeholders) (TEECE; PISANO; SHUEN, 1997).

The processes have the functions of coordination/integration (a static concept), learning (a dynamic concept), and reconfiguration (a concept of transformation) (TEECE; PISANO; SHUEN, 1997). Coordination/integration refers to what is coordinated and integrated within the organization, such as the integration of external activities and technologies, as well as strategic alliances, virtual corporations and supplier relations, and technological collaboration. Learning is the process by which repetition and experimentation allow tasks to be performed better and faster. Finally, recognition and transformation, which consists of detecting the need to reconfigure the

company's asset structure and carry out the necessary internal and external transformation (TEECE; PISANO; SHUEN, 1997).

Teece (2007) lists the nature of dynamic capabilities (*sensing, seizing, and transforming*), and some processes and routines that can provide certain microfoundations for DCs. The author cites analytical systems (and individual capabilities) to learn and capture, filter, shape, and calibrate opportunities, such as the microfoundations of the nature of sensing. Processes are listed to direct internal R&D and select new technologies, supplier development, and complementary innovations, avoid exogenous developments in Science and Technology, and identify the target market segments, changing the customer's needs and innovation.

The company's structure, procedures, design, and incentives for seizing opportunities are cited as microfoundations of the nature of seizing. Processes are listed for: designing solutions for the client and business model, selecting protocols for decision making, selecting corporate boundaries to manage add-ons and control platforms, building loyalty and commitment.

Finally, the continuous alignment and realignment of specific tangible and intangible assets are cited as microfoundations of the nature of transforming. In this context, the processes for decentralization and near decomposition, governance, co-specialization, and knowledge management are listed.

Many of the microfoundations listed by Teece (2007) and other authors, suffer criticism, as they have focused too much on the almost automatic aspects of capability development - based on routines. Gavetti (2005) considers the possibility of mutual coexistence between habits and cognitive logic. The author still advances by bringing the influence of the organizational hierarchy into the decision-making process.

The cognition aspect is also highlighted more recently by Eisenhardt, Furr, and Bingham (2010), who advance the discussion by clarifying the microfoundations of performance in dynamic environments. The authors propose a balance between efficiency and flexibility, emphasizing that managers must adhere to “simple strategies” based on method or processes, considering multiple environmental realities and “specialized” cognition.

When considering that routines and capabilities manifest themselves in different ways and focus on multiple phenomena, Felin et al. (2012) argue that the various manifestations and aspects of habits and (dynamic) capabilities are likely to have

implications for their respective microfoundations. The authors propose to identify the phenomena underlying routines and capabilities and explore how these phenomena contribute to these routines and capabilities, through partial approaches (such as, for example, explaining a well-defined aspect of a method clearly and transparently). For that, Felin et al. (2012) propose the mapping of the microfoundations of routines and capabilities through three components: individuals, processes and interactions, and structure. And these components, in addition to independently causing effects on routines and capabilities, are also related to each other, generating different interactions (individuals and individuals, individuals and processes, etc.). The result of these relationships is the generation of the second set of effects on routines and capabilities.

As individual-level components, choices and agency, characteristics, skills, and cognition are highlighted. As components of the procedural level and their interactions, we highlight the rigidly designed routines (which can result in limited variations at the organizational level), routines that allow managerial discretion in execution (which can result in heterogeneity within and between companies), learning trial and error, and *ad hoc* problem-solving. Finally, as structural level components, the structure or design of decision-making activities within organizations is highlighted, the design of the organizational structure and the environmental and resource conditions present in the company's foundation affect its subsequent development (path dependence).

Dynamic capabilities are shaped through the co-evolution of learning mechanisms, defined as routine activities aimed at the development and adaptation of operational routines. The arrangements range from the accumulation of experiences, through the articulation of knowledge and ending in knowledge coding processes in the evolution of dynamic, as well as operational routines (ZOLLO; WINTER, 2002). Dynamic capabilities process and routines (microfoundations) are identified in various innovation processes, including in the context of responsible innovation, as shown below.

During the development of innovation, a series of processes and routines are required to ensure a value stream. The connection of all value-added and non-value-added activities associated with the creation of a new product or service (COOPER, 2008). What defines if a set of processes or routines constitutes one (or more) dynamic

capability (s) is its capability in sensing, seizing, and transforming. Teece (2007, p. 1321) highlights that

> the identification of the microfoundations of dynamic capabilities must be necessarily incomplete, inchoate, and somewhat opaque and/or their implementation must be rather difficult. Otherwise sustainable competitive advantage would erode with the effective communication and application of dynamic capability concepts.

When recalling that the present thesis defends that they are DCs that enhance the inclusion of stakeholders in the RI process, it is essential to analyze which DCs have already been identified in this context.

2.4 DYNAMIC CAPABILITIES IN THE CONTEXT OF RESPONSIBLE INNOVATION

Despite the close relationship between the context of responsible innovation, since RI is often developed in highly complex environments, requiring dynamic capabilities to generate sustainable competitive advantage (TEECE; PISANO; SHUEN, 1997), few studies make this approximation. The importance of this relationship is established since the DCs encourage the company to learn new approaches and abandon the old ones through new knowledge components, such as new technologies, new markets, regulatory, and environmental conditions (BESSANT, 2013). But this learning raises questions about how expensive and how successful an interactive, inclusive, and open process of adaptive DC-based learning can be (SCHROEDER et al., 2016).

This section presents studies that address this relationship, as well as identifying and analyzing the microfoundations that contribute to the inclusion of stakeholders in the RI process.

When searching the main databases (Web of Science, Portal Capes, EBSCOHost, and Google Scholar), without determining the temporality, associating the terms of RI (and its variations) and DC (and its variations), twenty-two eight studies that seek to link, even if theoretically, the two themes. Unfortunately, many of them refer to DCs in the context of RI, but without any deepening.

However, studies like Mahlouji and Anaraki (2009) stand out, which, when questioning how to improve RI capability, bring DCs as mechanisms for the transition from a model based on corporate social responsibility to a model focused on

responsible innovation, through creative management, dynamic sustainability (regulatory system that creates a sustainable and predictable environment), cost-benefit and reputation. Here we highlight the importance given to creative management, considered as one of the most important channels to address the needs of stakeholders.

Studies such as Pandza and Ellwood (2013) bring aspects of the institutionalization of RI, through professional practices and organizational skills.

Finally, the proposal for constructive dialogues with stakeholders, through leadership and mobilization of DCs, is brought by Adams et al. (2016), who warns that the theme is still aspirational, or at least not tested empirically.

The studies presented above contribute to this thesis, reinforcing the significance to pay attention to the needs of stakeholders (MAHLOUJI; ANARAKI, 2009), and the importance of establishing dialogue (ADAMS et al., 2016).

Other studies have specific DCs, as shown below.

2.4.1 Types of Dynamic Capabilities in Responsible Innovation

Knowledge-based capabilities and absorptive capabilities are the most prominent dynamic capabilities[2] in studies on RI.

Given its recurrence and importance in the context of RI, **knowledge management** (KM) was suggested by Lubberink et al. (2017) as the fifth dimension of RI, with anticipation, reflexivity, inclusion, and responsiveness. According to the authors, companies do not have the necessary knowledge to develop an innovation that responds to the needs of stakeholders. Therefore, they develop different activities to create and integrate the knowledge generated internally, as well as that generated through the participation of external organizations or actors. The fifth dimension did not echo in other studies. This is because what is considered to be a dimension of RI may be a dynamic capability (based on knowledge) aimed at RI.

In addition to the studies listed by Lubberink et al. (2017), which deal with the critical activities of knowledge creation and integration, and of development, assimilation, and synthesis of knowledge, other authors bring **knowledge-based**

[2] Considered as DCs by the authors of the articles.

capabilities as essential to the RI process. DCs can contribute to the identification and access to relevant experience, integrated through guidelines and compliance monitoring (ADAMS et al., 2016). This integration can be done through knowledge management systems, since innovation must be managed through anticipatory governance tools, with a vision of the future and participation (GUDOWSKY; PEISSL, 2016). Complex formats of generation and exchange of knowledge guarantee the viability of scientific and technological advances. From the inclusion of the public, it allows people to think in terms of social and technological co-evolution and to anticipate their future needs and desires (HEIDINGSFELDER et al., 2015).

Often this exchange of knowledge occurs through different structures and routines. The process regarding face-to-face interactions generates tacit knowledge sharing. The result is the generation of understanding about long-term problems and the needs of users daily. The method based on online interactions makes explicit knowledge from an extensive network. In this case, the result is the generation of a systematic record of suggestions for improvements and new resources, requiring, here, the processing and combination of knowledge (THOMAS; SILVA, 2019).

About **absorptive capability** (AC), it is enhanced when there are stakeholder engagement and social responsiveness (SCHOLTEN; VAN DER DUIN, 2015). Knowledge positively influences the ability to absorb and apply knowledge for commercial purposes (MAVROEIDIS; TARNAWSKA, 2017). The development of RI requires a heterogeneity of resources and capabilities, in which case, strategies for implementing RI and the result of these strategies may differ from one company to another (BARNEY, 1991; TEECE; PISANO; SHUEN, 1997; VAN DE POEL, 2017).

The inclusion of stakeholders provides for the management and absorption of the knowledge generated from these interactions. For that, it was necessary to analyze other dynamic capabilities, which could, in some way, contribute to the RI process.

2.4.1.1 A new look at Dynamic Capabilities in Responsible Innovation.

Dynamic knowledge-based capabilities aim to identify and access relevant knowledge (LUBBERINK et al., 2017), be it tacit or explicit (THOMAS; SILVA, 2019) and can be integrated through guidelines and compliance monitoring (ADAMS et al., 2016). This DC requires routine activities aimed at the development and adaptation of

operational routines, through (1) accumulation of experience, (2) articulation of knowledge, and (3) knowledge coding processes in the evolution of dynamic and operational routines (ZOLLO; WINTER, 2002).

There are several types of knowledge based DCs. Denford (2013) analyzes the literature and organizes it in a comprehensive and consistent typology, identifying eight DCs, integrated into three dimensions - internal/external resources, focus on exploration/exploitation, and combative/absorptive capability. The DCs listed are creation, integration, reconfiguration, replication, development, assimilation, synthesis, and imitation. The last four are related to a look external to the company, which, in some way, establishes a connection with the inclusion of stakeholders. Table 7 presents these two typologies.

Table 7 - Typologies of Dynamic Knowledge-Based Capabilities

DC	**Development**	**Assimilation**
Dimension	External *Exploration* Combinative	External *Exploration* Absorptive
Purpose	Generation of new knowledge outside the company by recombining the knowledge of the company and the partner	Look for information outside the company to absorb in the company and apply it to commercial media
Mechanisms	*Equity joint ventures; joint R&D agreements; collaborative knowledge creation*	Acquisitions, collaboration networks, search for and internalization of joint knowledge
Management role	Develop alliances to maximize the value of the exchange and combination of knowledge	Search and internalization of new knowledge brought to the organization through partnerships
Impact on the company	Enables the company to create new knowledge with a partner	Enables understanding of changes in the external environment and the ability to react to them
Benefits	Mutual learning between companies resulting in new knowledge for both partners	Company growth through the acquisition or inclusion of industry networks (sector)
Limits	Joint ventures are subject to many dilemmas such as trust, sharing and knowledge transfer	Difficulty in accessing information; difficult to internalize acquired knowledge

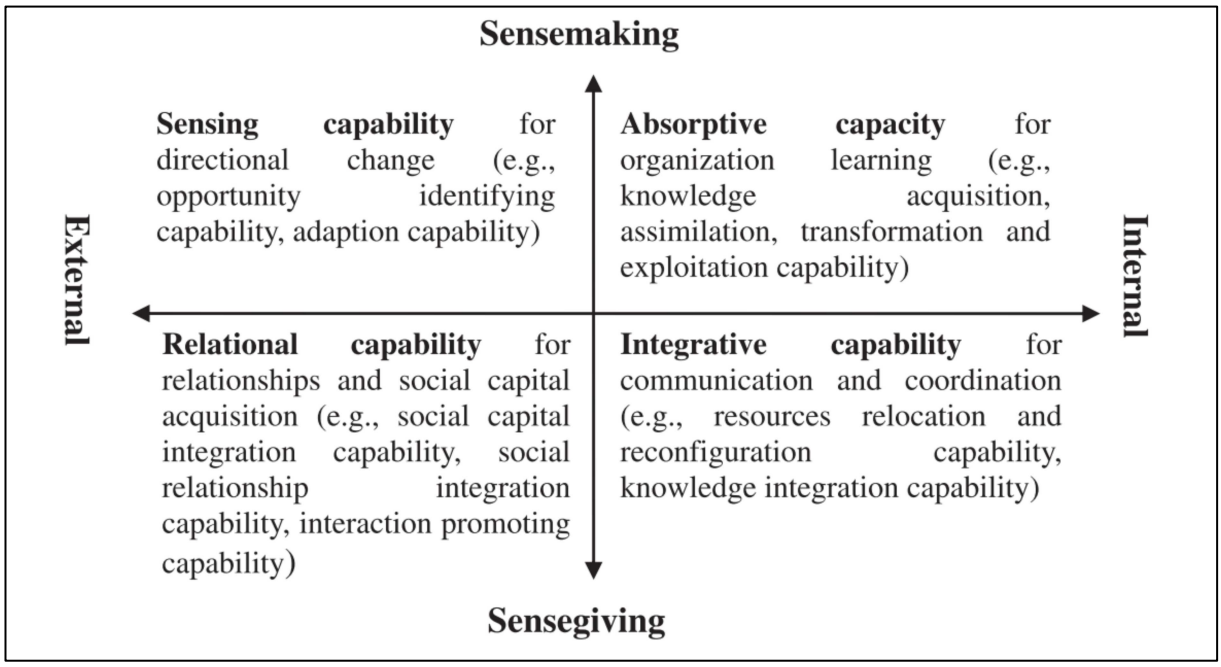
Source: Adapted from Denford (2013).

Within the typology of development and assimilation, some DCs stand out. In a study by Lin, Su and Higgins (2016), where it is discussed how DCs affect the adoption of innovation management, the authors present a framework with components of

dynamic capabilities (Figure 8). In it, the detection and relational capabilities are shown as more focused on the external environment, and the absorptive and integrative capabilities as more focused on the internal environment.

In addition to the external and internal levels, Lin Su and Higgins (2016) still dichotomizes the capabilities in *Sensemaking* - a process that consists of exploration, interpretation, and action (THOMAS; CLARK; GIOIA, 1993), and *Sensegiving* - a means of trying to influence *Sensemaking* towards organizational change (GIOIA; CHITTIPEDDI, 1991).

Figure 8 - Dynamic Capabilities Components



Source: Lin; Su and Higgins (2016).

In the first quadrant, which considers the external environment and a *sensemaking* capability, the dynamic capability presented is that of **sensing**. Detection DC refers to a cognitive process through which changes in the background are perceived and implemented.

In the second quadrant, which considers the external environment and a *sensegiving* capability, the dynamic capability presented is the **relational** one. Relational DC refers to building relationships and acquiring resources from these relationships.

In the third quadrant, which considers the internal environment and a *sensemaking* capability, the dynamic capability presented is the **absorptive**. The absorptive DC has the capability to assimilate, transform, and explore the knowledge acquired and transformed into incorporated experience.

Finally, in the fourth quadrant, which considers the internal environment and capability for *sensegiving*, the dynamic ability presented is the **integrative** one. The integrative DC concerns the reallocation, recombination, and reuse of existing and acquired resources.

In summary, what was sought in this subsection was to identify types of dynamic capabilities that are related to the external environment. The next subsection will try to establish a connection between the nature of the DCs and the dimensions of the RI.

2.4.2 Connection between the nature of Dynamic Capabilities and the dimensions of Responsible Innovation

Based on the proposition of Owen et al. (2013) that to innovate responsibly, it implies a collective and continuous commitment to be anticipative, reflective, deliberative, and responsive, managers and innovators must develop their mechanisms. Such mechanisms can be seen as processes and routines, which, in some cases, can be considered microfoundations of dynamic capabilities that enhance the inclusion of stakeholders.

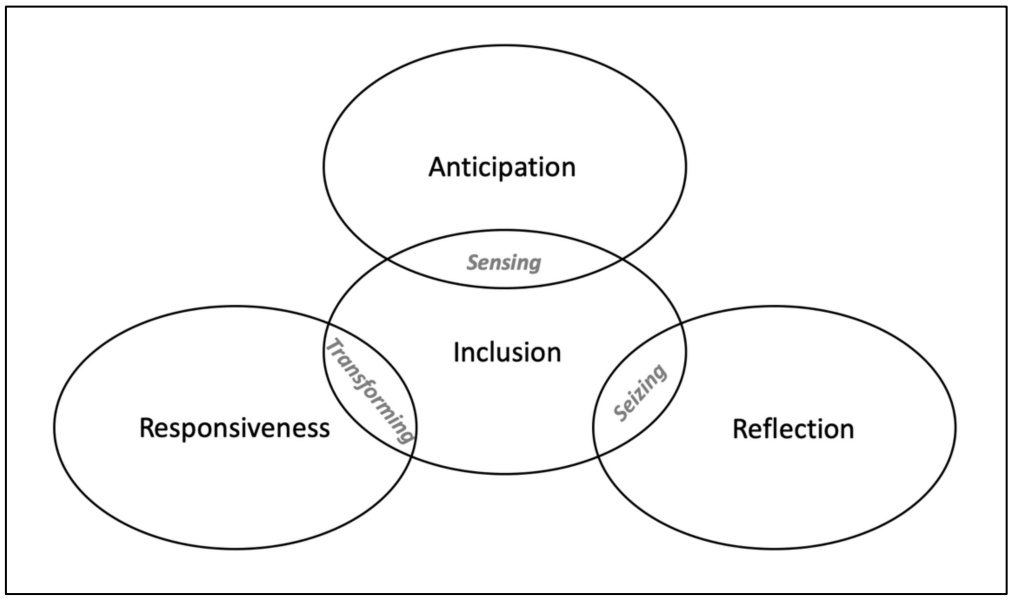
Seeking to advance the theoretical relationship between RI and DCs, there is a clear connection between the nature of dynamic capabilities (*sensing, seizing, and transforming*) and the dimensions of RI. From the model that considers inclusion as the main link of RI, the relationship of each aspect with the natures of DC is shown in Figure 9.

As previously presented, anticipation describes and analyzes the economic, social, environmental, intended, or emerging impacts (OWEN et al., 2013). To minimize uncertainties, entrepreneurs/managers must make conjectures based on information about the way forward. These conjectures become hypotheses that can be updated as evidence emerges (TEECE, 2007). Anticipation will only occur if opportunities and problems are detected (sensing). sensing can contribute to the determination of impacts and desired results through innovation, prevention, or

mitigation of adverse effects and development of maps for monitoring the impact (LUBBERINK et al., 2017). These key activities can be carried out, for example, through the identification of social needs (ARNOLD, 2010; EDWARDS-SCHACHTER; MATTI; ALCÁNTARA, 2012).

The reflection must take into account the purposes, motivations and potential impacts of what is known and what is not known (OWEN et al., 2013), demanding from the actors involved the externalization of (re) knowledge, values and beliefs (DEMERS-PAYETTE; LEHOUX; DAUDELIN, 2016). It is necessary to apprehend this knowledge (seizing), exploring the detected opportunities (TEECE, 2007). This can be done through the evaluation of the type of information available (presence, absence or subjectivity, for example) (LETTICE; PAREKH, 2010; LAMPIKOSKI et al., 2014), as well as through the knowledge management process, reframing problems and solutions (ELMQUIST; SEGRESTIN, 2009).

Figure 9 - Connection between the nature of DCs and the dimensions of RI



Source: by the author.

Finally, responsiveness, which requires the ability to change the form or direction of innovation, in response to stakeholder values (DEMERS-PAYETTE; LEHOUX; DAUDELIN, 2016), through an adaptive, inclusive, and open learning process (OWEN et al., 2013). Therefore, it is necessary to remodel processes and resources (transforming), ensuring a response to changes in the environment (LUBBERINK et al., 2017). This will happen through the customization of activities

(EVANS; PARTIDÁRIO; LAMBERT, 2007; DOSSA; KAEUFER, 2014), as well as changing operational routines (BARTLETT, 2009; LETTICE; PAREKH, 2010; KIRON, 2013).

Inclusion cuts across all dimensions and will influence each of the natures of dynamic capabilities. Concerning to sensing, its influence will be through the mapping of stakeholders (VON WELTZIEN HOIVIK, 2011), as well as the generation of ideas through the inclusion of multiple stakeholders (FRANKE; KEINZ; KLAUSBERGER, 2013; STEEN; BUIJS; WILLIAMS, 2014), helping the company to anticipate its needs. In the same way, seizing will take place through the reconciliation of different information and realities (from different actors) (PUJARI, 2006; CHALMERS; BALAN-VNUK, 2013). transforming will take place through the alignment of the strategic interests of stakeholders with the general objective of innovation (JAMALI; YIANNI; ABDALLAH, 2011; BLOK, HOFFMANS, WUBBEN, 2015).

2.4.3 Microfoundations of Dynamic Capabilities in Responsible Innovation

Despite the evident importance of including stakeholders in the RI process (OWEN et al., 2013), few studies detail how this happens. Comprehensively, Vaquero Martín, Reinhardt and Gurtner (2016) point to the identification, interaction, and integration of results in the innovation process as the primary inclusion capabilities of stakeholders. Silva et al. (2019) list the tools most described in inclusion studies, such as interviews, collective dialogue sessions, focus groups, workshops, and discussions with groups of experts. However, few studies provide details on the outcome of the inclusion process.

Several studies with companies like Intel, Frauenthal, Zenit Design, Starbucks, BPNC, and some anonymous companies point the inclusion of stakeholders in their innovation processes. Anonymous companies belong to the pharmaceutical, software development, orthopedics, and health education sectors. The methods and routines of each company are presented in Table 8.

What is perceived, from the cases, is a similarity in the actions of inclusion. Participation in fairs and events, organizing workshops, visiting customers, internal meetings to disseminate knowledge are the most frequent.

Table 8 - Business processes and routines for including stakeholders

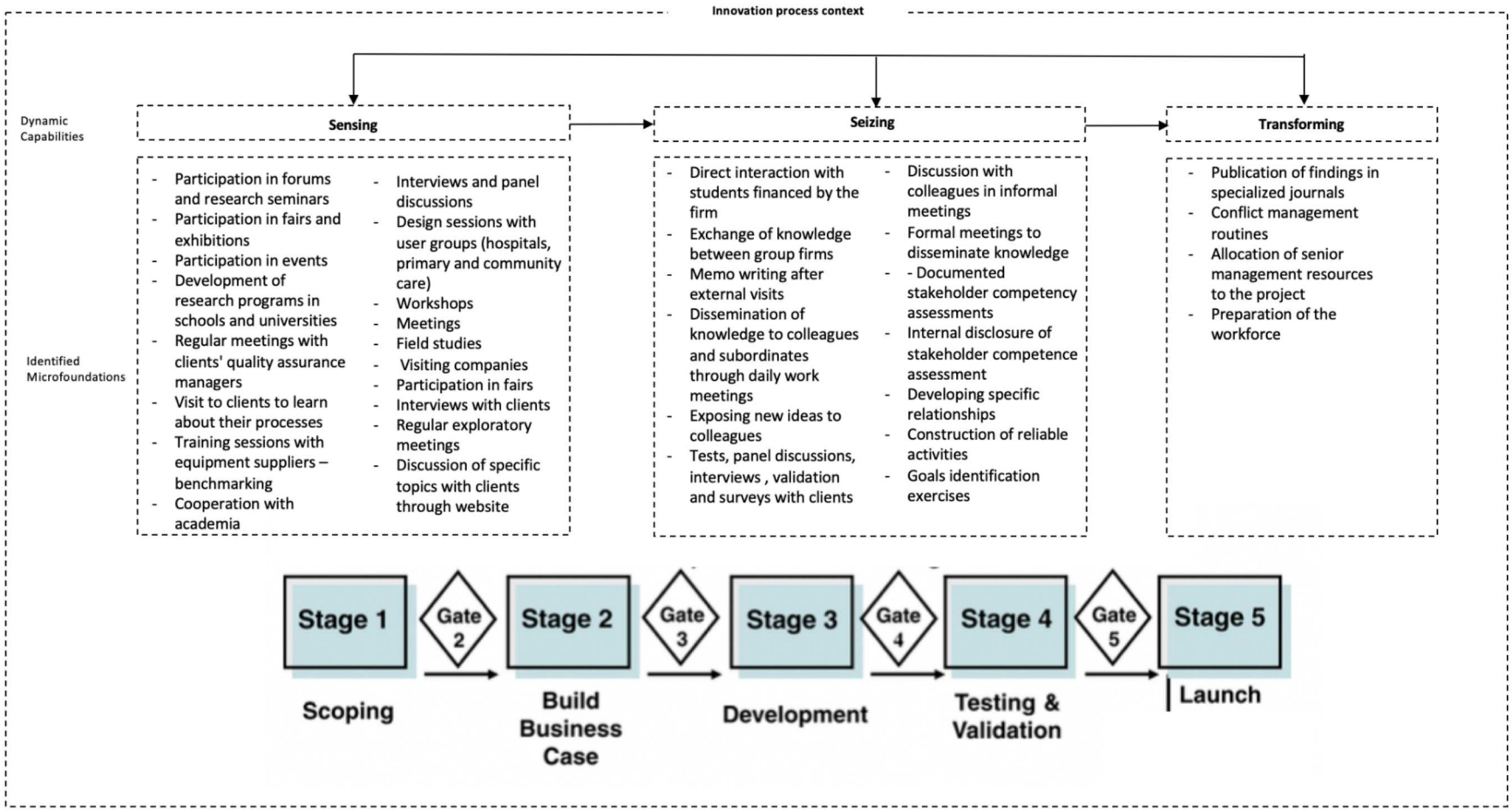
Company	Processes and routines	Reference
Intel	- Participation in forums and research seminars - Publication of findings in specialized journals - Development of research programs in schools and universities - Direct interaction with students financed by the company	Chesbrough, Vanhaverbeke, and West (2006)
Frauenthal	- Exchange of knowledge between group companies - Participation in fairs and exhibitions - Regular meetings with clients' quality assurance managers - Visit to clients to learn about their processes - Training sessions with equipment suppliers - benchmarking - Cooperation with academia - Memo writing after external visits - Dissemination of knowledge to colleagues and subordinates through daily work meetings - Exposing new ideas to colleagues	Lis, Sudolska (2015)
orthopedic company	- Discovery stage: interviews and panel discussions - Creation stage - tests, panel discussions and interviews - Refining stage - interviews, validation and survey	De Ana, Umstead, Phillips, and Conner (2013)
Health TV	- Design sessions with user groups (hospitals, primary and community care) - Participation in events	Bessant, Alexander, Wynne and Trifilova (2017)
HCC	- Workshops	Nudurupati, Bhattacharya, Lascelles, and Caton (2015)
Zenit Design	- Workshops - Meetings - Field studies	Andersen *et al.* (2017)
technology company	- Exploratory activities (experimental processes)	Khanagha, Volberda, and Oshri (2017)
unknown companies	- Visiting companies - Participation in fairs - Interviews with clients - Discussion with colleagues in informal meetings - Formal meetings to disseminate knowledge	da Mota Pedrosa, Välling, and Boyd (2013)
BPNC	- Workshops	Keeys & Huemann (2017)
pharmaceutical company	- Regular exploratory meetings	Kazadi, Lievens, and Mahr (2016)

	- Documented stakeholder competency assessments - Internal disclosure of stakeholder competence assessment - Developing specific relationships - Construction of reliable activities - Goals identification exercises - Conflict management routines - Allocation of senior management resources to the project - Preparation of the workforce	
Starbucks	- Discussion of specific topics with clients through website	Ramaswamy, Gouillart (2010)

Source: by the author.

From the listed processes and routines, a framework was developed (Figure 10), classifying the identified microfoundations of dynamic capabilities, which are used for the inclusion of stakeholders during the innovation process.

Figure 10 - Microfoundations of DCs for the inclusion of stakeholders in the innovation process



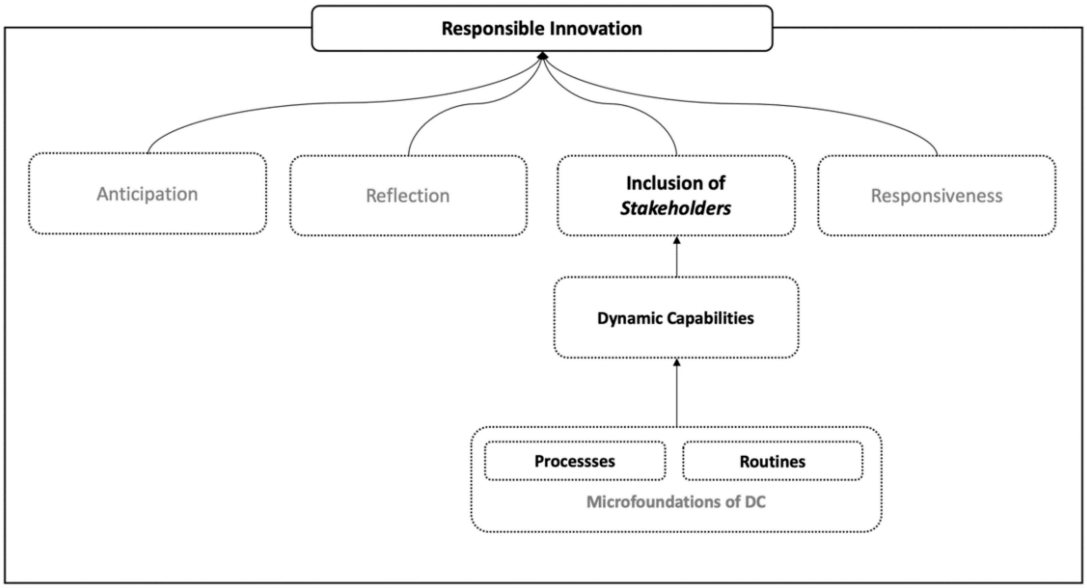
Source: by the author.

On the one hand, when analyzing studies that somehow describe the process of including stakeholders during the innovation process, it is clear that several methods and routines are used to learn and detect, filter, train and calibrate opportunities (sensing). Likewise, there are some corporate structures, procedures, projects, and incentives to take advantage of opportunities (seizing). However, the continuous alignment and realignment of specific tangibles and intangibles (transforming) have practically not been explored.

On the other hand, no research fully describes the inclusion of stakeholders during the innovation process. The result of the inclusion is reported mainly in cases where few interactions are carried out, such as through workshops. The knowledge of these activities is then absorbed. No study describes the entire process in a systematic and in-depth way.

Thus, the gap pointed out above is reinforced, regarding the lack of studies that detail, in a systematic and in-depth manner, the inclusion process. The importance of this thesis is also highlighted, which argues that dynamic capabilities leverage the inclusion of stakeholders in a responsible innovation process. These dynamic capabilities are operationalized from their microfoundations. At the end of the theoretical analysis, Figure 11 presents the conceptual map of the thesis.

Figure 11 – Conceptual Map



Source: by the author.

Thus, the chapter on the theoretical foundation is concluded, and the methodology used is presented in the next section.

3 METHODOLOGY

This chapter presents the methodology developed to answer the research question, namely: "How do dynamic capabilities leverage the inclusion of stakeholders in the responsible innovation process?". For that, it was investigated along with the theory, which methods contribute to the construction of the answer.

Thus, the research outline, techniques for data collection, and analysis are presented below.

3.1 RESEARCH DESIGN

The research design refers to the definition of its paradigm and method. This thesis is based on two case studies, using content analysis to identify the microfoundations of dynamic capabilities.

Since the objective of the thesis is to analyze how dynamic capabilities leverage the inclusion of stakeholders, it is necessary to examine a critical stage in the RI process.

Qualitative, or phenomenological, studies analyze complex or strictly particular situations (RICHARDSON et al., 1999). For this reason, the qualitative method was used, as it allowed to detail the process and analyze the DCs identified from the inclusion of stakeholders.

The healthcare sector was defined as the research context, as the theme “health” has attracted the attention of several researchers in the area of management and business. References such as John Bessant (BESSANT et al., 2017) and Michael Porter, Kaplan and Frigo (2017; PORTER; LEE, 2016) turned their studies to this area. Seeking to minimize problems and develop solutions that achieve the objectives of digitalization in healthcare - cost reduction and quality gain - are premises of several companies and are closely connected to the context of responsible innovation (RI). However, the number of studies on the digitalization of health is not significant, especially if combined with the phenomenon of responsible innovation.

3.1.1 Research method

For the description and explanation of the phenomena that were investigated, a systematic procedure or research method was carried out (RICHARDSON et al., 1999).

Since the research question is of the "how" type, the case study method was identified as the most appropriate, since it describes the situations in which decisions were made, how they were practiced — the result obtained through (s) chosen case (s) (SCHRAMM, 1971).

Since the topic has been little explored, the research has an exploratory character, which, according to Gil (2008, p. 27), "has as its main purpose to develop, clarify and modify ideas, to formulate more precise problems or searchable hypotheses for further studies". Exploratory research makes it possible, in the end, to present proposals.

The research method was established through multiple case studies to contrast and/or generalize the findings (YIN, 2003). Finally, a significant positive aspect was perceived, as it was able to develop a comparative analysis of the inclusion processes in companies recognized for the inclusion of stakeholders in different countries and contexts, reinforcing the identification of the dynamic capabilities that leverage the inclusion of stakeholders.

3.2 RECOGNIZING THE FIELD - SELECTING CASES

Since the researcher did not know (academic, professional, or personal) about the healthcare sector, it was necessary to make a recognition of the field. Thus, in-depth interviews were carried out with entrepreneurs, indicated for their outstanding projects, in addition to a representative from Universidade Federal do Rio Grande do Sul (UFRGS), linked to the state initiative of Telessaúde. Table 9 presents the interviewees.

Table 9 - Field reconnaissance interviews

Case	Interviewed	Date interviews	Interview time
SOSPS	SOSE1 – CIO; SOSE2 – partner; SOSE3 – client - hospital; SOSE4 – user; SOSE5 – client - hospital; SOSE6 – user; SOSE7 – consultant and user	Between November 16, 2017 and January 5, 2018	(exchange of emails and audio messages via WhatsApp)
Telessaúde	TELE1 - Responsible for the Communication Team	15/06/2018	1:31:41
Ceanne Telemedicina	CEAE1 - CEO	19/07/2018	50:50
Salux	SALE1 – CEO	10/08/2018	54:26

Source: by the author.

Analysis of documents related to each case was also carried out, as shown in Table 10.

Table 10 – Documents analyzed

Case	Documents
SOSPS	- Institutional website (http://www.sosps.com.br/) - Media reports
Telessaúde	- Institutional website (https://www.ufrgs.br/telessauders/) - Institutional presentation
Ceanne Telemedicina	- Institutional website (https://www.ceannetelemedicina.com/) - Master's thesis by Fernando Henrique Pisa
Salux	- Institutional website (http://www.salux.com.br/) - Master's dissertation by Fabrício Colvero Avini - Article written by Fabrício Colvero Avini

Source: by the author.

Finally, a survey was conducted with national companies that develop digital solutions for the healthcare sector. The main objective was to map who are the stakeholders involved in product development, in what stage of development do they participate and what are the participation strategies.

Before application, a pre-test was performed with the judges described below (Table 11) to assess the clarity and objectivity of the questionnaire. Based on the

considerations, the survey was adjusted, and its final version (Appendix A) was released.

Table 11 – Pre-test judges

Identification	Formation	Knowledge area	Operating time
J1	Ph.D. in Administration, in post-doctoral internship	Business	3 years
J2	Ph.D. in Administration	Business	12 years
J3	Master in Pathology	Medicine	8 years
J4	Master's student in Administration	Communications	7 years

Source: by the author.

The companies were identified in two ways:

1) Research on websites and electronic magazines - 98 companies were identified - startups or not - that develop (were) digital innovations focused on health. However, many of them were not reached because they no longer exist when the survey was carried out or because of the form of contact that takes place only use a form on their website, and it is not possible to send the targeted email. Some emails sent also returned with the information that the address was invalid;

2) Dissemination of research on social networks (Facebook and Linkedin), suggesting to the researcher’s contacts to answer and share the research.

The survey was available between August 11, 2018, and December 30, 2018, obtaining 24 valid responses (2 responses were excluded because (1) did not refer to companies in the sector; (2) answered in duplicate).

Most of the companies participating in the survey are micro-enterprises (60%), with up to 9 employees. The vast majority (80%) have been on the market for more than two years. The business deals mainly with health education and information (28%), connected medicine (20%), telemedicine (20%). They are strongly related to the Sustainable Development Goals (SDGs), proposed by the UN. For example, a startup has developed an application to connect the user to a nutritionist, helping with a better diet and quality of life. On a larger scale, the benefits generated by telemedicine, through access to specialist medical doctors, stand out. The waiting time for appointment decreases, as well as trips to hospitals in urban centers that have a more substantial structure and relief in tuning in these hospitals.

Users, researchers, educational organizations (such as universities), and medical doctors are the most frequent participants in the inclusion process, with regular participation in the initial stage (generation of ideas) for commercialization. The SOSPS application well illustrates the inclusion of users and medical doctors. In the pre-project stage, users were responsible for evaluating the factors of choice, view of emergency services, and responsiveness to the waiting time monitoring service for occasional users, such as parents of young children in pediatrics) and chronic patients (recurrence of use). Medical doctors and managers contributed to the understanding of the problem, preliminarily identifying the challenges and positive and negative opinions of the product's receptivity. After the application was developed, users were responsible for usability testing, information architecture, and ease of use validation. Medical doctors and hospital managers were responsible for collaborating in the definition of standards, minimum update periods, appropriate specialties for the launch of the Minimum Viable Product (MVP), service and screening protocols, and essential information that users should be aware of.

As inclusion tools, the most used are workshops, and interviews. One of the Telemedicine managers highlighted the significant contribution of the workshop held in the initial stage of business development. The manager pointed out that "So I think that was the most valuable point in my research process. And from ... I understood several points, several triggers that could favor me for the project floor." Informal conversations were also used, mainly to validate some information.

In summary, what is perceived is that Brazilian companies that develop products or services for the healthcare sector behave similarly to companies in developed countries (THOMAS; SILVA, 2019), especially regarding the inclusion of external stakeholders from the initial stages. In the interviews, it was clear that all entrepreneurs share the vision of the benefits of this early inclusion.

Also, it was clear that Brazilian companies face the difficulties inherent in developing countries. Exploring the difficulty in delaying medical care was the idea explored by SOSPS. Likewise, companies that offer specialized telemedicine services. Even in another area, such as the development of an ERP system (Enterprise Resource Planning) for hospitals, a Brazilian company ends up taking advantage of the space that will be difficult for large multinational companies, due to the complexity

of the healthcare system, the intense regulation and the frequent changes in legislation.

3.3 CASE DEFINITION

One of the main challenges of the thesis was to identify and access companies that had their (responsible) innovation processes, and that counted on the inclusion of multiple stakeholders throughout the process on a consolidated basis. It was tried to avoid a case in which the addition occurred only in one of the stages (SILVA et al., 2019) or that was made based on trial and error (GASSMANN; ENKEL; CHESBROUGH, 2010). Besides, it needed to mean the potential for disclosure and wealth of data (GIOIA, 2004).

Based on the definition of the research objective, and also based on the literature and after conducting the field recognition, the selection criteria for the companies studied were established:

- Criterion 1 - the company has recognition in the healthcare sector, the context of the research, in addition to explicitly (through the mission, vision, or values) being aligned with the concept of RI.

- Criterion 2 - the company has the stages of the innovation process already established (established and responsible processes and routines, aware of the expected result in each stage);

- Criterion 3 - the company can fully develop the innovation process;

- Criterion 4 - the company has maturity and continuity in the stakeholder inclusion process;

- Criterion 5 - the company comply with the other dimensions of RI governance.

Once the case selection criteria were established, it was found that the companies that made up the field recognition stage did not fit the requirements, as they are small companies, still operating on a “trial and error” basis (Criterion 4) in the innovation development stages; for belonging to joint projects, such as Telemedicine (Criterion 2); or because they are not concerned with RI (Criterion 5).

The first case investigated was known from a project developed in partnership between the University of Vale do Rio dos Sinos (UNISINOS) and Siemens Healthineers. The researcher was introduced to the responsible person for the project,

who agreed to participate in the research. German Siemens is one of the largest global companies operating in several areas such as energy, industrial automation, and healthcare, and its premise is to develop products for society. Siemens Healthineers is currently a leading medical technology company with over 120 years of experience and 18,500 patents worldwide. It operates in more than 70 countries, with more than 50,000 employees. Approximately 70% of critical clinical decisions are influenced by Siemens technologies, with 240,000 patients coming in contact with its products and services every hour. The company met the five established criteria.

The second case investigated was known from contacts with the University of Stavanger, during the period of the doctorate visiting period. Laerdal is a Norwegian company, a world reference in the manufacture of mannequins for simulation of services, but also in-service education. Over the years, it has established a strong partnership with recognized medical associations and even with users of its equipment. In 2018, the company challenged, until 2020, to save 500,000 lives. To this end, it heavily invests in improving its products and disseminating knowledge to save lives through the (exhaustive) simulation of risk situations, such as cerebrovascular accidents (CVA) and births. Laerdal also met the established criteria.

To contribute to the evaluation of criterion 5, even though it is not the objective of the present thesis, it was necessary to analyze the other three dimensions of RI (anticipation, reflection, and responsiveness). A model of the dimensions of the RI was developed, inspired by the Canvas model, and applied in both cases. The model does not influence the analysis of the inclusion dimension. On the contrary, it presents, in a synthetic way, based on the 3W1H model (SILVA et al., 2019), who are the agents involved in the inclusion, when (in which stages of the RI process), who are the stakeholders involved and, finally, how the inclusion is made.

From the analysis of the dimensions table, it was confirmed that both organizations are considered companies that develop responsible innovations since only the inclusion process would not adequately respond to this responsibility. The researcher points out that other contexts, such as open innovation (CHESBROUGHT, 2003) and co-creation (PAYNE; STORBACKA; FROW, 2008), also consider the participation of stakeholders in the innovation process to be necessary, but by themselves do not guarantee responsibility in the process. The model is presented at the end of the analysis of each case, in the next chapter.

The next section describes how the data was collected.

3.4 DATA COLLECT

The contact with the company Siemens Healthineers (from now on called Siemens) was initially established through the manager responsible for Ideas, Patents, and Collaboration of the company Siemens Healthcare GmbH (from now on called Siemens), located in the city of Forchhein, Germany. The first contact was made by email on August 17, 2018. After the first contact, several emails were exchanged, to explain the needs for the research and alignment of agendas. Up to the date of the primary interviews, held on December 6 and 7, 2018, around fifteen emails were exchanged, and three audio conferences were held. Based on these alignments, a confidentiality agreement was signed between the parties and the first scheduled interviews. An interview was also conducted with a Brazilian researcher who develops a project in partnership with Siemens. More information about the meetings is presented below.

The contact with the company Laerdal Medical (from now on called Laerdal) located in Stavanger, Norway, was initially made through the Corporate Director of Quality Assurance, Regulatory Assurance, and Intellectual Property. From that first interview, the interviewee indicated the next, that who indicated the next. In addition to the meetings at the company's headquarters in Norway, some interviews were conducted in Brazil, with users of the equipment and national representatives of the company.

The researcher used three data collection techniques: semi-structured interviews, written and electronic documents, and non-participant observation.

The interviews were conducted with employees of the companies, but also with people who relate to the companies (for example, a researcher associated with a joint research project, commercial representative, and users of the products). Respondents will be introduced next. As a tool for non-participant observation, a field diary was created to record not only data and information but also perceptions about the visits.

3.4.1 Interviews

The interview script was prepared following the guidelines of Charmaz (2009), with open questions. Table 12 presents the protocol with semi-structured questions for in-depth interviews.

Table 12 - Guiding research questions

Dimension	Questions (28)
About the product (6)	1) What is the name of the product? 2) How long is the product development process? 3) What stage is it in? 4) How was product development funded? 5) What makes the product innovative? Has the product development process generated any patents?
About the stakeholder's participation (9)	1) Can you tell me, in detail, the history of *stakeholder* participation in the development of this product? 2) How did the idea come about? 3) What have been / are being the big challenges? 4) How have they been / are being overcome? 5) Who participated in the development process ... why did you participate? 6) How was each chosen or started participating? 7) How did you participate, did you develop processes or routines for this? 8) Which were used? 9) Did they differ for each *stakeholder* type? Why?
About the method and earnings/contributions (10)	1) Is multi-*stakeholder* participation a practice / policy of the company or is this the first project that contemplates this participation? 2) Were gains realized through the participation of multiple *stakeholders*? 3) What kind of gain? With which *stakeholders*? 4) What is the benefit to the *stakeholder* in participating in the product development process? 5) Who participated in product development over time? 6) What was the reason for your participation? What was your contribution? 7) At what stage (s) of the product development process were the *stakeholder* (s) involved? How was this definition made? 8) What method was used for these participations (interview, focus group, questionnaire)? 9) Was the same method used at all stages of the product development process? 10) Have processes or routines been developed to manage *stakeholder* participation? Why were they developed it? Who developed it?
Complementation (3)	1) Who do you indicate for upcoming interviews? 2) Is there anything else you would like to report?

	3) Is there something you would like to ask me?

Source: by the author.

As predicted, when interviews are conducted based on guiding questions, new questions arise as the interviewees bring new components. In some cases, further questions were asked, since the interviewee was not directly involved with the project, or did not have relevant information about the project, such as the interviewees in the Siemens Patent sector.

Table 13 shows the list of respondents.

Table 13 - Interviewees of the studied cases

Interviewee	**Department**
Siemens	
S1	Ideas, Patents and Collaboration
S2	Marketing
S3	R&D
S4	Marketing
S5	Patents
S6	Patents
S7	R&D
S8	*Define* (Marketing area, responsible for defining new products, or improving current ones)
S9	Marketing – Sale price
S10	Marketing – Sale price
S11	Marketing – Digital eco-system
S12	R&D software App
S13	R&D open apps
S14	Software engineer
S15	Unisinos researcher - develops a joint project between Unisinos, Siemens and FAU (Brazil)
Laerdal	
L1	Production manager
L2	Corporate Director of Quality Assurance, Regulatory Assurance and Intellectual Property
L3	Product Development Manager
L4	Design Manager
L5	Associate Professor, Department of Security, Economics and Planning, Faculty of Science and Technology, University of Stavanger. Former Laerdal Medical employee.
L6	Senior designer
L7	Nurse and lecturer of the Unisinos Nursing course (Brazil)
L8	Regional Sales Manager (Brazil)
L9	Director of Biomedical - regional representative of Laerdal (Brazil)
L10	Business Development Director - Patient Care (USA)
TOTAL	

Source: by the author.

Based on the interviewees' presentation, Table 14 summarizes the interviews conducted. In some cases, more than one respondent participated, mainly at Siemens.

Table 14 - Interviews conducted on the studied cases

Interview	Interviewee	Interview date	Interview time	Modality
Siemens				
1	S1	28/08/2018	00:15:08	Conference Call
2	S2	15/10/2018	00:10:23	Conference Call
3	S1 e S2	22/10/2018	00:27:47	Conference Call
4	S2	06/12/2018	00:36:39	Presential
5	S3 e S1	06/12/2018	00:47:56	Presential
6	S4	06/12/2018	00:28:23	Presential
7	S5 e S6	06/12/2018	00:20:09	Presential
8	S7	06/12/2018	00:19:05	Presential
9	S8	07/12/2018	00:51:23	Presential
10	S9 e S10	07/12/2018	00:22:52	Presential
11	S11 e S1	07/12/2018	00:22:39	Presential
12	S12	07/12/2018	00:21:35	Presential
13	S13	07/12/2018	00:24:44	Presential
14	S8	20/02/2019	00:31:05	Conference Call
15	S2	21/02/2019	00:14:18	Conference Call
16	S14	13/03/2019	00:33:16	Conference Call
17	S15	25/04/2019	00:22:52	Presential
Laerdal				
1	L1	16/06/2017*	01:45:00	Presential*
2	L2	11/01/2019	00:30:28	Presential
3	L3	30/01/2019	00:46:09	Presential
4	L4	01/02/2019	00:45:23	Presential
5	L5	22/02/2019	00:23:57	Presential
6	L6	26/02/2019	00:36:35	Conference Call
7	L7	10/05/2019	01:00:05	Presential
8	L8 e L9	03/07/2019	00:44:09	Presential
9	L10 e L9	12/07/2019	00:30:00	Conference Call
TOTAL	**26 INTERVIEWS**		**14:32:00**	

Source: by author.

* Directed by Raj Kumar Thapa, from Stavanger University[3].

In total, 25 people were interviewed, 26 interviews were done, and 14 hours and 32 minutes of recording. Almost all interviews were conducted in English. For technical

[3] Ph.D. candidate at Stavanger University – the content of the interview was used, together with other materials, to compose a chapter in the book “Responsible Innovation in Digital Health Empowering the Patient”.

problems, the interviews ES1, ES2, and EL9 were not recorded, but notes were made in the field diary. All the others were recorded and transcribed, crossing with other data collected. For the interviews carried out by conference call, the Zoom.us tool was used, which allowed the availability of images and the recording of the meetings.

It was necessary to translate some excerpts, maintaining the reliability of speech as much as possible, following the recommendations of Strauss and Corbin (2008).

3.4.2 Documents

Throughout the interviews, documents and public information were cited. Some documents were sent by email by the interviewees after the interviews were conducted, as well as printed materials were provided.

The documents and information available on the companies' website and other specialized websites/magazines are listed below and served as the basis for the triangulation. Table 15 presents the analyzed documents.

Table 15 – Analyzed documents

Document		Source	Pages
Siemens			
DS1	Siemens Healthinners - Institutional website	https://www.healthcare.siemens.com/	1
DS2	The Company: May 2019	https://www.siemens.com/press/pool/de/homepage/Siemens-company-presentation.pdf	65
DS3	Shaping the future: Qualities that set Siemens apart – after 170 years	https://assets.new.siemens.com/siemens/assets/public.1506341881.38754e5ae3933ce8038e2d78293aa98317335cea.094-shi-siemens-at-170-years-the-siemens-narrative-2017-e.pdf	17
DS4	Digital Ecosystem	https://www.healthcare.siemens.de/infrastructure-it/digital-ecosystem	1
DS5	Digital Ecosystem for partners	https://www.healthcare.siemens.de/infrastructure-it/digital-ecosystem/portfolio/for-partners	1
DS6	Cios Alpha – Brochure	https://www.healthcare.siemens.com/surgical-c-arms-and-navigation/mobile-c-arms/cios-alpha-cmos	1

DS7	Cios OpenApps_Introduction	Institutional document - internal use	32
DS8	Cios OpenApps: App Developer Guide	Institutional document - internal use	27
DS9	Siemens Healthinners Politics	Institutional document	1
DS9	Magazine Somatom Sessions	Institutional magazine	83
DS10	Email about project “OpenApps”	Christian Dressler	6
DS11	Participation process in medical congresses - equipment demonstration	Manfred Wittmann	2
DS12	Report “How to lead in the VUCA World - Lessons from Siemens Healthineers”	Harvard Business Review, December 2018 edition	10
DS13	Management Manual Siemens Logistics GmbH	https://assets.new.siemens.com/siemens/assets/api/uuid:89b72b08b7cf2ca467bb549924a438359cd271ec/version:1532599867/management-manual-mobility.pdf	14
Laerdal			
L1	Laerdal Medical – Institutional website	https://www.laerdal.com/	1
L2	Book Saving more lives – together: The vision for 2020		123
L3	Book Saving more lives – together: 500.000 every year by 2020		31
L4	Responsible Research and Innovation: Innovation initiatives for Positive Social Impact	Chapter 8 of the book: Responsible Innovation In Digital Health Empowering the Patient	18
L5	The Laerdal Development Process: The Core Process 00044432 Rev D	Institutional document - internal use	17
L6	Reportagem “Nytt prosjekt skal redde flere liv” (Novo projeto vai salvar mais vidas)	Stavanger Aftenblad (jornal local), published on January 17, 2019. Electronic translation into Portuguese.	6
L11	Email of 04.02.19	Frederik Hansen	15
L12	Resusci-Anne to the Rescue	http://www.scienceheroes.com/index.php?option=com_content&view=article&id=346&Itemid=292	1
L13	Resusci Anne and L'Inconnue: The Mona Lisa of the Seine	https://www.bbc.com/news/magazine-24534069	1
L14	Annie...Annie. Are you ok? Resusci Anne	https://archive.fo/20141227115243/http://www.emsmuseum.org/virtual-museum/Equipment/articles/399766-Annie-Annie-Are-You-OK-Resusci-Anne	1

L15	The Closed-Chest Method of Cardiopulmonary Resuscitation: Revised Statement	https://www.ncbi.nlm.nih.gov/pubmed/14278052	3
L16	Resusci Anne Simulator: user guide	http://cdn.laerdal.com/downloads/f3897/user_guide_ra_simulator	28
L17	Code of conduct	http://cdn.laerdal.com/downloads/f4247/Laerdal_Code_of_Conduct.pdf	9
DOCUMENTS 30		**TOTAL OF PAGES** 515	

Source: by the author.

Table 16 shows the analyzed videos, in both cases.

Table 16 - Analyzed videos

Video		**Source**	**Time**
Siemens			
S1	Reducing diagnostic errors through digitalization	https://www.youtube.com/watch?v=m9kugCOXL1o	00:03:17
S2	Siemens Healthineers - shaping the future of healthcare	https://www.youtube.com/watch?v=o8NIN8dJqdc	00:01:46
S3	Changes in healthcare - the value of partnerships	https://www.youtube.com/watch?v=7CNauH2ykKM	00:02:00
S4	The truth about Siemens Healthineers	https://www.youtube.com/watch?v=djxdS0dWz3g	00:01:04
S5	Cardiovascular care in Monaco - a success story	https://www.youtube.com/watch?v=AQ1_pqt0bHE	00:03:04
S6	X-ray analytics - boost the efficiency in your radiology department	https://www.youtube.com/watch?v=Y96A192nEXY	00:02:51
S7	Innovative x ray technology improves access to care	https://www.youtube.com/watch?v=BYFopyAI9nc	00:03:54
S8	Manufacturing, retail and digitalization in healthcare - Dr. Mike Modic	https://www.youtube.com/watch?v=Y9C9tsX-6U0	00:10:11
S9	Building trust in the digital age - Melissa Hathaway	https://www.youtube.com/watch?v=eY4q_j9OV5s	00:10:41
S10	Siemens Healthineers in the community	https://www.youtube.com/watch?v=7JV4_hzA_Jk	00:02:55
S11	Mobile c-arm machine cios alpha simens	https://www.youtube.com/watch?v=kbJc1UXLgZ0	00:35:02
S12	Siemens cios alpha c-arm demo	https://www.youtube.com/watch?v=XE4Euh0wMBk	00:02:26
S13	Cios alpha in cardiac surgery – clinical video	https://www.youtube.com/watch?v=E8ndXSaCHso	00:07:10
Laerdal			

L1	How Collaboration Makes It Happen - Tor Inge Garvik - Tedxarendal	https://www.youtube.com/watch?v=srAaQaO3zh0	00:14:20
L2	Webinar “Helping babies grow”	https://www.youtube.com/watch?v=_476eFJGafo	00:29:12
L3	Annual video (2019 edition) about initiatives and solutions	https://www.youtube.com/watch?v=kI7G46IOwWc	00:02:35
L4	MamaBirthie design process	https://www.youtube.com/watch?v=hE3o4fbJxPQ&t=71s	00:02:43
L5	Helping save lives through innovative partnerships: Tore Laerdal at Tedxstavanger	https://www.youtube.com/watch?time_continue=1207&v=d9bYTgUcsP8	00:20:10
L6	Laerdal Development Process – Introduction	https://www.youtube.com/watch?v=v8JELyJvOe8&list=PLneKGZujojT3zn3YiUfgpMY6Vk0QHSMmw&index=1	00:01:23
L7	Laerdal Development Process – Principles	https://www.youtube.com/watch?v=vFAYF1e6S90&list=PLneKGZujojT3zn3YiUfgpMY6Vk0QHSMmw&index=2	00:01:45
L8	Laerdal Development Process – Explore	https://www.youtube.com/watch?v=MtCxbQkSfn0&list=PLneKGZujojT3zn3YiUfgpMY6Vk0QHSMmw&index=3	00:02:33
L9	Laerdal Development Process – Conceptualize	https://www.youtube.com/watch?v=qpnrHLMvOr0&list=PLneKGZujojT3zn3YiUfgpMY6Vk0QHSMmw&index=4	00:03:14
L10	Laerdal Development Process – Develop	https://www.youtube.com/watch?v=onLZ6gMHpMc&list=PLneKGZujojT3zn3YiUfgpMY6Vk0QHSMmw&index=5	00:01:56
L11	Laerdal Development Process – Deliver	https://www.youtube.com/watch?v=Uss5ZHe7NwU&list=PLneKGZujojT3zn3YiUfgpMY6Vk0QHSMmw&index=6	00:02:26
L12	Laerdal Development Process – Duality	https://www.youtube.com/watch?v=WAyazEot4PM&list=PLneKGZujojT3zn3YiUfgpMY6Vk0QHSMmw&index=7	00:01:15
DL13	Laerdal Development Process – Implement	https://www.youtube.com/watch?v=sRwBKScBUoI&list=PLneKGZujojT3zn3YiUfgpMY6Vk0QHSMmw&index=8	00:01:40
VIDEOS 26		**TOTAL** 02:51:33	

Source: by the author.

In total, 30 documents were analyzed, totaling more than 500 pages. Twenty-six videos were also analyzed, which completed 2 hours, 51 minutes, and 33 seconds.

In addition to the interviews and documents, the visit to the headquarters of the companies, spaces observation, and perceptions about the meetings were also rich material for analysis, described below.

3.4.3 Field diary

To ensure that all information and perceptions were recorded, the researcher organized a field diary. In it were noted the impressions at each interview, as well as information about the visits made at the headquarters of the companies. In some moments, audios were recorded, to streamline the filing of information, in addition to having a complete record, with the perceptions about the environment and the interviews. Also, photos were taken, of the visit to UNISINOS laboratories, which uses Laerdal Medical equipment, as well as a C-Arm that is being used in a joint project between Siemens, UNISINOS, and FAU. The photos are in Appendix C.

Altogether there were 40 pages of notes and 05 audio recordings made after the interviews, which totaled 15 minutes.

One of the perceptions about the interviews concerns the conference calls. When using the Zoom.us tool to conduct the calls with Siemens respondents, the researcher chose to leave the video camera off for both the researcher (interviewer) and the interviewee. There was a greater fluidity in the conversation when the interviewee was not being "seen."

The interviews at Siemens were carried out at the company's headquarters, in a room next to the Ideas, Patents, and Collaboration department. Respondents came to the room according to their schedule. There were a high table and four highchairs. In some interviews, ES1 participated at the beginning or throughout the meeting, seeking to facilitate interaction with the interviewee (s). All were receptive and attentive but limited themselves to responding to what was asked. Greater formality and care with information were noticed. The last interview, with ES12, was carried out in one of the company's cafeterias, as it is a location closer to its sector.

After lunch, on the first day of interviews, the interviewee ES1 took the researcher to the showroom, where there is an exhibition of multiple equipment. There it was possible to have a better dimension of the size and application of the equipment. We also visited a new production area where the material is assembled. It was not

possible to get close to the area, as they were still changing and not all access was possible. Besides, there was a great concern to safeguard the production process.

In the case of Laerdal, the interviews at the company's headquarters were carried out in meeting rooms or the interviewees' room. On several occasions, the interviewee was introduced to employees with whom she passed in the corridor. The company's environment proved to be more open to the proximity between people. It was also possible to visualize, mainly in the department of product design and development, several prototypes, and materials that are used to assemble the mannequins. The interviewees were very receptive and open, including bringing their personal experiences.

After personal interviews at both companies, the relationship between the way the companies manage the innovation process and the way information is transmitted is clear. At Siemens, there is a concern with generating patents, which requires greater confidentiality and care with information. At Laerdal, by contrast, there is almost no concern about patents. Data is transmitted more openly.

3.5 DATA ANALYSIS AND PRESENTATION

For data analysis, we used the content analysis method (BARDIN, 2016) and the organization took place as proposed by the author, presented through three chronological poles:

1) pre-analysis;
2) exploration of the material;
3) treatment of results, inference, and interpretation.

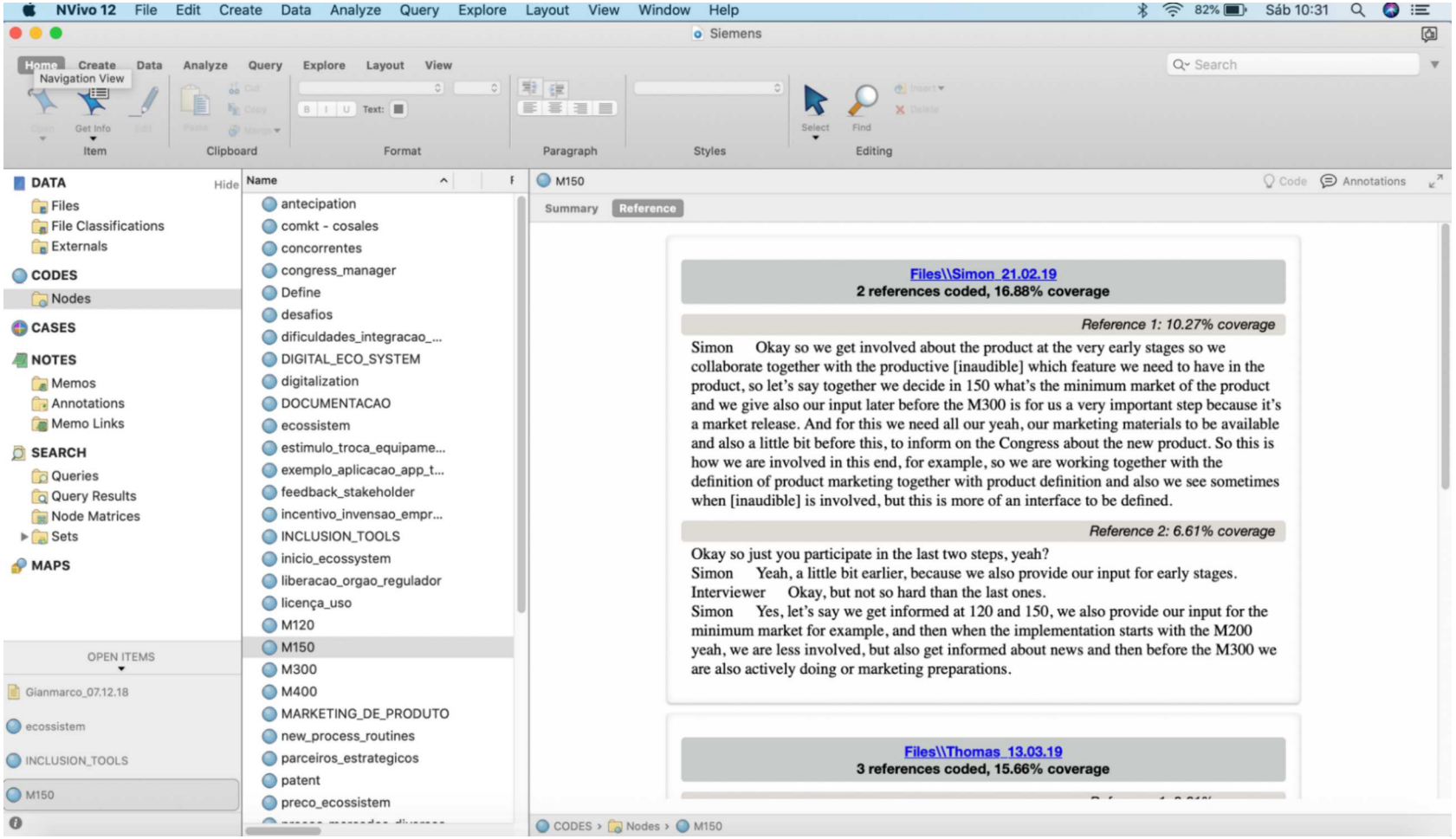
3.5.1 Pre-Analysis

For Bardin (2016), this is the stage of the organization itself. The material was organized through the selection of documents, transcription of interviews, and recordings in the field diary. In total, we analyzed 541 pages of content and 18 hours, 50 minutes and 33 seconds, including audios from the interviews and videos.

3.5.2 Exploration of the material

Written material (transcripts, video captions, diary notes) were added to the NVivo12 software. From the reading of the material, nodes were created, from the categories of analysis, and the sections considered necessary were demarcated. Figure 12 presents an illustrative screen of the material analyzed in the NVivo12 software.

Figure 12 - N-Vivo image from the Siemens case



Source: by the author.

The pre-analysis was performed considering the categories described below.

3.5.2.1 Categorization

One of the assumptions of content analysis is the definition of analysis categories, seeking to make the analyzed content objective (FLICK, 2004). Based on the theoretical framework, 03 main categories were stipulated (Table 17).

Table 17 - Content analysis categories

Category	Goal
C1 – Responsible innovation process stages	a) Description of each of the stages of the innovation process.
C2 – Microfoundations of stakeholder inclusion	a) Identification of the processes and routines that count on the participation of stakeholders; b) Identification of the stakeholders involved.
C3 – Dynamic capabilities	a) Analysis of the relationship between micro-foundations and the nature of dynamic capabilities: - sensing - seizing - transforming b) Identification and analysis of specific dynamic capabilities

Source: by the author.

Category 1 seeks to identify and describe the stages of the innovation process, as well as the gates between each one.

Category 2 presents the processes and routines developed for the inclusion of stakeholders, as well as the identification of which group (s) of stakeholders are involved.

From the processes and routines identified in the inclusion of stakeholders, Category 3 analyzes the dynamic capabilities, and their microfoundations (emerged from the processes and routines), for the inclusion of stakeholders, through their nature: *sensing, seizing and transforming*. Other possible DCs related to the addition of stakeholders were also considered.

3.5.3 Treatment of results and interpretations

The last stage refers to the moment of reflective and critical analysis (BARDIN, 2016). By using the three data collection techniques (interviews, documents, and non-participant observation), it was possible to analyze the data from its triangulation, where there is a combination of different sources and data collection methods, which produce various assessments of the same phenomenon (DAVIDSON, 2005; YIN, 2003)

When using interviews as the primary source of data on the stakeholder participation process, the data from observation and documentation served as complementary sources for data triangulation. In this way, it was possible to understand the events, their presentation, as well as the discrepancies between the statements of the interviewees, as a means of obtaining additional perspectives on critical issues (CORLEY; GIOIA, 2004).

To make the description of cases more fluid, the researcher chose to present them in a narrative form, which explores, interprets and demonstrates action through stories, meanings, and mechanisms (LANGLEY, 1999).

3.6 RESEARCH VALIDATION AND DESIGN

Empirical research of quality that uses case studies must contemplate four criteria (YIN, 2003): construct validity, internal validity, external validity, and reliability.

The construct's validity is established through some operational measures, such as the use of multiple sources of evidence, the establishment of an evidence chain, and the review of a draft by key informants (YIN, 2003). It is noteworthy that all were attended, according to Table 18:

Table 18 - Number of sources of evidence

Type	Siemens	Laerdal	Total
Interviews	17	9	26
Documents	13	17	30
Videos	13	13	26
Total	43	39	82

Source: by the author.

Information from interviews, documents, and videos and non-participant observation were used. Through data triangulation (YIN, 2003), the cases were adequately described. Finally, the drawings for the development of innovation were presented and approved by those responsible for the process, and even contributed with additional information.

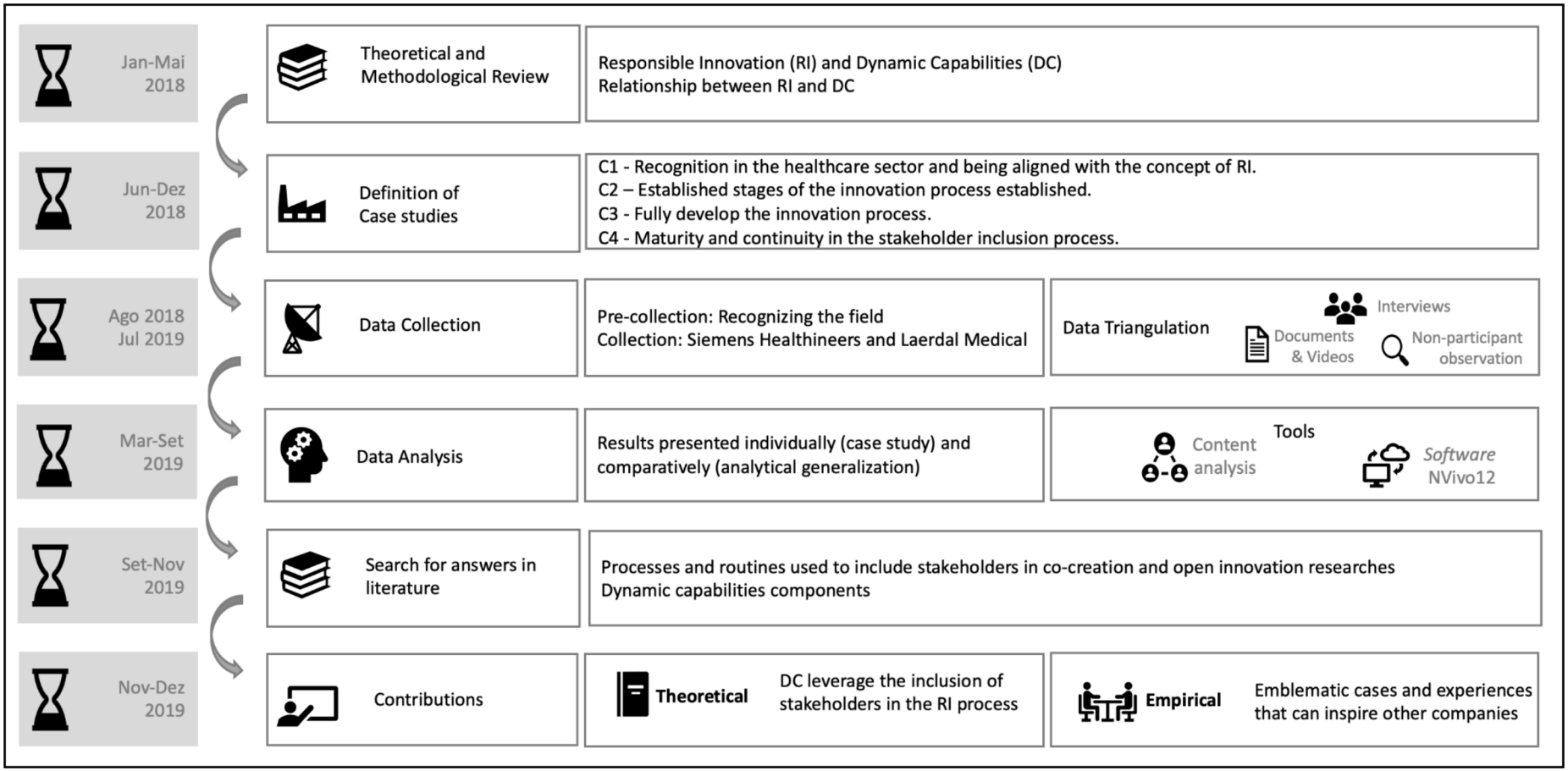
Internal validity concerns analysis within cases (YIN, 2003). This criterion was met since each case was described and analyzed according to the previously established categories and based on a theoretical framework.

External validity deals with the degree to which a study's findings can be generalized in social contexts (YIN, 2003). In the present study, we analyzed two cases of inclusion of stakeholders in companies known to develop responsible innovations. From each case, common points were highlighted, in addition to crossing with the literature. The comparative analysis of the cases contributed to enrich the study and produce analytical generalizations regarding the CDs that contributed to the inclusion of stakeholders and their respective micro-foundations.

The fourth and final criterion concerns to reliability, which refers to the degree to which different observers would obtain the same result from the study (YIN, 2003). Despite the difficulty pointed out in the replication of social studies (BRYMAN; BELL, 2001), the interview protocol and the presentation of the analyzed documents made it possible to guarantee the reliability of this study.

Figure 13 presents the stages, as well as the period in which they occurred, summarizing the stages involved in the study.

Figure 13 – Research design



Source: by the author.

This concludes the methodology chapter. The next chapter presents the cases, individually, and their empirical results, followed by chapter 5, which offers a comparative analysis between them.

4 RESPONSIBLE INNOVATION IN HEALTHCARE TECHNOLOGY COMPANIES

In this chapter, we analyzed the cases of the company's object of the study. After the presentation of each company, the innovation process and the inclusion of stakeholders are explained. From there, the microfoundations of dynamic capabilities are identified for the inclusion of stakeholders in the RI process.

4.1 CASE 1: SIEMENS

In this section, case 1 will be presented, from Siemens Healthineers. The case will detail the company's relationship with the following stakeholders: technology developers and healthcare professionals, such as medical doctors and radiologists, among others.

4.1.1 The history of Siemens Aktiengesellschaft

Siemens was founded in 1847, at the back of a building in Berlin. Werner von Siemens founded the company that manufactured a new model of the telegraph (Figure 14). With only ten employees, already in 1848, the company won a contract for the construction of the first long-distance telegraph line in Europe. Over the years, the company's area of activity has expanded, becoming one of the largest companies in the world. Currently, its products and services related to construction technologies, energy, finance, industrial automation, mobility, and health.

Figure 14 - Pointer Telegraph

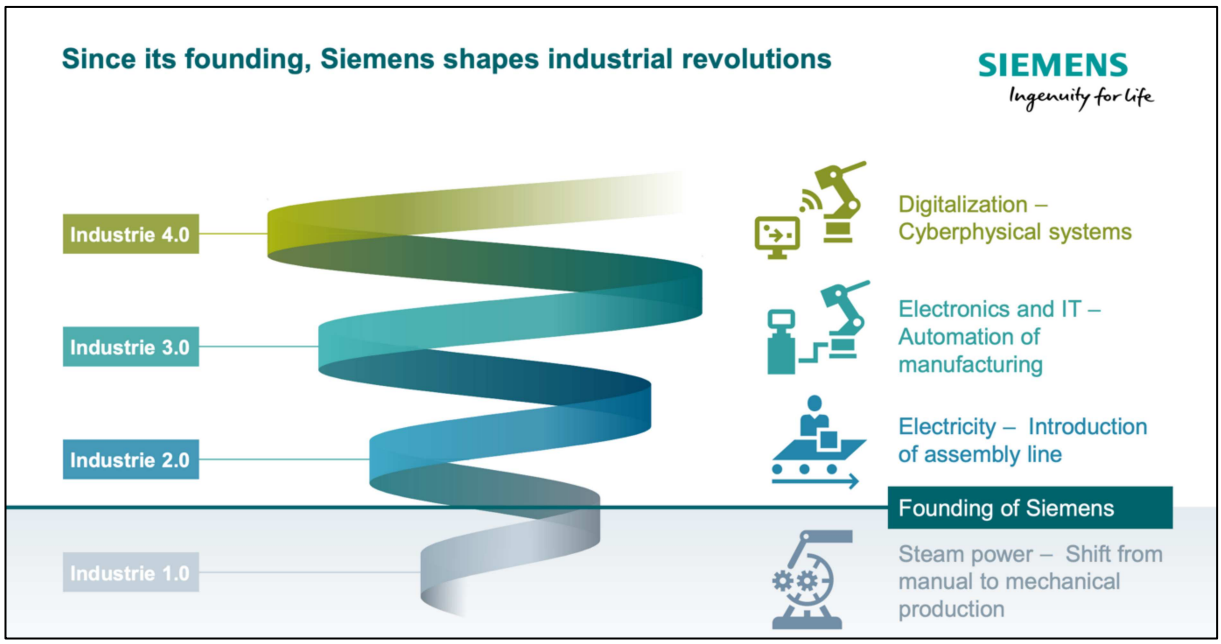
Source: Pointer Telegraph. In: Siemens website… (2019).

Some characteristics make Siemens the current company: innovation, internationalization, commitment to quality and customers, performance-tested in times of crisis, adaptability, and a strong sense of responsibility. And it is the interaction between these characteristics that defined Siemens in the past, and that illustrates what it represents today. From the beginning, Siemens was set as an **innovative** company. It began by refining and commercializing the pointer telegraph, work that was done amid the revolutionary acceleration of communications technology. The invention of the dynamo came shortly afterward and guided his contribution to electrical engineering. Currently, it remains innovative, with a system for the Internet of Things, MindSphere.

Over the years, the main participants in this story have combined scientific curiosity with entrepreneurial action to transform Siemens into a large corporation that dominates the entire electrification value chain. A particular aspect of Siemens has been the company's ability to not only change itself but also to shape the world around it.

Siemens followed the technological development and the different stages of the industry. Being founded in the era of Industry 1.0, the company acted and updated itself in the other stages (Figure 15).

Figure 15 - Phases of Siemens technological development



Source: Siemens Company Presentation. In: Siemens website... (2019).

Another essential characteristic is **internationalization,** since the beginning of its operation. Siemens was forced to take this stage when the first sales crisis hit the Prussian telegraph market. To overcome the crisis, the Siemens brothers sought new demands that their new company could serve. At the time, they built more than 9,000 kilometers of telegraph lines in Russia and installed underwater telegraph cables from their base in London. It currently operates in more than 200 countries, being seen not as a German company, but as a domestic company in each country. Its executives worked to establish the company as a local partner and member of the local society.

To have this global recognition, Siemens needed to have a strict focus on **quality and customers**. This quality emerged at the beginning of the company's history, spanning the years until recent initiatives such as the founding of a digital hub in Singapore, where it collaborates with customers, partners, and representatives of civil society there to address the main issues of the future-facing the city-state.

Over the years, the company has demonstrated its **ability to change and adapt to times of crisis**. An example of this is to have overcome the two great wars (Figure 16). The company has gone through several crises over its 170

years. Overcoming these crises contributed to the company developing skills to remain competitive today.

Figure 16 - Siemens headquarters in Berlin in 1945

Source: Siemens' History. In: Siemens website… (2019).

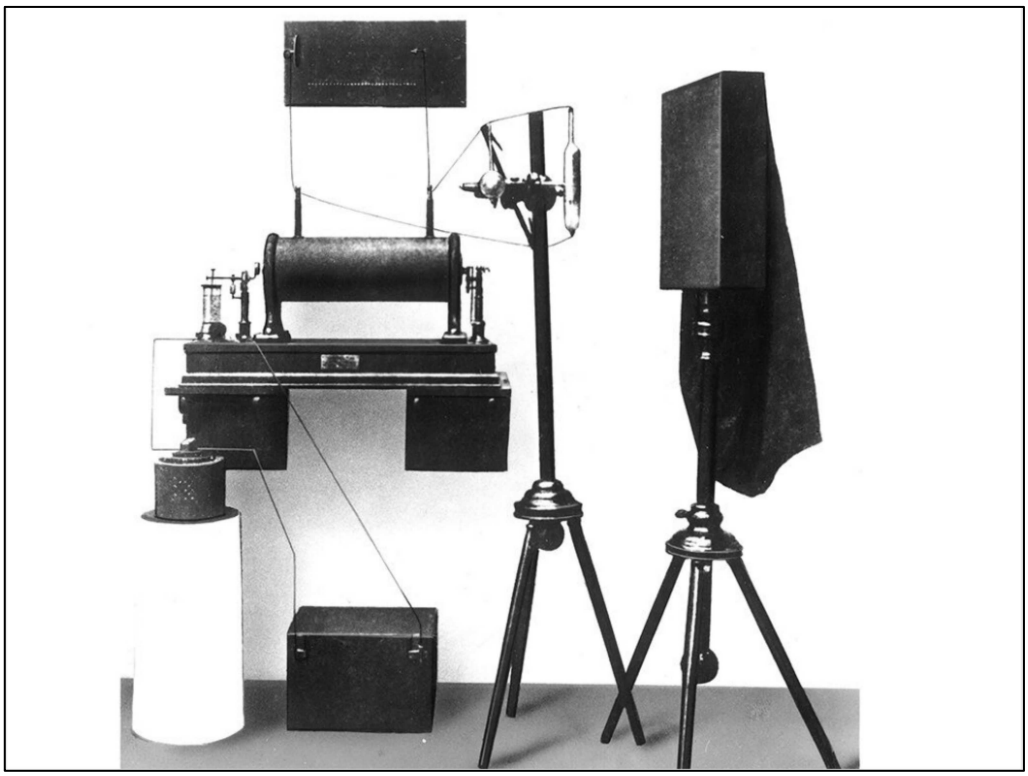
Siemens' vision is not only to be a company focused on maximizing results but also on serving society through its technologies, products, and practices. Siemens' purpose is to **serve society, create value for all stakeholders**, and do **what matters** (emphasis added). Value creation is also generated through open innovation initiatives, such as the establishment of research partnerships, favoring the exchange of knowledge, and collaboration with universities, research institutes, and startups.

With 171 years of history, it currently has 379,000 employees, generating a result of six billion Euros and revenue of eighty-three billion Euros (data from 2018). The main focus is on energy, automation, and digitalization, with three companies in strategic sectors: Siemens Mobility, Siemens Gamesa (renewable energies), and Siemens Healthineers.

4.1.2 Siemens Healthinners

Siemens Healthinners' history begins in 1896, with the industrial production of the first X-ray equipment (Figure 17).

Figure 17 - Siemens & Halske X-ray Unit (1896)



Source: Halske X-ray Unit (1986). In: Siemens website… (2019).

Over the years, its equipment and systems have evolved, as has the provision of services to customers. The relentless pursuit of innovation is not restricted to the material it develops. In 2014, it launched *Teamplay*, a cloud-based network that connects medical institutions and their imaging devices. The solution monitors quantities such as image transfer rate or dosage levels, staff utilization, rooms, and department-wide resources for each method and procedure, showing customers where workflows need adjustment. The system links the user to other users and their data, comparing and exchanging images and reports.

The products developed are central to clinical decision-making across the health spectrum, through image diagnosis (computed tomography, magnetic resonance, molecular imaging, X-ray equipment, ultrasound systems, and Healthcare IT), laboratory diagnosis (tests, automation systems, and information technology), advanced therapies (minimally invasive treatments and procedures such as angiography, mobile surgical arches and hybrid rooms for guided

imaging therapies) and services (corporate and digital service systems that aim to maximize opportunities and minimize risks with changes in the health area).

Due to its strategic nature and the impact that health products represent, Siemens Healthineers complies with four Environment, Health and Safety policies:

- Protect the health and safety of employees, contractors, and visitors;
- Minimize the impact on the environment and contribute to a sustainable future;
- Continuously improve aspects of the environment, health, and safety throughout the product's life cycle;
- Comply with environmental, health, and safety regulations.

Given the diversity of products, for this research, the **Cios Alpha** product innovation process was analyzed. Interviewee S1 indicated the Cios Alpha, once it sought to meet the requirement of having a developed version that had the participation of multiple stakeholders during the innovation process. Besides, Siemens was preparing for June 2019[4], the launch of a new service interface, adapted to the equipment. Other companies that develop software that is used with Cios Alpha could have their applications downloaded and installed at the Siemens app store. In this way, the systems could work together, facilitating the use of health professionals.

4.1.3 Cios Alpha

X-ray equipment has always been part of Siemens' history. From the industrial-scale production of the first equipment, in 1896, to present days, the search for the best image, with the least degree of invasion and damage to the patient and the medical team, is one of Siemens' challenges.

A growing concern during minimally invasive surgery is exposure to radiation from patients and the surgical team. El-Sayed et al. (2017) present evidence of damage to cellular DNA in operators who perform endovascular

[4] The researcher did not take notice if it was effectively launched.

procedures. With the increase in the world population and surgical procedures, the workload (and, consequently, the exposure) of surgeons is increasing.

In image-guided surgeries, the main challenge is the balance between image quality and dose. Dose reduction generally means lower image quality - and difficulties in correctly identifying anatomy and devices. A higher dose involves potential health risks for patients, surgeons, and the surgical team.

To offer a product with better image definition and low dosage, Siemens developed the Cios Alpha® (Figure 18), a 2D high definition mobile C-arm designed to facilitate use, generate fewer distractions in workflows, and optimizing the use of the equipment.

Figure 18 - Cios Alpha

Source: Cios Alpha. In: Siemens website… (2019).

The equipment allows you to see tiny small details, regardless of clinical application, patient size, or duration of surgery. Cios Alpha offers excellent images thanks to the new *Retina Image Chain*[5] with CMOS (*Complementary*

[5] The Retina Imaging Chain consists of five elements: Retina FD Technology: Cios Alpha is equipped with the latest generation of flat detectors, characterized by a higher sensitivity and a lower electronic noise level than conventional flat detectors. The result is optimized low-dose performance, which means better image quality with less radiation dose from the patient; Retinal calibration: Each pixel in the Cios Alpha flat detector undergoes a complex temperature calibration. As a result, temperature compensation takes place in real time during acquisition. This ensures that the system provides excellent low-dose images at all temperatures - even when the detector is cold right after switching on; Retina Plaque: Specifically designed for Cios Alpha,

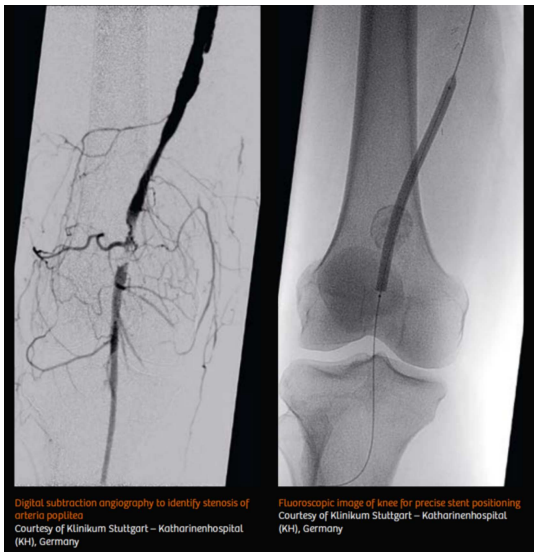
metal-oxide-semiconductor) technology. The dose is applied through a set of exams, dose buttons, and collimation for intraprocedural imaging according to the ALARA (*as low as reasonably achievable*) principle. CIOs Alpha allows you to deal with complex cases, as its Energy Storage Unit (ESU) ensures intelligent energy and cooling management, preventing overheating of the system, even during procedures.

In addition to the quality of the images (Figure 19) and secure handling, another advantage of Cios Alpha is an efficient infection control. Several C-arm surfaces feature antimicrobial paint, limiting the potential for infections. The system can be easily covered with sterile curtains, and the mouse is washable and can be quickly disinfected, facilitating the maintenance of a high level of sterility.

---

the Retina Plaque continuously optimizes image quality during acquisition, eliminating all artifacts related to the detector; Retinal examination sets: provides a selection of optimized examination sets with predefined exposure parameters for a wide range of clinical applications. Simply select your application and automatically obtain excellent image quality with a very low dose of radiation from the patient. The simple customization of the set of exams allows you to adapt it to the specific needs of your operating room; IDEAL dose reduction: The Intelligent Dose Efficiency Algorithm - IDEAL algorithm is an intelligent dose management system designed especially for Cios Alpha. It continuously analyzes each and every one of the detector's 2.2 million pixels * and constantly optimizes its dose efficiency. The result is an always optimized balance of image quality and dose, as well as automatic adjustment of contrast and brightness. (Source: SIEMENS. The Intelligent Dose Efficiency Algorithm – IDEAL, 2020. Available in: https://www.siemens-healthineers.com/en-us/medical-imaging/low-dose/low-dose-information-by-clinical-specialty/approaches-to-dose-reduction-in-surgery / dose-reduction (Access in 05 Jan 2020).

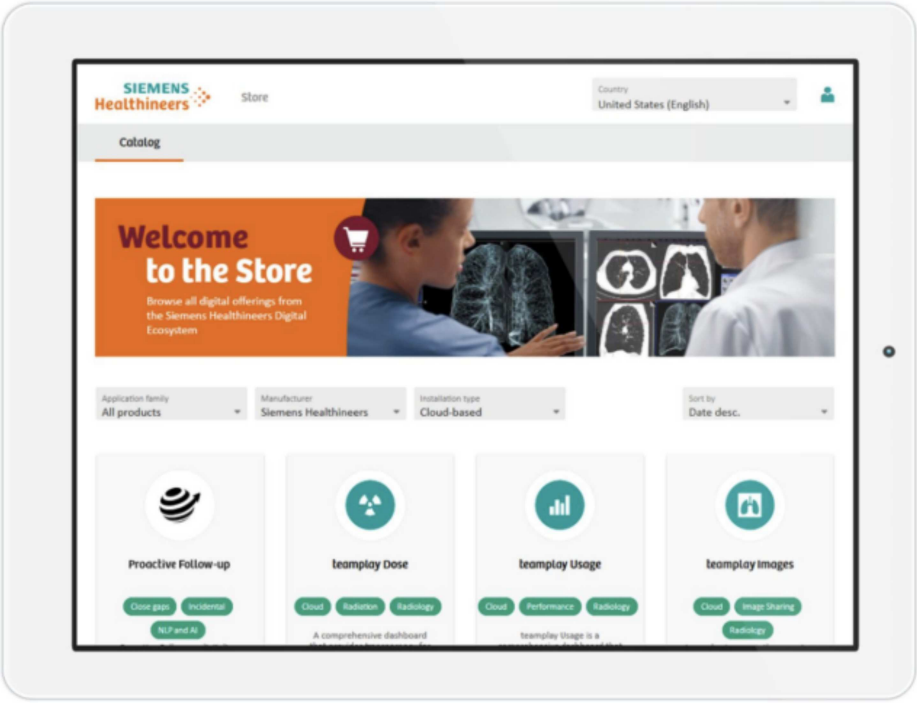
Figure 19 - Images obtained with Cios Alpha



Source: Cios Alpha brochure. In: Siemens website… (2019).

Finally, intending to contribute to the reduction of health institutions' costs, without sacrificing safety and efficiency in the quality of images, the new intraoperative imaging equipment helps institutions to expand their clinical capabilities through digital technology. Instead of having to invest in new hardware, it is possible to download additional applications for Cios Alpha through the Siemens Healthineers Digital Ecosystems Store (Figure 20). Access is via the Siemens Healthineers II digital ecosystem, an open and secure environment for digitizing healthcare services. The digital ecosystem integrates and interconnects healthcare data and knowledge from a global and diverse network of healthcare stakeholders.

Figure 20 - Siemens Healthineers Digital Ecosystem e-Store



Source: Digital Health Solutions Marketplace. In: Siemens website… (2019).

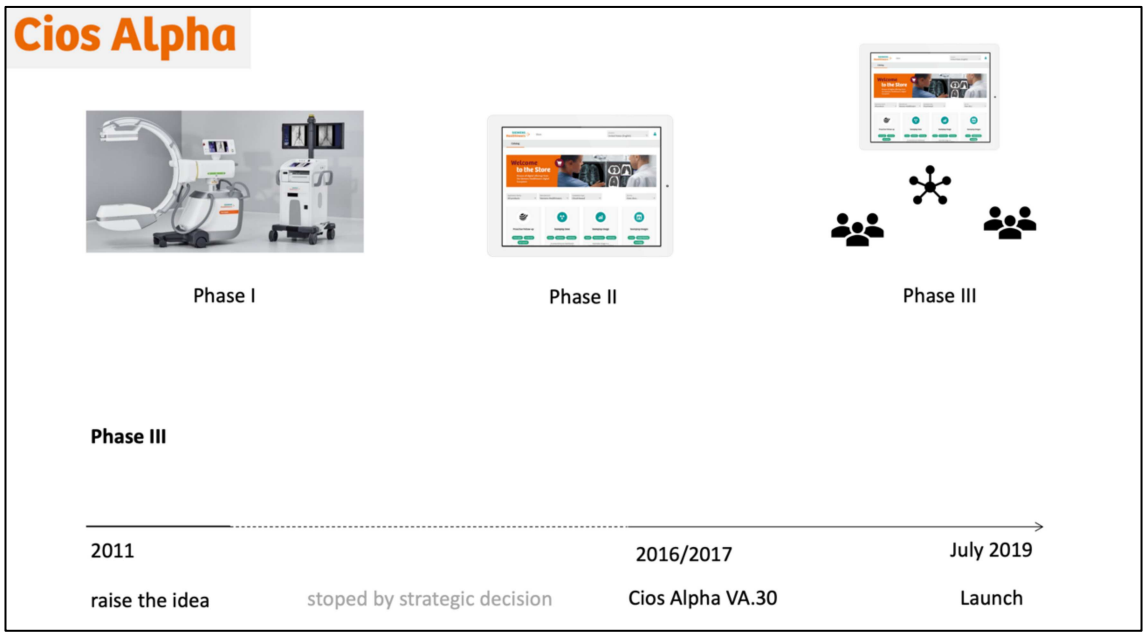
The next stage, still under construction, is the possibility for other systems, from companies outside Siemens, to be connected to the equipment. Therefore, some companies were selected, for fields such as cardiology, neurology, chronic diseases, oncology, among others (DIGITAL MARKET PLACE SIEMENS, 2019). Figure 21 shows the stages of scanning the product.

Stage III, known as "OpenApps," was conceived in 2011 and sought to solve some problems:

- For the client: many devices in the *operating room* (OR); hardware for software solutions are included in the price, although it was not always necessary; no ergonomic view for the screens of other devices.

- For Siemens: it is not possible to meet each customer's wishes, bidding requirement with own software development; additional sales channels (application provider) are always useful; extra revenue by charging a commission fee.

Figure 21 - Digitalization stages of Cios Alpha



Source: by the author.

Stage III, known as "OpenApps," was conceived in 2011 and sought to solve some problems:

- For the client: many devices in the *operating room* (OR); hardware for software solutions are included in the price, although it was not always necessary; no ergonomic view for the screens of other devices.

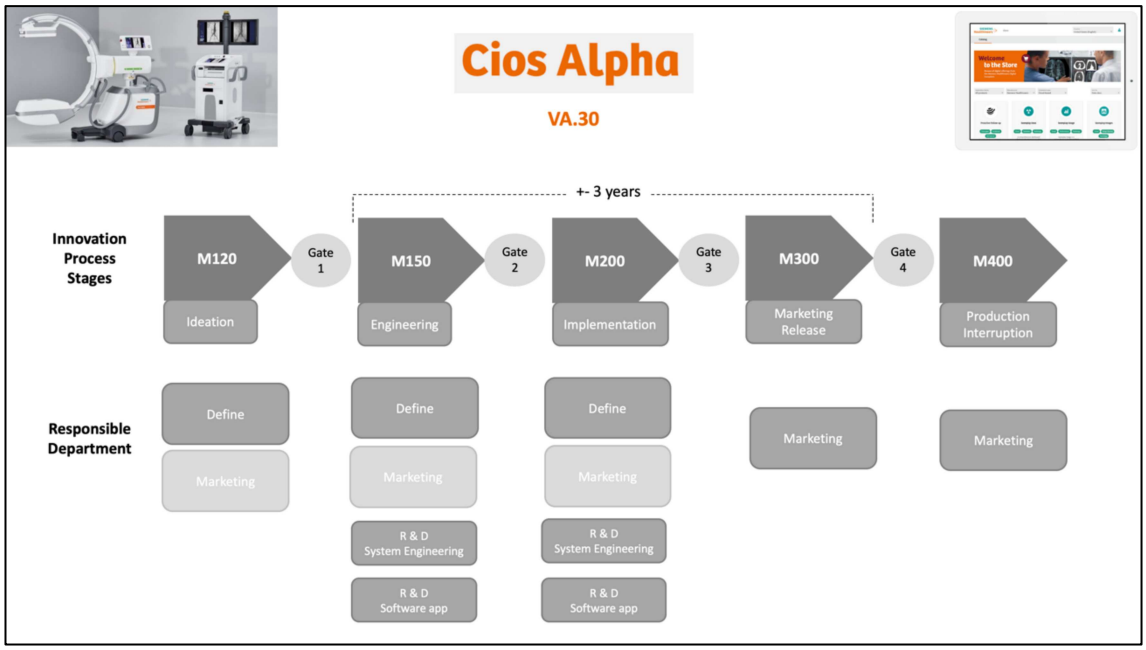
- For Siemens: it is not possible to meet each customer's wishes, bidding requirement with own software development; additional sales channels (application provider) are always useful; extra revenue by charging a commission fee.

The Cios Alpha development process will be analyzed below.

4.1.4 The development process of Cios Alpha and the inclusion of stakeholders in the integration of OpenApps

Siemens has established five stages in its innovation process. With its nomenclatures, between each stage, the company uses gates, with departments responsible for each one of them. Figure 22 depicts the innovation process, validated by respondents S2 and S8.

Figure 22 - Stages of the innovation process at Siemens and the responsible departments



Source: by the author.

The innovation process model used by Siemens is close to the traditional *Stage-gate* model (COOPER, 2008) since it presents a flexible process and adaptable to each need. Interviewee S14 reinforces the model by stating that

> These stages are in a cube process, they are defined like this, but of course we are working on more current engineering, so some of the stages may be done before ..., but this is our implementation

Although each stage has a responsible department, this department does not act exclusively; they try to involve others as necessary. This workflow refers to the *Stage-gate* model (COOPER, 2008), which points that each stage is multifunctional. There is no research and development (R&D) or marketing stage. In fact, at each stage, different departments participate. For Siemens, the gates are moments of analysis and reflection on the way forward.

Several stakeholders can contribute to the development of responsible innovation. A group that stands out is software developers, as well as healthcare professionals. Software developers are classified as economic stakeholders - who are interested in the profit of the business (BLOK, HOFFMANS, WUBBEN., 2015). The other group, healthcare professionals, are classified as non-economic

(BLOK, HOFFMANS, WUBBEN, 2015), and in many cases, they will be future users. Their motivation is given by the interest in the result of the product/service, benefiting from improvements or new solutions.

It is the inclusion process, in the development of Cios Alpha's OpenApp, called by Siemens as a "digital ecosystem," which will be further explored in this section. What is called an "ecosystem" by Siemens can be understood as a business ecosystem, where

> companies co-evolve capabilities around a new innovation: they work cooperatively and competitively to support new products, satisfy customer needs, and eventually incorporate the next round of innovations (MOORE, 1993, p. 76).

In other words, the company establishes collaborative arrangements through which companies combine their offers in a coherent solution focused on the customer (ADNER, 2006).

The idea of creating the digital ecosystem, integrating the Cios Alpha equipment with applications, came up for two reasons. The first of them is internal, based on the observation that there was not much else to do about the *hardware* of the mobile *C-arms*, which were becoming more and more commoditized products. To expand the business chance, Siemens focused on software resources. They launched a challenge described by interviewee S8: "How can I have a platform for our innovation team to develop new ideas and bring them to the product very quickly?

The concept of the ecosystem is broader, as explained by interviewee S11

> […] as I said, this is not a product, but it is the concept. Therefore, we are creating one of the largest medical networks of stakeholders. We have the cloud that is connecting all these parts. Today, we have three and a half thousand institutions connected in that cloud. On the one hand, we are aggregating data from these institutions, to be used now in some of our applications, but in the future this can also be used by other stakeholders and we have applications to analyze data, so we have Siemens Healthineers applications, but we also have third-party applications connected to this network.

Siemens has a very high product (hardware) development cycles, which can take three, four, or five years. If software development used at the same time,

it would still be, according to Interviewee 8, unacceptable for a faster market. Interviewee S3 highlights the choice for this new business model

> So you have to fill in the checklist and if there is something on the hospital checklist that you cannot provide, then you are out [...] So you have two options: develop it yourself - it usually takes about three years for the intermediate resource or, with this solution, with the app solution or (our) maps - now, you can only integrate a partner that has this resource and they can be executed in our system. You save the cost of developing this feature and, in addition, receive a commission fee from the partner. Compared to Google, our fees are comparable at around 30% of the amount charged by the customer.

The alternative was to make the software as medical devices, not exclusively integrated with C-arm. It does not require customers to create a new investment in equipment, which, on average, can be used for ten years. Developing applications that could be used on existing equipment was the defined alternative.

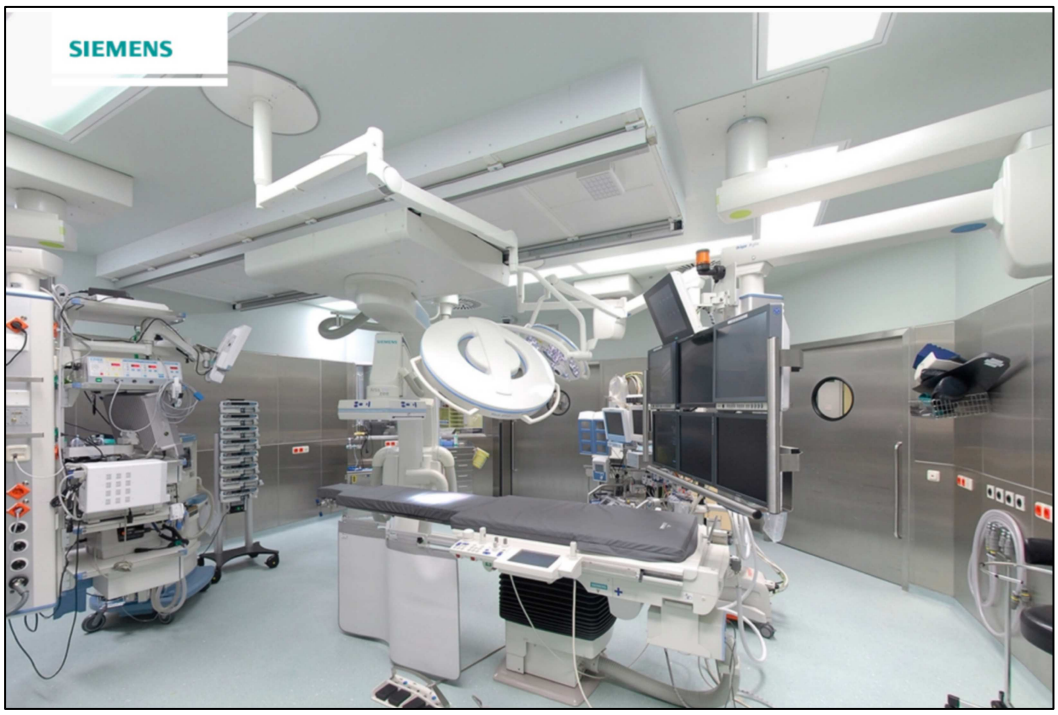
The second reason is competition. According to interviewee S8, this is a substantial market trend, and other companies are already working on it.

But the primary motivation for implementing the digital ecosystem is, from the premise of the client as the main focus, to save time and space in the operating room (Figure 23). This economy is aligned with the digitalization of healthcare, since it generates improved productivity, in addition to better results, higher quality and reliability (BESSANT et al., 2017).

With that, it is no longer necessary to have different systems in an operating room. From the integration, it is possible to share the keyboard, monitors, and the workstation. Interviewee S4 highlights that: "The benefit is having an integrated data communication between the X-ray and the diagnostic images and the application of our partners."

However, this integration is not risk-free for Siemens. Once systems are integrated into the platform, the customer understands that Siemens is responsible, even if it is a partner application. This type of risk is not addressed in the literature on including stakeholders in the context of RI.

Figure 23 – Operating room



Source: Tour 360. In: Siemens website… (2019).

As previously presented, the main critical points or difficulties related to the consumption of time and other resources (LIGARDO-HERRERA et al., 2018), different views (BLOK, HOFFMANS, WUBBEN, 2015; MORATIS, 2018) and the question of power (BALKA; RAASCH; HERSTATT, 2014; LUBERINK et al., 2017). To better understand this dynamic, it was necessary to seek a basis in strategy studies, mainly in the Delta model (HAX; WILDE, 2001). The answer is the integration with complementors (supplier of products and services that enhance a company's offer) that takes into account all the essential participants in the system that contribute to the creation of economic value.

Especially concerning the ISO9001 Certification, which defines the way the organization operates to meet the requirements of customers and stakeholders, it highlights the need for documentation of processes, procedures, and responsibilities involved in complying with quality policies and objectives (SISTEMAS DE GERENCIAMENTO DE QUALIDADE, 2015).

Siemens' innovation process, including the process involving OpenApps, respects integrated management systems, such as ISO9001, ISO14001, and BS OHSAS18001, having their own stages and nomenclatures.

4.1.4.1 Stage M120

The first stage is M120, corresponding to the ideation stage. In that stage, marketing is more involved, as well as *Define*, an area of the marketing department, responsible for defining new products or improving current ones.

For this stage, Siemens has defined processes, which involve the development of new projects, product definitions, and the creation of a business plan. Marketing follows what happens in the market, if it is relevant, what competitors do, and why they need, for example, certain resource.

A lot of market information comes through the teams in the countries, as the interviewee S2 points out:

> We see what our competitors are doing, and we are also informed by our sales teams when we receive feedback from countries. For example, when our competitor is pushing at very low prices or is very strong marketing, for example, in addition to customer feedback, for example, we also make competitive comparisons and see comparisons about us, our products and that of our competitors. And yes, it is how we see what our competitors do.

After going through the gate, the suggested changes go on to the next stage.

The choice of partners is made through the identification of companies at trade fairs or even in the search for software companies that may be interesting, linked to surgery. For example, in the case of spine surgery, Siemens sought out companies that are developing software aimed at this specialty.

Interviewee S3 details this process:

> you'll have few possible companies to talk to, and then you'll rank, of course, which is the most effective solution. For example, after surveying applications (software), we chose them because they are market leaders in Germany and I think that Europe, not the USA, and the spine is also one of our technical conditions that we are focusing on here.

Interviewee S11 reinforces that what exists is a concept of co-creation, validation, and, subsequently, an ecosystem. The co-creation process takes place through workshops with partners, to obtain contributions related to different topics and then to structure the programs they offer. For the client, there is an

exploration section with the clients, and they are very involved with the client, but in general, the team did an exploration section, and there is also validation.

During the interviews, in December / 2018, Siemens had a partner in an integration stage already concluded. A second partner was underway, and integration was already being demonstrated at trade fairs. In addition, two other companies were potential partners, and the development of the alliance was about to start. Since the official launch was scheduled for June / 2019. The names of the companies were not disclosed.

Siemens still had a list of candidates, which they were analyzing. Many of them are from similar applications (with the same functions). This aspect is not exclusive, since each client (hospitals, for example), uses different systems. To maximize the needs of these customers, it is important to provide the complete solution. Preferably with applications that are already being used by the customer. This strategy generates value for the customer, as it understands the customers' perceptions of use and creates a model of the customer's value hierarchy (WOODRUFF, 1997). In addition to the importance of continuous learning about customers, the generation of value requires constant dedication to innovation, in addition to the focus on the organizational process (SLATER, 1997). And the customer will perceive value through two dimensions: goods and services, and through the relationship with the company (LINDGREEN; WYNSTRA, 2005).

Interviewee S3 justifies this decision

> The hospital is not going to change (the software) just because it uses our C-Arm. We want them to keep the software they are using, as it is certainly easier for them. And people don't need to be trained to do something different.

The specificity of the partners concerns the disciplines that need to be attended to, such as vascular, spine, gastric surgery. Siemens is looking for suitable partners companies, who can provide applications that help their customers.

An example of the application of OpenApps is presented by interviewee S2.

> This is more orthopedic, or, it could be more ... concrete, it's about spine, it's called Medi-CAD OR, ... it had some applications for preoperative planning, so you can plan your spine surgery, e.g. scoliosis, etc. And then, you can load this preoperative planning via a USB stick directly on your Cios Alpha and you can make some interoperative correspondence between your planning and your actual surgery. So, this is also a very interesting and important feature, because you can see it live, if you are carrying out your planning and if everything is done as you thought before ... So, these two applications can provide some explanations about the use of the applications CIOS-Alpha. And the applications that you will get directly from an application store, such as your mobile device, you can log in to Siemens and your store [...] and download the applications directly on your device, in this case C- Arm mobile, and you can even try it for 90 days for free. This is also an advantage for surgeons, as they can test it for a longer period and then they will be contacted, for example, by the ordering partner and will receive an offer on the package.

Interviewee S4 reinforces the gain of this integration for the hospital and the patient.

> We create the image of the C-Arm, put it in the partner's planning software and then plan (it) in five minutes, define a new position for joints, folding systems or broom glow system, the final result calculated , we select a new implant, the cost, the selected implant does not fit in things like that, and this in the system based on the diagnostic images and then we put it (here), we have the (guidelines) So, how to put it in this quality, in terms of three-dimensional thinking and then we create an image of control and we have 99% that we could have reached or 70% or just 30% the patient is there (30%) we plan again, we readjust until we get a certain quality and that, in minutes, with partner software, this is a real benefit for the patient and the hospital.

One strategy adopted by Siemens was the search for smaller partners since the benefit is mutual. Interviewee S13 details the difficulty in working with larger partner companies:

> because the bigger the company, the less interest they have for us, because if they are already big, they already have a market share. The win-win condition only exists because we have a market here and others want to have a market share and that is why it only fits into the big player versus collaborating with smaller players scenario.

This win-win relationship is reinforced by interviewee S11:

> in fact, you need to benefit from stakeholders, you need to balance in a way that we have a situation where everyone wins, so that partners also want to sell their application to customers and this ecosystem.

An essential factor is that the software is already available on the market so that it does not need to be sold and consolidated.

From the actions taken initially, it is possible to identify the processes and routines of stage M120 for the inclusion of stakeholders, which underlie category C2 (Table 19).

Table 19 - Stakeholder inclusion processes and routines in M120 stage

Processes and Routines	**Representative data for M120 stage**
Observation of the use to improve the integration of hardware and software	"...one of the main interests ... is to improve not only the dynamics of the (operating room) but also the organization of the equipment and the ergonomic aspects. We have already seen surgery. There are people who come and go all the time, there are a number of issues that we can improve to expose people to radiation less. There are a number of possibilities..." (ES15)
Co-creation with partners and customers to choose the type of system to be integrated	"In fact, it is a co-creation of all stakeholders, partners are contributing, Siemens, internal teams are contributing, and client institutions are also contributing, and you can introduce anything without improving the marketing validation of the solution based on your comments." (ES11)
Establishment of partner selection criteria	"I think the first phase was scheduled as a learning phase, we said that we don't know exactly what the partners want, so we created a learning version, that only a limited number of partners can participate and we select these partners according to their applications, to learn as much as we can. Therefore, with applications, we select according to this criterion, because we have applications with very different requirements and applications with dedicated requirements in relation to the type of image they need from us." (ES12).
Partner search and selection	"There are different stages for identifying partners; therefore, a phase is very simple: if you are at a trade fair and simply look for software companies that might interest you, ... looking for companies that are doing something with surgery" (ES3)
Registration and documentation	Meeting the standards of the integrated management systems ISO9001, ISO14001 and BS OHSAS18001

Source: by the author.

The next stage is the M150.

4.1.4.2 Stage M150

The M150 stage refers to the engineering and market definition stage for the product.

Interviewee S14 details the relationship between the M150 and M120.

> This is defined for now we usually take a big stage, a new system and, of course, we get a new stage and we define mainly if it is responsible for activating a new version, usually starting with an M120 or M150, usually because it can also be done as a platform too. And 150 would mean that you have a new marketing requirement in principle.

In the end, one more gate is carried out, and the decisions are passed on to the next stage.

The process of integrating the partner software with Siemens is simplified. There is no need for significant interactions between teams. After the hiring stage, the team responsible for integration performs its work in isolation, contacting the partner in cases of inconsistency. In the previous stage, when selected, the partner was already notified of the technical prerequisites for the integration, available in the document *App Developer Guide* V1.0.

From the action taken initially, it is possible to identify the processes and routines of M150 stage, for the inclusion of stakeholders, which underlies C2 category (Table 20).

Table 20 - Stakeholder inclusion processes and routines in M150 stage

Processes and Routines	**Representative data for M150 stage**
Relationship with a partner to integrate the software into the OpenApps system	“Of course, we also have the kind of technical clarification, ..., what they need to support to be (positionable) in our system, you know, this is what basically a partner manager assumes, so he is basically, the point of single contact for the partner in all directions. If we have questions for the partner, we will also seek out our internal managers, so this is something we have in this year. Yes, it's a new role.” (ES13)
Registration and documentation	Meeting the standards of the integrated management systems ISO9001, ISO14001 and BS OHSAS18001

Source: by the author.

The third stage is called M200.

4.1.4.3 Stage M200

M200 stage refers to the implementation of what was designed in the previous one. After a new gate, it moves to the M300 stage, which refers to the launch.

M200 stage is divided into two development cycles. The first cycle is to produce the first unit (or two) with all the resources. These two samples are tested at 2 to 3 customer sites, in regular clinical operation, without simulations. It is clear to Siemens that there are some restrictions, as perhaps not all features work as they should. The customer is also aware of this when he understands that he is testing a product already considered in the launch stage, which has quality and safety.

In the case of applications developed by Siemens, for use in Cios Alpha, the test is performed directly on a previously selected customer. Based on this action, it is possible to identify the processes and routines of M200 stage for the inclusion of *stakeholders*, which are the basis for C2 category (Table 21).

Table 21 - Stakeholder inclusion processes and routines in M200 stage

Processes and Rooutines	**Representative data of the M200 stage**
Customer relationship to test the integration of software embedded in OpenApps and the use of C-Arm	“We plan first what size of client we will test - a clinic, for example - and then we test the system, if everything works well in our store - and not just in our test. And yes, if this use opens the connector for the store and, if you can download an application, for example, if you can start an application on the system, all this technical material is tested on the client.” (ES2) “Yes, so what we usually have in general is our clinical test of use, before the product launch. You usually go to the clinics and check if everything is right ... we ask you to download the app and ask about what you think of the process” (ES3) “Yes, we need to test it again and, normally, this is not the time for us to release the same customer here again .. It works full time, I think, once we got involved very early before the system integration test TIS), so we had some customers here and they were here during TIS - again, after some of the improvements they told us, we are incorporating it into the software and we could show them again.”(ES7)

Registration and documentation	Meeting the standards of the integrated management systems ISO9001, ISO14001 and BS OHSAS18001

Source: by the author.

Since the interviews were conducted between October / 2018 and February / 2019, the launch of OpenApps had not yet occurred. Concerning the inclusion of *stakeholders*, it was only possible to analyze the first stages of the development process. However, the other stages of the innovation process are presented below.

4.1.4.4 Stage M400

The M400 stage refers to production or interruption. In it, a second development cycle is carried out, focused mainly on the removal of any defects that may remain during the test stage of the customer's use. Formal tests are performed, which means that there are test specifications that prescribe what actions should be completed and what types of functions should be tested. Any deviation from the specification is documented as a defect, and there is a defect tracking system in which all of these defects are managed.

In December 2018, the Cios-Alpha equipment is in its VA30b version, with Siemens working on the VA30c. The company defaults to changing the version name (20 to 30, for example), when there is a significant update, such as a new system. From the stage, there can be several versions, such as a, b, c.

Interviewee S14 points out, however, that the innovation process starts even before the M120. He points out that

> I also see competitor systems, of course we go to hospitals from time to time and talk to them - which is the focus of marketing and, of course, sales. Sales (area) have many contacts with different customers and, in principle, what you describe here is the development process. The innovation process would be earlier. We make a kind of prototype with functionality and we work long before and then come with a special process, with new ideas and always present them directly to Define.

Although OpenApps is still in the early stages, this is the crucial stage. For Cooper “the game is won or lost in the first few plays” (2008, p. 217). This is the part of the model that most contributes to much higher success rates.

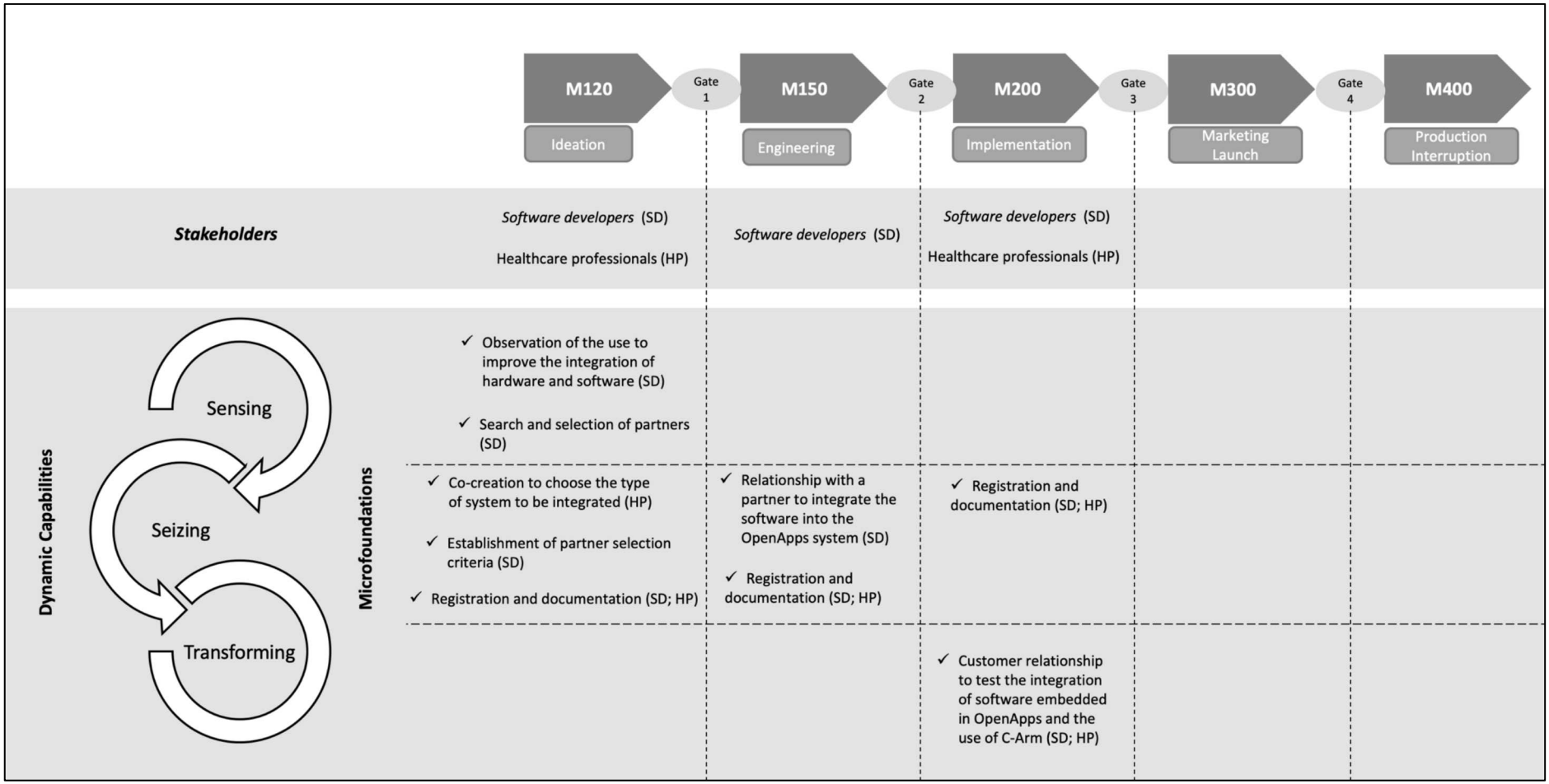
At the end of the presentation of the product development process, the next section describes the inclusion of stakeholders in the development of OpenApps Cios Alpha.

4.1.5 Microfoundations of Siemens' dynamic capabilities in the inclusion of stakeholders

The *stakeholder* inclusion process requires new configurations of resources, through organizational and strategic processes or routines (EISENHARDT; MARTIN, 2000). These processes and methods show the microfoundations for specific DCs.

As the Cios Alpha OpenApps process is still in its initial stage, and because it requires a less complicated business model than those already established in the improvement of products, or even the development of *hardware* and *software* integration, there are not many processes and routines for the inclusion of stakeholders. Figure 24 shows its relationship with the nature of DCs.

Figure 24 - Microfoundations of dynamic capabilities in the inclusion of stakeholders - Siemens case



Source: by the author.

The processes and routines identified for the inclusion of stakeholders in Siemens can be considered microfoundations of DC since they all contribute to the detection, apprehension, and transformation during composition.

Figure 24 demonstrates what had already been commented by interviewee S14, who stated that the model is not so linear. The establishment of criteria for the selection of partners has priority among other processes and routines. Teece (2007) presents dynamic capabilities (and their microfoundations) as a linear procedural model. However, one realizes that, in practice, there is no such linearity.

For example, **the establishment of partner selection criteria** is, procedurally, the **search and selection of partners**, as it is necessary to know "who" (what characteristics, such as degree of relationship with the company) is looking for it. However, the criteria are configured as *seizing*, while search and selection are configured as *sensing*.

As already highlighted in the methodology chapter, and to meet criterion 5 for case selection, it is essential to analyze the dimensions of RI in both cases. Siemens' dimensions are shown below.

4.1.6 The Dimensions of Responsible Innovation at Siemens

The dominant approach to RI involves the model proposed by Owen et al. (2013) and Stilgoe; Owen and Macnaghten (2013), which seeks to contemplate the political and ethical spheres, related to social convenience and acceptability, allowing unavoidable tensions, dilemmas, and conflicts to be identified, with a view to a democratic, equitable and legitimate objective.

Each of the dimensions of the RI refers to an issue, which guides the actions of companies. **Anticipation** seeks to answer how it is possible to use technology and its potential impacts, integrating it into the innovation process (Van de Poel et al., 2017).

The idea of developing the OpenApps digital ecosystem reflects the anticipation developed by Siemens. Interviewee S4 pointed out that the motivation came from the market and observation, seeking to improve the processes in the operating room. These Siemens anticipation actions are consistent with the need to monitor the environment and social needs (BIONDI; IRALDO; MEREDITH, 2002; CHADHA, 2011).

According to interviewee S4

> there is a limiting area, time and space and all cables ... So, the complexity is very high. We have to reduce complexity in terms of area and space, on the other hand, we have to expand the planning, interaction and control process ... But integration in terms of having an independent workstation sharing the monitor, sharing the keyboards and having the right partners on board is not that easy, (but) it takes us one stage ahead of the competition in the operating room.

Siemens follows the trend to digitize (or enlarge), not only its equipment but the environment where the material is used. This generates gains in efficiency and quality of care for patients, but it also makes a better environment for health professionals. As already mentioned in the company's presentation, approximately 70% of critical clinical decisions are influenced by Siemens technologies, with 240,000 patients coming in contact with its products and services every hour (company website). These numbers are only possible thanks to their ability to anticipate. Despite the monitoring of the environment, the generation of the OpenApps idea is developed internally (BOCKEN et al., 2014), strengthening the engagement and awareness of employees.

In another dimension, **reflexivity**, the company must reflect on its impacts on society, purposes, motivations, and values, integrated into the innovation process (VAN DE POEL et al., 2017).

At Siemens, some practices provide the necessary support, especially during the product development process. The gates established between the product development stages stimulate reflection, by allowing the product to only pass from one stage to the next if it meets the objectives of the product itself, but also the company's purpose. Besides, the development and encouragement of research at universities are guided by Siemens' values and objectives. The alignment of the company's mission and the research and innovation process is essential for the development of RI (AYUSO; RODRÍGUEZ; RICART, 2006; BOCKEN et al., 2014), encouraging new knowledge management processes (ELMQUIST, SEGRESTIN; 2009).

Interviewee S15, involved in a partnership project between Siemens and Unisinos, works on the hybrid operating room concept (imaging equipment inside the operating room). The interviewee exemplifies:

> Imagine that the patient suffered a trauma, a traffic accident, then he goes to the hospital, there is that question, if he takes the patient to have a tomography, a radiography, or if he takes him to the operating room. So, the idea is to place the imaging equipment inside the operating room. This makes less intrusive surgery, surgery with a multidisciplinary team that will work together to detect and operate.

The challenge in the development of this equipment is to rethink its functionality, which can be from its design to its placement in the environment. There are cases when the machine is installed and is "inside the wall" and is moved using rails. If a CT scan is needed, for example, the equipment is transferred to the operating room and then removed again. But besides the space in the operating rooms, another critical point is the emission of radiation. Surgeries may require multidisciplinary teams, such as traumatologists, general practitioners, cardiologists, in addition to the usual group, such as anesthesiologists, surgeons, and nurses. In such cases, care must be taken with the emission of radiation. Siemens, therefore, seeks to minimize emissions, ensuring safety for medical teams. In this way, Siemens reinforces its actions and responsibilities, understanding the company's role and power in society (VON WELTZIEN HOIVIK, 2011; DOSSA; KAEUFER, 2014).

Creating value for all stakeholders is part of Siemens' purpose. The company understands the importance of **including** stakeholders. The inclusion dimension seeks to answer whether the company engages in dialogues with relevant stakeholders and whether the ideas in these dialogues are integrated into the company's R&D process and other relevant business processes (VAN DE POEL et al., 2017).

The acronym 3W1H can summarize the stakeholder inclusion process, which presents **who** are the agents that include the stakeholders, **when** the inclusion occurs, **who** are the stakeholders involved and **how** the addition occurs (SILVA et al., 2019). Table 22 summarizes the process:

Table 22 - 3W1H of inclusion - Siemens

WHO (agentes)	**WHEN**
Employees in the Departments of: • Define (Marketing) • Marketing • R&D Software App	Stages: • M120 • M150 • M200
WHO (stakeholders)	**HOW**
• Software developers • Healthcare professionals	• Concern with the ease of use and integration of hardware and software • Co-creation to choose the type of system to be integrated • Partner selection • Software integration to the OpenApss system

	• Test the integration of the embedded software in OpenApps and use in C-Arm

Source: by the author.

The basic premise of the inclusion dimension is the participation of different voices in different stages of the innovation process. Although still in its initial stage, the Cios Alpha OpenApps project meets this requirement, with external participation in the first three stages. The fact of having partners in the development of the application solves a technical problem of the company (HALILA; RUNDQUIST, 2011). Also, the selection of partners requires a sharing of values between companies (DOSSA; KAEUFER, 2014).

But what stands out, aligned with the concept of RI, is the participation of health professionals. Many of them will be future users, influencing the purchase of Siemens equipment by their workplaces (hospitals, clinics). The emphasis on the user ensures better alignment of expectations and greater assertiveness throughout the process (ORNETZEDER, 2001; AYUSO; RODRÍGUEZ; RICART., 2006; FRANKE; KEINZ; KLAUSBERGER, 2013).

For some authors, inclusion also requires deliberation (OWEN et al., 2013; STILGOE; OWEN; MACNAGHTEN, 2013). Other authors already differentiate the addition of reflection (PELLÉ, REBER, 2014). Deliberation refers to

> Deliberation refers to a process of argumentation and communication in which the participants engage into an open process in which they exchange opinions and viewpoints, weigh and balance arguments, and offer reflections and associations. (VAN DE KERKHOF, 2006, p. 282).

It is worth mentioning that, exclusively about the Cios Alpha OpenApps project, the concept of deliberation is not applied.

It is important to note that the *How* dimension presents the microfoundations of DCs previously presented (Figure 24, p. 131). Many of these microfoundations are explored by other companies, without, however, contributing effectively to genuinely responsible innovation. This discussion will be resumed in the next chapter.

Among the five microfoundations listed, the one that stands out and contributes most to the responsibility for innovation is the *Concern with the ease of use and integration of hardware and software*. This Concern is related to the care in the emission of X-rays, regarding the patient and the medical team, as well as the search

to simplify the use of medical equipment, enabling the use of other software necessary for the best medical care, which can be done more effectively and efficiently.

The last dimension proposed by Owen et al. (2013) and Stilgoe, Owen and Macnaghten (2013), concerns to ***responsiveness***. In it, the company wonders if its research and innovation meet social needs, in addition to responding to new insights and developments (VAN DE POEL et al., 2017).

The development of OpenApps itself sought to solve some problems, highlighted by interviewee S3:

- Too many devices in the operating room;

- Hardware for *software* solutions was included in the price, although it was not necessary;

- No ergonomic view of screens from other Siemens Healthineers devices;

- It was not possible to meet all the requirements of customer orders with their *software* development; and

As a benefit, from the development of OpenApps, interviewee S3 highlighted the usefulness of additional sales channels (application provider).

In addition to the search for efficiency in the operating room, the simplification of the use of its equipment also reflects the competence of responsiveness. As an example of this simplification, we can mention the case of the SOMATOM scanner used in cities such as Madurai, India. The main benefit, in addition to the speed of scanning, is to allow a mobile workflow via *Tablet,* preventing the medical team from having to switch between the control room and the scanner and being able to follow the patient. The speed of scanning helps to reduce claustrophobia, in addition to offering excellent image quality. It also provides gains when operated by untrained professionals. In addition to the direct impact on making the diagnosis, the use of this type of technology allows the patient to save the cost of hospitalization and surgery in a hospital, being treated in a single day (PRASAD, 2018). Initiatives like this, in countries with low investments in health, are an example of how technology can contribute to the sector.

Both cases (Cios Alpha OpenApps and SOMATOM), seek to satisfy the needs of customers/users (EVANS; PARTIDÁRIO; LAMBERT, 2007; BERKER, 2010), collaborating with an adequate response (CHALMERS; BALAN-VNUK, 2013).

To summarize Siemens' RI dimensions, a summary table (Table 23) is presented, inspired by the Canvas model (OSTERWALDER; PIGNEUR, 2010) expanding the 3W1H model of inclusion.

Table 23 - RI dimensions – Siemens

RESPONSIBLE INNOVATION DIMENSIONS

WHO WE ARE?

Mission, Vision or Purpose

"We make what matters real by setting the benchmark in how to electrify, automate and digitize the world. Ingenuity moves us and what we create is for you. Together, we make it happen. "

INCLUSION

WHO (agents)	WHEN
Employees in the Departments of:	Stages:
Define	M120
Marketing	M150
R&D Sofware App	M200

REFLEXION

What are you working on? Why are you working on this?

Gates established between one stage and another of product development - it only moves to the next stage if it meets the objectives and purpose

Research development and stimulation in universities

ANTICIPATION

Who can be affected in the future?

Need to keep up with market demands.

Search for efficiency and quality of patient care, through the improvement of processes in the operating room.

WHO (stakeholders)	HOW (como)
Software developers	• Concern with the ease of use and integration of hardware and software
Healthcare professionals	• Co-creation to choose the type of system to be integrated
	• Partner selection
	• Software integration to the OpenApss system
	• Test the integration of the embedded software in OpenApps and use in C-Arm

RESPONSIVINESS

How could you approach it differently?

Search for solutions for the operating room.

Satisfy users' needs.

Simplifying the use of your equipment.

Source: by the author.

When developing the RI Canvas of the Siemens case, it is confirmed that it is a company focused on responsible innovation, meeting criterion 5 of cases choice. At the end of the analysis of the Siemens case, the next section presents the second case, from the Norwegian company, Laerdal.

4.2 CASO 2: LAERDAL MEDICAL

In this section, the case of Laerdal Medical will be presented. The case will detail the company's relationship with the following stakeholders: institutional partners, healthcare professionals (medical doctors, paramedics, firefighters, nurses), and ordinary people.

4.2.1 The history of Laerdal

In 1940, Åsmund S. Laerdal founded the company Laerdal S.A. Based in Stavanger, Norway, the company produced wooden toys and published children's books. With the vision of constant product development, in 1949, the company started the production of toys using soft plastic, being the pioneer in this type of product throughout Europe. When the founder realized the possibility of mass production, he started to export to more than 110 countries.

In 1953, the Civil Defense of Norway suggested the production of imitations of injuries, for training. From experience with dolls and soft plastic cars, and working in collaboration with medical doctors and surgeons, the first models were developed, as well as a special glue that could be removed without hurting (Figure 25). At this time, the company expands its business to the medical area.

Throughout all these years, the company had the participation of anesthesiologists, cardiologists, and other health professionals, as the company has always sought to generate and strengthen partnerships. International alliances contributed to the company's multicultural adaptation. One of the first long-standing alliances is with the *American Heart Association* (AHA), a collaboration on large-scale projects, including the distribution of more than 1 million kits to train school children, HeartCode eSimulation courses and the Health Improvement program. Quality in Resuscitation (RQI).

Figure 25 - Imitations of injuries

Source: Book Saving more lives – together: The vision for 2020 (TJOMSLAND, 2018).

In addition to AHA, other partnerships support training and dissemination. The British Heart Foundation (BHF) ensures that CPR skills are learned across the country, through schools, workplaces, and the community, and has resulted in more than 148,000 CPR kits used. The National League for Nursing (NLN) contributes to patient simulation training for nursing education in the United States. The Stavanger Acute Medicine Foundation for Education and Research (SAFER), created in 2005 in conjunction with Stavanger University, Stavanger University Hospital, and Laerdal Medical, developed, in 2016 alone, 12,000 days of participation in training activities. Finally, the Global Resuscitation Alliance (GRA), is a global network of experts focused on collaborating to increase the survival of sudden cardiac arrest.

In product development, Laerdal has a partnership with the American Academy of Pediatrics (AAP), in the development of several simulators designed to support the Newborn Resuscitation Program (NRP), e-learning programs and the set of educational modules "Assisting Babies Survivors" (emphasis added). It also has Jhpiego, which is a non-profit healthcare organization affiliated with The Johns Hopkins University. HealthStream is a provider of the SimCenter simulation management system platform and HeartCode course distribution. Finally, Philips Healthcare, with projects such as HeartStart automated external defibrillators and QCPR technologies.

The importance of partnerships is reinforced by EL2 when he states that "I think Laerdal is probably unique in the way we work, as we depend a lot on partners."

Global in scope, it operates in 24 countries and has 1,500 employees. In 2010, Laerdal Global Health was created, a non-profit company, to develop affordable and

high-impact products that contribute to saving lives in childbirth in non-developed countries (TJOMSLAND, 2018).

Currently, Laerdal does not only focus on the development and production of mannequins and other medical equipment. It also contributes to the training of professional and lay users. Recent studies (for example, BHANJI et al., 2015) demonstrate that frequent training, of less time, is more efficient than long, but widely spaced training. Also, it is possible to make them exciting and stimulating through the QCPR (*Quality Cardiopulmonary Resuscitation*) Race (Figure 26).

Figure 26 - QCPR Race

Source: Resuscitation-training. In: Laerdal website… (2019).

In the simulator, there are 12 ambulances on the screen. When performing the practice correctly, the student makes his ambulance advance with more speed, having the best CPR quality. This strategy made the training sessions more exciting. EL4 commented that

> It is a great success and people love it and can say "I want to try again; I want to beat this guy because I know how to do it". The course students asked: can I go home now? And now they ask: can you try again? That's what we want to achieve, we want to become good at performance.

CPR practice is performed with the Little Anne mannequin, from the Resusci Anne line. To understand how the company includes stakeholder participation, the development of the Resusci Anne product was used as the basis for the analysis.

4.2.2 The history of Resusci Anne

In 1954, Laerdal's founder, Mr. Åsmund S. Laerdal, had to use resuscitation practices on his two-year-old son, who had drowned in the sea. Inspired by the incident and based on information from the director of the Swedish Red Cross, Åsmund learned of a group of medical doctors and engineers in Baltimore (USA) who developed a new method of resuscitation, mouth-to-mouth breathing. Impacted by his son's recent accident, the businessman entered the market for the production of mannequins for cardiopulmonary resuscitation (CPR). Saving more lives became an obsession for Åsmund and the company itself.

At the time, the main challenge was how to teach people the technique of mouth-to-mouth breathing. When developing and testing volunteers with a face mask, Åsmund was convinced that the best would be a life-size mannequin. He worked for a year together with Stavanger anesthetist Bjorn Lind, until he obtained an anatomical dummy, of high quality, but at an affordable price. There Resusci Anne was born. According to data from the AHA (American Heart Association), more than 2 million lives were saved, and 500 million people trained. The CPR method is recognized as one of the most critical public health initiatives of the last two generations.

In 1960, Åsmund took the prototype to the United States, where he met the pioneers of the resuscitation method, Peter Safar and Archer S. Gordon. With the partnership and commitment of Peter Safar and Åsmund, Bjoern Lind played an essential role in demonstrating the importance of mass resuscitation training.

In August 1961, in Stavanger, the First International Symposium on Emergency Resuscitation took place, through collaboration between Laerdal Medical, Peter Safar, and German specialists, with the participation of specialists from all over the world.

In 1961, resuscitation pioneers, doctors Kouwenhoven, Safar, and Jude discovered that external chest compressions could provide blood circulation to the brain when the heart stopped beating, increasing the chance of resuscitation (GUIMARÃES, et al., 2009; HISTORY of CPR, [2019?]). This discovery proved to be a significant potential for Laerdal Medical, as it required the company to update its mannequins. That year, a Cardiopulmonary Resuscitation Committee was also established by the World Federation of Anesthesiologists. The creation of the

committee reinforced the importance of resuscitation techniques, further expanding Laerdal's business opportunities.

Figure 27 - Resusci Anne – 1970 version

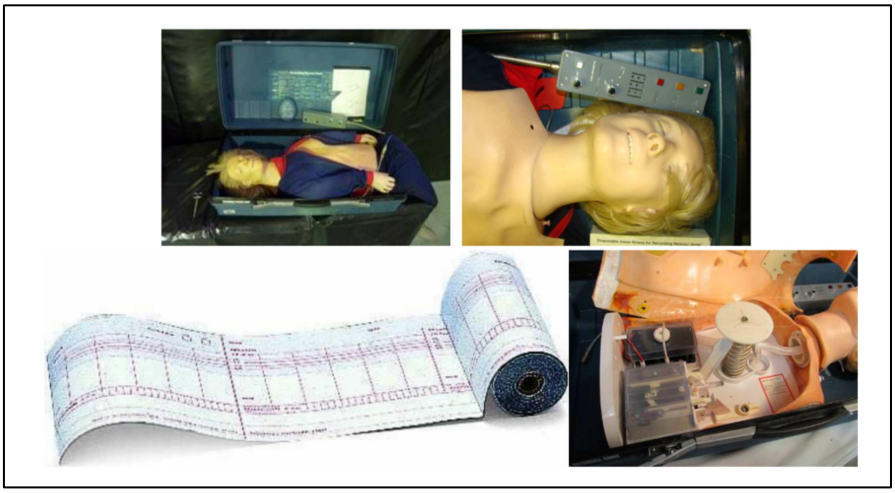
Source: Resusci-Anne. In: EMS Museum… (2019).

In 1969, the company produced the Resusci Anne mannequin for CPR (Figure 27), capable of being used for the practice of artificial ventilation and external chest compressions[6]. Always seeking to improve its products and listening to users, such as medical doctors and nurses, and discussing with its growing network of experts, such as AHA, and users, in 1971, Laerdal introduced the Resusci Anne mannequin,

[6] There are two known versions of CPR: The first, for health professionals and trained professionals: conventional CPR using chest compressions and mouth-to-mouth breathing at the rate of 30 chest compressions per 2 per breath. In adult victims of cardiac arrest, it is reasonable for rescuers to perform chest compressions at a rate of 100 to 120 / min and at a depth of at least 2 inches (5 cm) for an average adult, avoiding excessive depths of chest compression (greater than 6 cm). The second, for the general public or for spectators who witness an adult suddenly collapse: CPR only by compression or CPR only with the hands. CPR with hands alone is CPR without mouth-to-mouth breathing.

equipped with a printer that provides feedback on real-time training efficiency and possible areas for improvement on the mannequin (Figure 28).

Figure 28 - Resusci Anne printer equipped



Source: Resusci-Anne. In: EMS Museum… (2019).

More recently, QCPR technology was developed, which allows the monitoring and analysis of CPR performance more effectively, increasing the efficiency and the use of training. QCPR technology allows instructors and students to monitor and analyze the performance of CPR, increasing the ability and the use of exercise. The Resusci Anne QCPR has realistic anatomy (full-size mannequins) and chest resistance (the same strength as a person), helping the student to observe the chest elevation during ventilation, needing to tilt the head/chin lift to ensure that the airways are open. Besides, there are compatible feedback devices.

Figure 29 - Resusci Anne QCPR

Source: Resusci- Anne QCPR. In: Laerdal website… (2019).

The SimPad with SkillReporter, allows wireless control on up to 6 models, controlling heart rates and executing scenarios, even wirelessly. With SkillGuide for QCPR mannequins, it is possible to expand the measurement, monitoring, and improve CPR skills (Figure 29). The search for digitization is presented below.

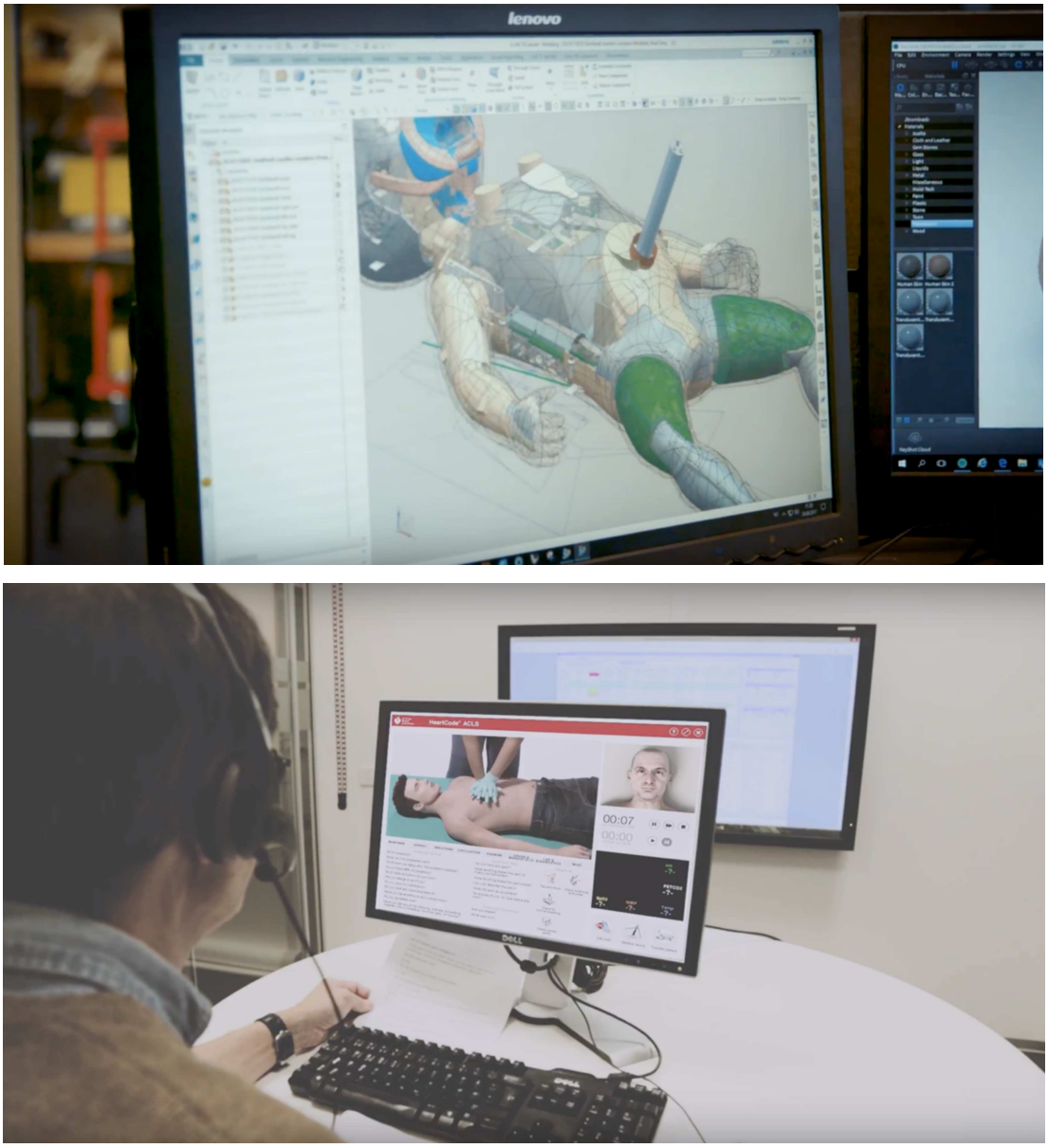
4.2.3 Digitalization

The manipulation of mannequins using electronic equipment is not recent. In 2001 the company already used mannequins with electronic and pneumatic components, controlled by a computer program. In this sensor system, the feedback was given in real-time, through a light, and the printing of a receipt. In the past ten years, these sensors have been introduced into more affordable products. Thus, currently, the use of sensors occurs even for the most basic training, whereas before, only for the most advanced training and with more expensive products.

From the insertion of the sensors, the next stage was the use of software on computers, installed through disks. Then the connection of the mannequin via Wi-Fi, but still very local. More recently, the company uses apps for more consumers, where people install an app. Then data can be sent to the cloud more quickly so that we can get insight into not just how people are doing clinically and about how they are doing CPR but also how they are using the product.

For EL4, digitization was a milestone in the development process. One of the main benefits of the cloud connection is the adjustment of the products for the use that the customer is making. In the case of applications that allow, for example, up to 42 connections, if the company realizes that the majority of customers used only 8, there is no need to adjust the link to 42. Feedback is fast and in a different way from personal monitoring of the customer.

Figure 30 - Digitization in the product development process



Source: Laerdal Medical Services Solution. Intro Ingrid. Laerdal Development Process: Youtube... (2018).

Prototyping has also benefited through digitalization, which precedes the physical prototype (Figure 30). The next stage is to develop prototypes with cardboard.

The literature states that "technology allows for cost savings due to remote processes and the ability to treat a greater number of patients" (IAKOVLEVA; OFTEDAL; BESSANT, 2019). Although Laerdal does not deal directly with patients, the gains that the use of technologies and digitalization have brought to both the development of innovations and the training of users are evident.

EL4 reinforces that "Everything is better and easier with digital, but the process is still the same. It's still about construction and sharing." Digitization is also influenced by stakeholder participation, as shown below.

4.2.4 The development process of Resusci Anne and the inclusion of stakeholders

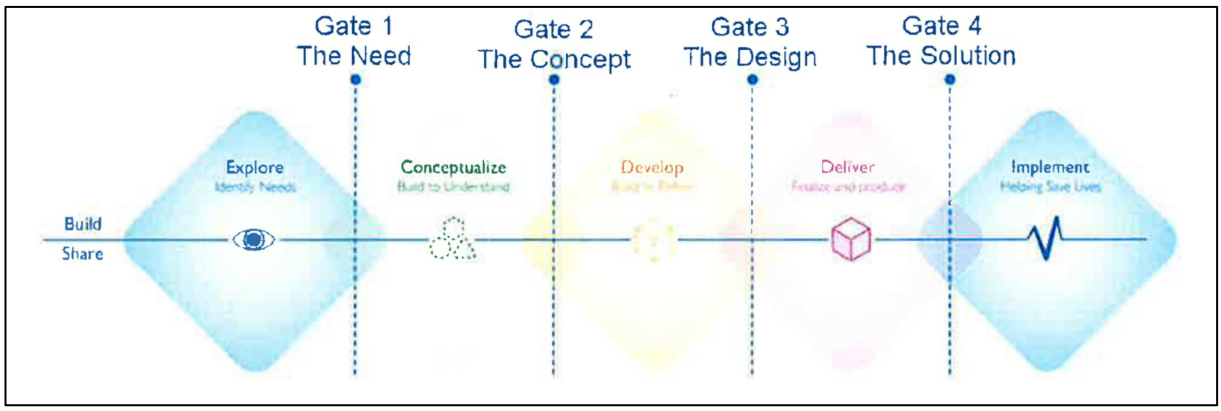
To define a structure that supports the development of products, services, and programs that meet customer needs, business requirements, user and market conditions, as well as the ISO 9001 project control requirement, Laerdal has developed the document "*Laerdal Development Process 00044432 Rev D*".

Even though the practice of standardization processes, such as ISO, is a long way from incorporating RI standards (WICKSON; FORSBERG, 2015), Laerdal's interest in promoting a change in organizational culture is perceived. By integrating control standards, Laerdal offers a structure of criteria and quality indicators necessary for the full achievement of the RI potential (WICKSON; CAREW, 2014).

The new development concept supported the organizational changes introduced in September 2016, with a focus on the user-oriented organization. The initial version dates from May 2017 (*Revision A*), with revisions being made in September 2017 (*Revision B*), February 2018 (*Revision C)*, and the last in November 2018 (*Revision D*).

The company's development process consists of five stages of the life cycle (*stages*) and five screens (*gates*) (Figure 31).

Figure 31 - Stages of the innovation process at Laerdal Medical



Source: Laerdal Medical Services Solution. Laerdal Development Process 00044432 Rev D.[2019?] Stavanger, 2019. Institutional document - internal use.

Despite the apparent linearity of Laerdal's innovation process, the model is more agile than shown in the figure. What we see is an approximation with the *Agile-Stage-gate* model (COOPER, 2016). The model recommends product development through a prototype in the early stages (Sprint), and quickly obtain feedback from customers (COOPER, 2016). But the main point of convergence between the model proposed by Cooper (2016) and the process applied at Laerdal is the construction-test-feedback-review interaction spirals. The application of this model will be deepened by analyzing the stages of the innovation process.

The stages are diamonds-shaped, which indicate that there is a divergent and convergent stage in all aspects. In this way, the company expands to investigate more possibilities and then to limit, prioritize and select (Figure 32).

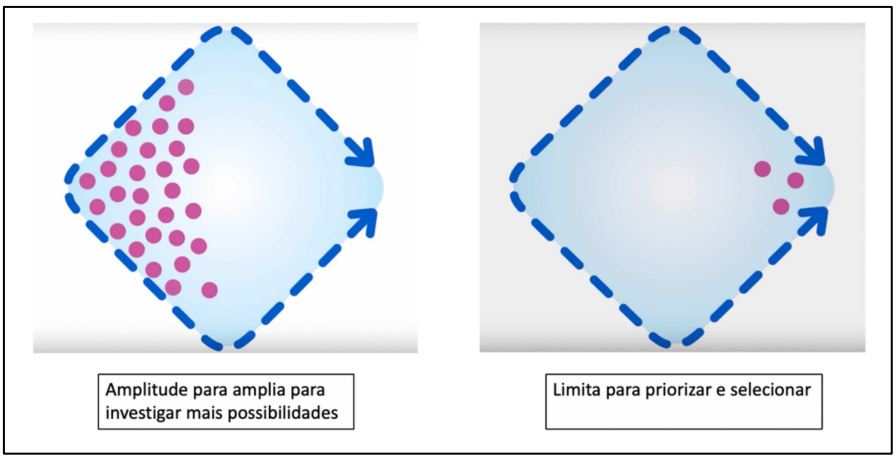
The diamond-shaped stages used by Laerdal are inspired by the "Double Diamond" model, a design tool (WHAT IS THE FRAMEWORK FOR INNOVATION?, [2019?]). The proposal of the device comprises four stages: discover, define, develop, and deliver.

The first diamond consists of the stages of:

- Discovery: Helping people to understand, instead of merely assuming what the problem is. It involves talking and spending time with people affected by the issues, and

- Definition: From the insight collected from the discovery stage, assist in defining the challenge differently.

Figure 32 - Diamond-shaped stages



Source: Laerdal Medical Services Solution. Intro Ingrid. Laerdal Development Process: Youtube... (2018).

The second diamond consists of the stages of:

- Development: I encourage people to give different answers to the clearly defined problem, seeking inspiration elsewhere and creating a joint project with a variety of different people, and

- Delivery: Different Test solutions on a small scale, rejecting the ones that don't work and improving the ones that worked.

The model used by Laerdal is restricted to the first diamond (discovery and definition).

The limitation in each of the "diamonds" ends up being the sieves (*gates*), which aims to indicate that the necessary activities in each of the stages were carried out and that the appropriate information was captured. The sieve can lead to three possible results:

- Moving on to the next stage - it is a suitable product, and enough is known to move on;

- Stay at the current stage - further investigation is needed;

- Finish - it is not desirable or viable or doable.

The possible results presented by Laerdal are consistent with one of the stages proposed by Cooper (2008), namely, the criteria based on which the project is judged. For the author, this stage includes rules that must be met or eliminatory questions (a checklist) designed to eliminate misfit projects quickly; and it must meet the criteria that

are scored and added (a point counting system), which are used to prioritize projects (COOPER, 2008, p. 215).

What draws attention in the model used by Laerdal is the transversal line that runs through all stages. To achieve the main objective of helping to save lives, what is built in each of the stages must be shared. Collaborative construction and sharing are perceived in almost all stages. To this end, the company uses practices that are a reference in the industry and Design Thinking methodology.

The development process was built on eight principles:

1) Saving lives and business potential - projects are prioritized, defined their scope and monitored, intending to save lives and the business potential that it can represent;

2) Focus on the user and the customer - first, understand users and partners and keep them involved throughout the process while solutions are developed and tested;

3) Expanding before narrowing - diverging into new possibilities, being creative and considering new opportunities and then converging, deciding what should be prioritized;

4) Focus on building and sharing - building several prototypes, sharing and receiving feedback, to be able to refine further;

5) Easy to understand - simplify the focus on the requirements and principles of ISO9001, as opposed to a detailed recipe for development;

6) A typical process - the development process is standard between Laerdal Medical and Laerdal Global Health;

7) Focus on the method, not on the documents - the understanding that is obtained throughout the process is described in the papers. Reports are necessary, but the most important thing is to develop the process and arrive at the right solutions;

8) Integrated solutions - work in an interdisciplinary way to develop integrated solutions that can include digital, physical components, sales, and services. They complete the system and are not perceived as fragmented pieces.

Despite the certainty that partners are very present in the innovation process, there is some difficulty in describing how this process is done. EL2's speech illustrates this.

> It's complex to answer them directly because it's kind of just like a natural activity. It's so embedded in the way that we work, so for us it's not like a question to be answered. It's just it's the way we work, yeah. And we work so close to our partners. Our partners rely on us and we rely on our partners,

Not only in the case of Resusci Anne, but also for other products, the inclusion of specialists and users is carried out in different stages. EL2 also reinforces that

> You will see that not only for the products that we do in partnerships, because we don't develop everything in partnerships. We do something that we do just internally, but we always do it with the customers. So the users, the end users are being involved in the development activities, even though they aren't like formal partnerships. So again, using this development process, whenever we are working on something new and create a prototype, we bring it out to users.

Despite the difficulties pointed out in the literature, especially about maintaining power over the process (LUBBERINK et al., 2017) and different views and interests (BLOK, HOFFMANS, WUBBEN, 2015), it appears that at Laerdal the process is standardized, flowing naturally throughout the organization.

What was evident is that there is the active participation of institutional partners, such as the American Heart Association (AHA), the British Heart Foundation (BHF), the National League for Nursing (NLN) and the Stavanger Acute Medicine Foundation for Education and Research (SAFER). In addition to them, the primary users are also included, as advanced life support practitioners - health professionals, especially paramedics and people working in ambulances, firefighters and nurses - but also ordinary people, such as people working in hotels, gyms, swimming pools, people who have other jobs, and health is a secondary issue for them. The groups vary according to the stage of development.

Laerdal explores the diversity of stakeholders, including basically non-economic stakeholders (BLOK, HOFFMANS, WUBBEN, 2015), who have no economic interest based on innovation, but rather seek to contribute to the quality and applicability of products.

The identification of the need for an improvement or new product occurs in several ways. One is through long-term relationships with organizations, and these associations, talking to people from other agencies involved. EL3 illustrated through the mannequins developed to reduce infant mortality, the identification of the opportunity in this field: "The challenges around maternal death linked to birth is no secret.". For EL3, there are different ways for a project to start. Still, it often begins as

part of the ongoing conversations it has with stakeholders and who can be experts and program organizers but can also be healthcare providers. In some cases, the solution was developed as a student project during the summer. This prototype was presented at a conference in the area.

The time for development is not very long, already part of the routine. To explore the need, the company believes in reading, researching, and talking to people and devising a formula. The way to do this is private to the company, according to EL3.

> We have a kind of a way to formulate need statements and the resource of one technique called questions which we use quite a lot. Where you need to make a sentence that describes a challenge. One sentence. And then in the truth and explore stage, you might have madly different sentences like that, and you choose one to organize the project around.

The first job is basically to find the challenge that has the most significant potential. From there, the implementation team will suggest the network or some people who can help find the right people to be involved. The next stage is to configure what to do while building prototypes. The objective of this stage is to gain confidence, understand the need very well, and also develop an outline of a solution that has the potential to meet that need.

As highlighted by the Vice President of the Patient Care Business Unit, Ingrid Laerdal (video L6), and previously mentioned, the development process uses the *Design Thinking* methodology. *Design Thinking* is used in the first stages of the process, as in the exploration and conceptualization stages.

4.2.4.1 Explore

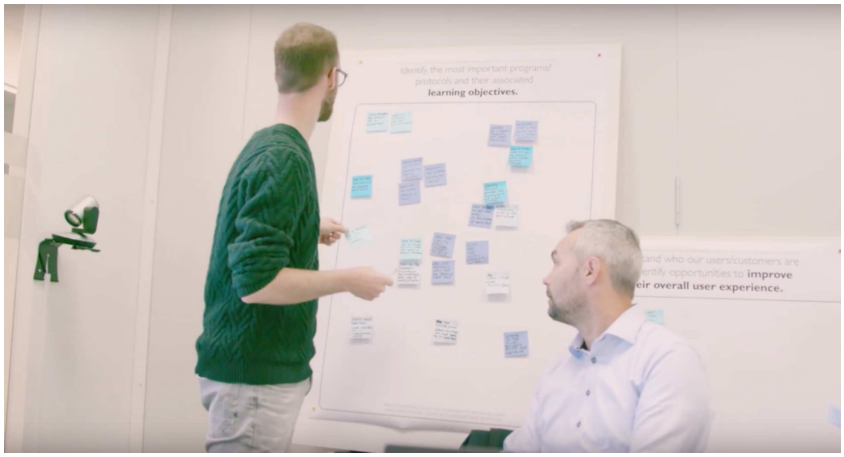
Based on the principles, the Explore stage seeks to detect needs, identifying, or learning something. It includes actions to develop insights, identify needs, and promote direction for the next stage (Figure 33).

This stage is considered the starting point when it is known what they are "curious about," and what can be a solution. Different sources can trigger an exploration stage:

- Partners pointing out a gap, the company investigates the business potential;
- User feedback or the identification of a market opportunity identified by the sales area;

- Rethink or improve an existing product or service.

Figure 33 – Explore process



Source: Laerdal Medical Services Solution. Intro Ingrid. Laerdal Development Process: Youtube... (2018).

From sketches and prototypes of different solutions (without seeking the solution immediately), the dialog with users and experts is open. For EL3, this is the main objective.

> We want to learn about – the main purpose in the early stage would be to learn more about the need and also figure out should this be an app or should it be a practical tool, should be a reusable tool, should it be like there's always different pathways you can follow and if we can make different prototypes.

Also, according to EL3, they can spend a few weeks while the team is building and generating ideas, to later organize a meeting with users and specialists, or even use the local hospital. They also participate in events and conferences. Besides, many international experts visit Laerdal regularly.

There is a full flow of interested people who come to the company. How they do this, or the context may be different in each case, but do not proceed to the next stage without first sharing what was created with experts and users.

EL1 describes that the workflow of the team involved, who considers that after an idea has been developed, it may again have adjustments, according to the feedback. EL3 summarizes this stage by describing that,

> What we learned through that iteration, after our meetings and sharing sessions, and make a plan for the next iteration and then we say okay, out of these 3 things that we presented, number 1 seems less – there is less

> potential for 1 but B with some elements from C might be interesting. And we also learned something new about the need that stimulates us to explore this site idea. And then we build a new prototype and do the same thing again. Share with people and summarize what we learned and make a plan for the next iteration.

EL4 further details the prototyping process, stating that the physical and digital process is quite similar. The main change is that before making the prototype with cardboard and plastics and making a model of a product and talking about it with people, they do precisely the same thing, only with digital prototyping tools. It's just a matter of how fast and cheap it can be. For him, "It is still about building and sharing."

EL4 assumes the responsibility that it is vital to "make it happen" in the first two stages. That is, failing too early, having as much exposure as possible to our customers and users in the beginning. So, when they fail, it's easy to redo and move in a different direction. The financial aspect weighs in this process, because for EL4, "If we can use the design process to fail earlier and fail more cheaply, that's success I think for us."

By including stakeholders already in the first stage (and in the following, as described below), Laerdal directs the innovation process to generate the most favorable results in favor of people, the planet, and, also, financial sustainability (ILLIES; MEIJERS, 2009; SUTCLIFFE, 2011).

The first *gate (1 - The need*) is made from that moment. The activities conducted and the refined needs statements are presented in a summary project.

The decision may be to proceed to conceptualize, but it may also decide that the topic initially brought up does not have the expected potential, and it is interrupted.

The assumption adopted by Laerdal is related to maintaining the results and their models with the essential information necessary for decision making (COOPER, 2008).

Different sources can trigger the Explore stage. Concerning external stakeholders, it can occur through gaps pointed out by partners (such as the American Heart Association (AHA) or the National League for Nursing (NLN)), driven by user feedback (as health professionals) (Figure 34).

For this, healthcare professionals can be interviewed or observed, use sketches or *mock-ups* to start dialogs with partners, visit paramedics working in ambulances, invite partners and users to workshops.

Since the partners are not always physically close, some are invited to come to the company. In other cases, Laerdal employees travel to where people are. The conferences are also very explored, as it is a productive meeting point, which generates the opportunity to meet many talented people in organizations. Laerdal has been organizing the Simulation User Network (SUN) for over ten years in the United States, considered one of the most traditional events of realistic clinical simulation. With the target audience of academic coordinators and specialists in the field of realistic clinical simulation, teachers, medical students, nurses, managers of simulation centers in hospitals and universities, technicians of simulation laboratories and educators in the areas of emergencies, the event bets on presentation of best simulation practices, *networking*, introduction of new strategies and technologies, mixing the performance of academic research with the most modern solutions developed in the area.

Figure 34 - Stakeholder participation in Explore stage

Source: Laerdal Medical Services Solution. Explore. Laerdal Development Process: Youtube... (2018).

From the actions performed initially, it is possible to identify the processes and routines that underlie the fundamental dimension of **Explore** (Table 24).

Table 24 – Stakeholder inclusion processes and routines in the Explore stage

Processes and Routines	**Representative data of Explore**
Conversation with users	“So, the users, the end users are being involved in the development activities, even though they aren’t like formal partnerships.” (EL2)
Observation of product use	“Throughout this stage there are many methods that can help us identify needs. Some of these activities might be ... observing healthcare workers.” (VL7)

Participation, organization and exhibition in Congresses	"...when I joined Laerdal, I did the first event in Brazil, called Mini Sun (Simulation User Network) that takes place at a university for a day, to connect people who are interested, no matter the level, but who have a link with the simulation or with health education." (EL8) "And during that conference, we showed a concept to different people and got interest from Japaigo on like the topic..." (EL3)
Attention to contacts made by customers and users through social networks, CSC	"Laerdal uses multiple channels as….social media, customer services"(EL10)
Exploring the contact of employees in the marketing and sales areas	"Júlia, for example, at Unisinos, when she has a problem, she sends an email to Biomedica, but copying Janaína, copying the service in SP and everyone is warned of what is happening so that she has a quick response." (EL9)
Participation and organization of training and qualification events	"I'm an instructor and I can see that they struggle with something and the feedback is not good, is easy to remember and it's hard to fail, because I've experienced it and seen someone's struggle and I want to fix it.". (EL4) "We go 3 times within these 3 months to 3 conferences. One is an external conference which is a simulation conference, it's called I am [inaudible] that's where a lot of different companies come who are engaged in simulation and then you can also fish for some user feedback and then the two other conferences are in Europe and the other one is US. So that's now our plan, to cover 3 conferences, to have 10 customers for these generative or reflective kind of work and at the end we are planning to send out a survey with a test to validate all the qualitative input we have discovered on a bigger scale." (EL6)
Registration and documentation of ideas and suggestions	"It is important to document and summarize the insights and share them, because we will then be able to discuss and decide which needs to focus on. (VL8)

Source: by the author.

In this stage, there are also some external stakeholders, shown in Table 25:

Table 25 - Stakeholders included in Explore stage

Phase	***Stakeholders***	
Explore	Institutional partners	• American Heart Association (AHA) • British Heart Foundation (BHF) • National Leaghe for Nursing (NLN) Stavanger Acute Medicine Foundation for Education and Research (SAFER)
	Healthcare professionals	• Medical doctors • Paramedics • Firemen • Nurses

	Common people	Employees of: • Swimming pools • Hotels • Gyms

Source: by the author.

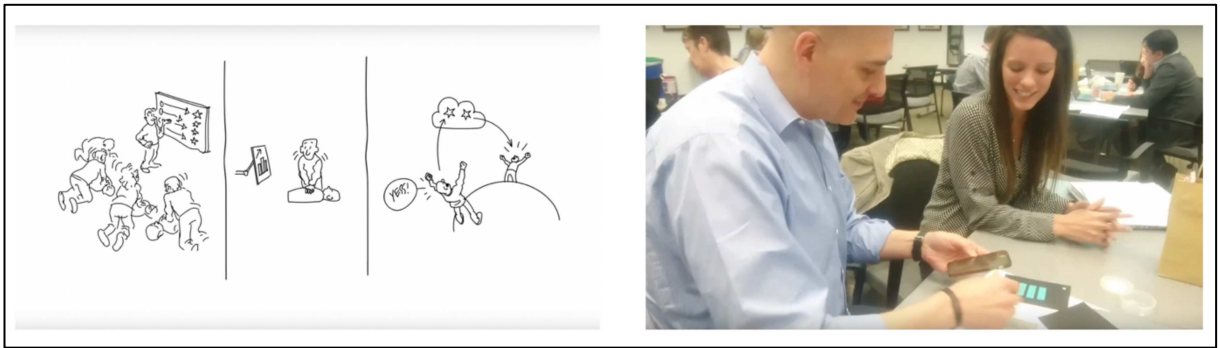
The next stage is **Conceptualize**.

4.2.4.2 Conceptualize

When the decision is made to move forward, it moves to the **Conceptualize** stage, which works to create several ways to meet the identified need. In this stage, possible concepts are developed, which must be evaluated (with users and partners). The selected concept must be aligned with the company's mission, fulfilling the user's needs and developed with the technology available within a solid business case.

The stage begins with the divergence, where different alternative ways appear to meet the user's selected needs. In this stage, several prototypes are created quickly to obtain feedback. The prototype can be any way to communicate better an idea, such as a mockup (models or representations of objects and products, in their original size or on a large scale), a video made through a smartphone, or sketches of buttons on a screen (Figure 35).

Figure 35 - Prototypes



Source: Laerdal Medical Services Solution. Conceptualize. Laerdal Development Process: Youtube... (2018).

Prototypes can be shared internally, with partners or with end-users.

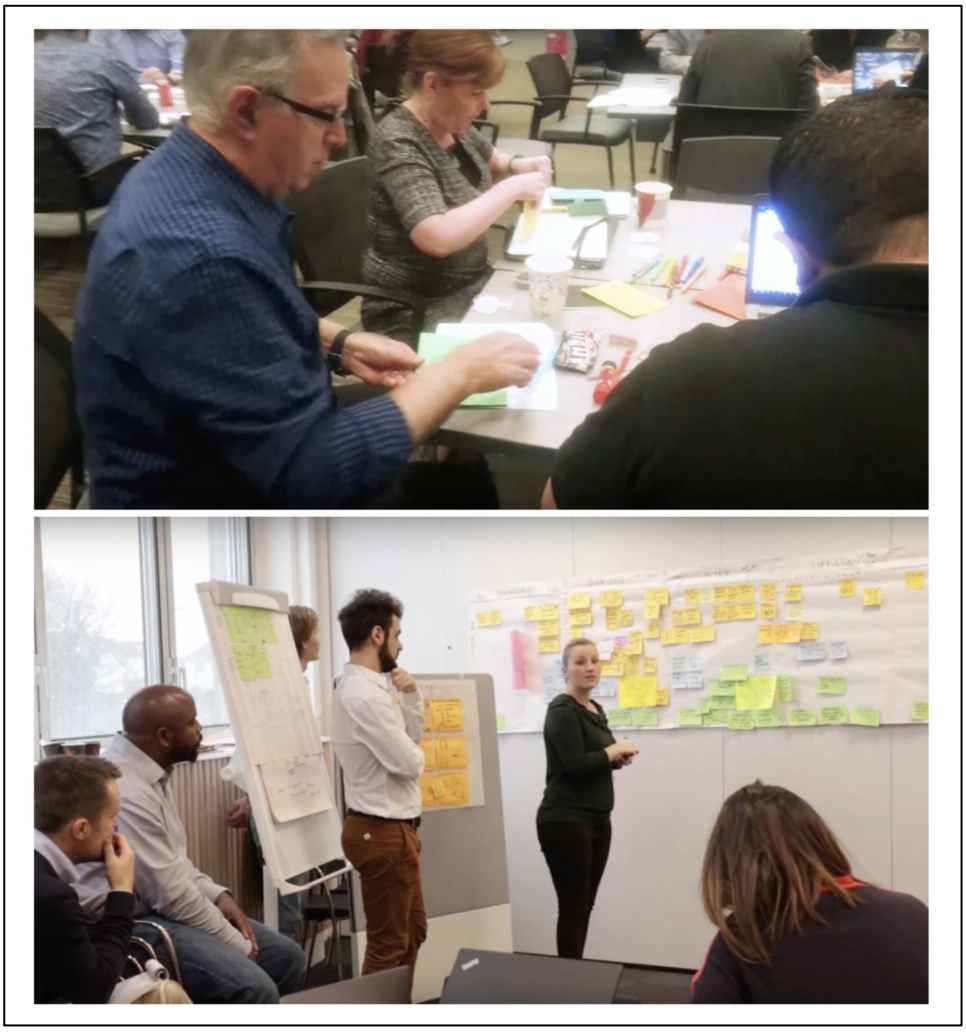
The concepts will be selected at the expense of others based on relevant parameters, such as user feedback, life, and business potential, and how to bring it to market.

The stage ends with Gate 2 - The Concept, where the selected concept and its justification of choice (how it will save lives and its business potential) is presented, in addition to the journey required to reach this conclusion.

In the **Conceptualize** stage, when prototypes are created, the participation of stakeholders is essential. Since prototypes can be shared with partners or end-users, one of the strategies is to bring several types of prototypes, which allows people to provide comparative feedback.

Besides, prototypes can be created in conjunction with users, where they can make their ideas tangible (Figure 36).

Figure 36 - Stakeholder participation in the Conceptualize stage



Source: Laerdal Medical Services Solution. Conceptualize. Laerdal Development Process: Youtube... (2018).

From the actions carried out in the conceptualization stage, it is possible to identify the processes and routines (Table 26).

Table 26 – Stakeholder inclusion processes and routines in the Conceptualize stage

Processes and routines	Representative data of Conceptualize
Presentation of several prototypes through visits to partners	"...it might be as much as a week to organize a meeting with users or experts and that can happen with – sometimes we will use the local hospitals, sometimes we will be part of events, or take advantage of meetings that are happening anyway. "(EL3) "All of these iterations we got in touch with users and experts and we were in during one of the field tests we went to the town of Mikaela in northern Ethiopia. And we spend a week with this group of midwives and birth attendants at training that they had in front of the visit." (VL3)
Presentation of several prototypes by calling partners and users to the company's headquarters	"It's just as important to summarize, document and share this information effectively." (VL9) "And then we summarize what we learned through that iteration, after our meetings and sharing sessions, and make a plan for the next iteration and then we say okay, out of these 3 things that we presented, number 1 seems less – there is less potential for 1 but B with some elements from C might be interesting." (EL3)
Registration and documentation of ideas and suggestions	"It's just as important to summarize, document and share this information effectively." (VL9) "And then we summarize what we learned through that iteration, after our meetings and sharing sessions, and make a plan for the next iteration." (EL3)

Source: by the author.

In **Conceptualize**, some external stakeholders are highlighted, shown in Table 27.

Table 27 – Stakeholders included in the Conceptualize stage

Phase	***Stakeholders***	
Conceptualize	Institutional partners	• American Heart Association (AHA) • British Heart Foundation (BHF) • National Leaghe for Nursing (NLN) Stavanger Acute Medicine Foundation for Education and Research (SAFER)
	Healthcare professionals	• Medical doctors • Paramedics • Firemen • Nurses

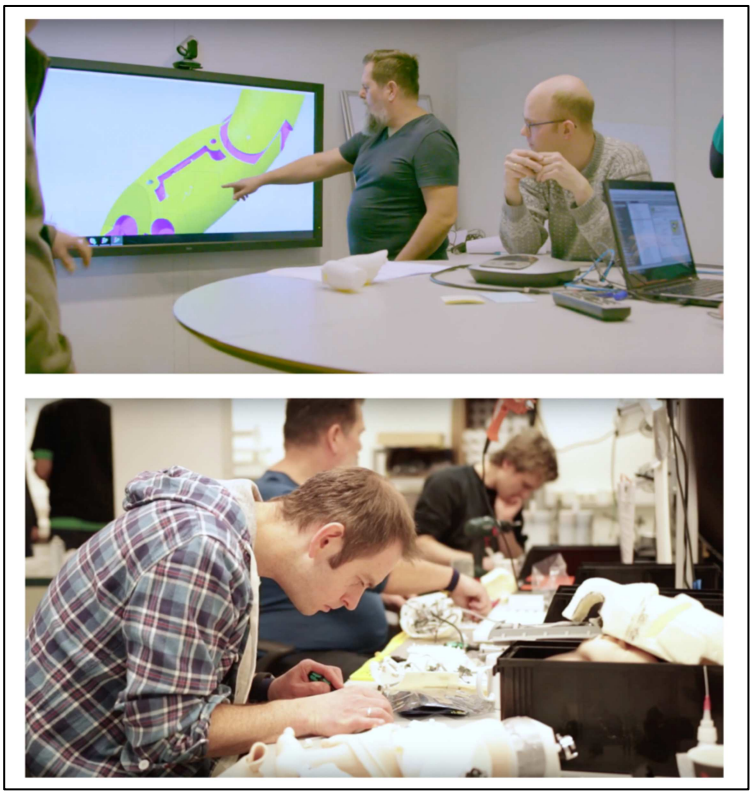
Source: by the author.

The development of the final project is carried out in the next stage.

4.2.4.3 *Develop*

The next stage is to **Develop,** which develops the final project for the selected concept. It details the solution, manufacturability, risk reduction, and technical and regulatory requirements. In this stage, there are still dialogues about improvements with specialists, users, and partners and the supply chain.

Figure 37 - Prototype development



Source: Laerdal Medical Services Solution. Develop. Laerdal Development Process: Youtube... (2018).

As the stage progresses, integrated working prototypes are shared, tested, and proven in dialogue with partners and fellow users' experts (Figure 37). According to EL2,

> And then we learn, then we go back, and we do the modifications, we create a new prototype, we go back to the partner. So, this is going back and forth and this is very much described in our development process.

Conceptual design is refined through iterations, which is the way the company works, assesses risks, and plans each iteration. For Laerdal, the way to perform

iterations is to ask: What is the most significant risk? What are the most difficult tasks that need to be solved with the product? Are there any knowledge gaps that we need to fill?

At the end of the development stage, the Gate 3 - The Design, refers to the exact details of the project, what to deliver and how to deliver it and why it is done in this way. The remaining work must be planned, and the risk of not fulfilling the plan is acceptable.

In the **Develop** stage, prototypes are shared, tested, and proven together with partners, specialists, and users (Figure 38).

Figure 38 - Stakeholder participation in the Develop stage

Source: Laerdal Medical Services Solution. Develop. Laerdal Development Process: Youtube... (2018).

From the actions carried out in the **Develop** stage, it is possible to identify the inclusion processes and routines (Table 28).

Table 28 - Stakeholder inclusion processes and routines in the Develop stage

Processes and routines	**Representative data of Develop**
Demonstration and testing of the prototype by visiting partners	Mamabirthie Design Process (VL4)
Demonstration and testing of the prototype by calling partners and users to the company	As the stage progresses, integrated working prototypes are shared, tested and proved in a dialogue with users' experts' partners at al. (VL10)

Registration and documentation of ideas and suggestions	“During the develop stage, design input, design output, risk assessment and plans for deliver stage are documented.” (VL10)

Source: by the author.

In this stage, there are also some external stakeholders, shown in Table 29:

Table 29 - Stakeholders included in the Develop stage

Phase	***Stakeholders***	
Develop	Institutional partners	• American Heart Association (AHA) • British Heart Foundation (BHF) • National Leaghe for Nursing (NLN) Stavanger Acute Medicine Foundation for Education and Research (SAFER)
	Healthcare professionals	• Medical doctors • Paramedics • Firemen • Nurses

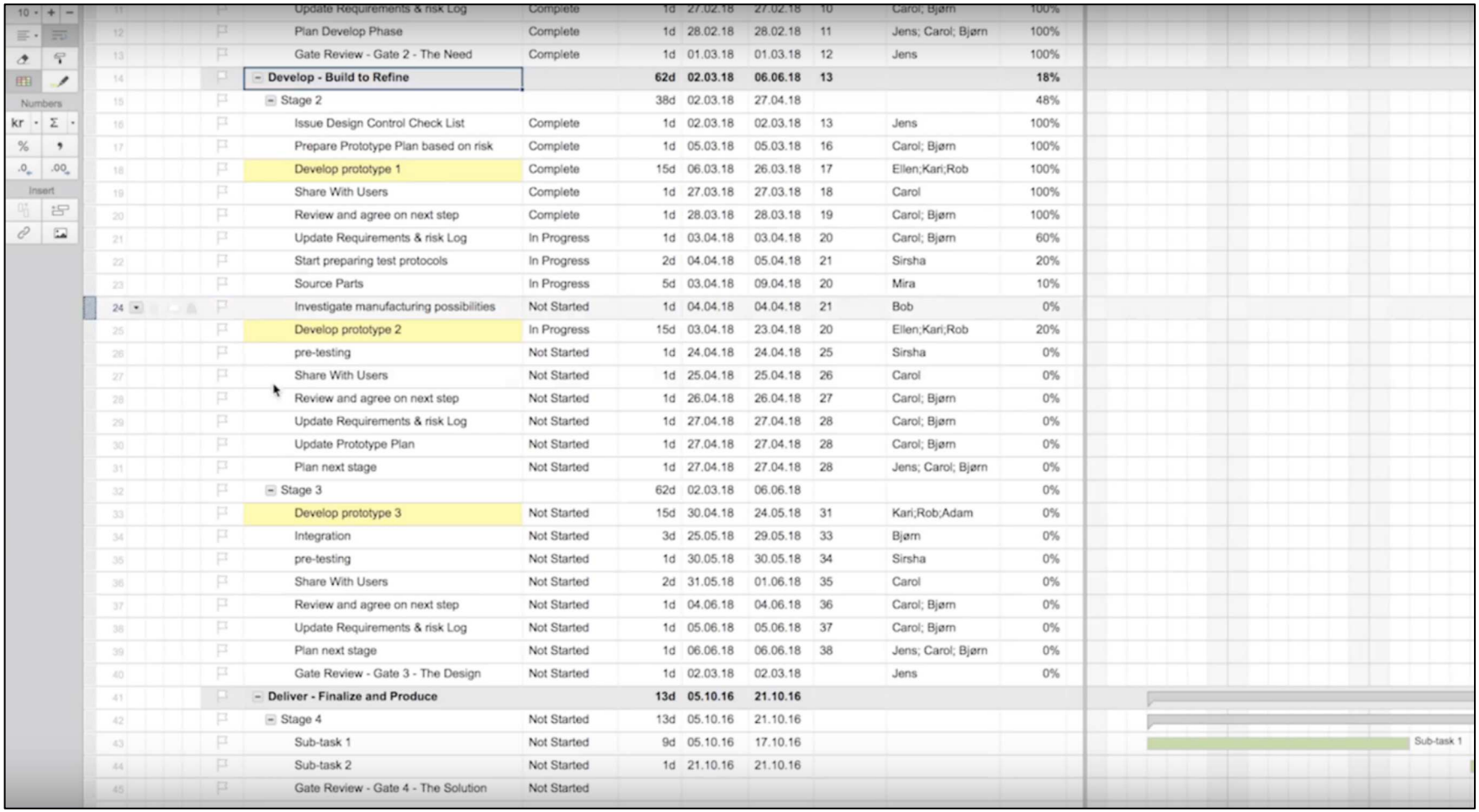
Source: by the author.

At the end of the **Develop**, it moves to the **Deliver** stage.

4.2.4.4 Deliver

The **Deliver** stage goes from being an iterative process of compilation and sharing to becoming a linear delivery process. In this stage, the technical and design risks have been reduced to an acceptable level, and it is considered that the remaining work of the project can be carried out on time and budget. The project organization is expanded at this stage, starting with the project management (Figure 39). Production implementation and product launch activities are also carried out.

Figure 39 – Laerdal Project Management System



12	Plan Develop Phase	Complete	1d	28.02.18	28.02.18	11	Jens; Carol; Bjørn	100%
13	Gate Review - Gate 2 - The Need	Complete	1d	01.03.18	01.03.18	12	Jens	100%
14	**Develop - Build to Refine**		**62d**	**02.03.18**	**06.06.18**	**13**		**18%**
15	Stage 2		38d	02.03.18	27.04.18			48%
16	Issue Design Control Check List	Complete	1d	02.03.18	02.03.18	13	Jens	100%
17	Prepare Prototype Plan based on risk	Complete	1d	05.03.18	05.03.18	16	Carol; Bjørn	100%
18	Develop prototype 1	Complete	15d	06.03.18	26.03.18	17	Ellen;Kari;Rob	100%
19	Share With Users	Complete	1d	27.03.18	27.03.18	18	Carol	100%
20	Review and agree on next step	Complete	1d	28.03.18	28.03.18	19	Carol; Bjørn	100%
21	Update Requirements & risk Log	In Progress	1d	03.04.18	03.04.18	20	Carol; Bjørn	60%
22	Start preparing test protocols	In Progress	2d	04.04.18	05.04.18	21	Sirsha	20%
23	Source Parts	In Progress	5d	03.04.18	09.04.18	20	Mira	10%
24	Investigate manufacturing possibilities	Not Started	1d	04.04.18	04.04.18	21	Bob	0%
25	Develop prototype 2	In Progress	15d	03.04.18	23.04.18	20	Ellen;Kari;Rob	20%
26	pre-testing	Not Started	1d	24.04.18	24.04.18	25	Sirsha	0%
27	Share With Users	Not Started	1d	25.04.18	25.04.18	26	Carol	0%
28	Review and agree on next step	Not Started	1d	26.04.18	26.04.18	27	Carol; Bjørn	0%
29	Update Requirements & risk Log	Not Started	1d	27.04.18	27.04.18	28	Carol; Bjørn	0%
30	Update Prototype Plan	Not Started	1d	27.04.18	27.04.18	28	Carol; Bjørn	0%
31	Plan next stage	Not Started	1d	27.04.18	27.04.18	28	Jens; Carol; Bjørn	0%
32	Stage 3		62d	02.03.18	06.06.18			0%
33	Develop prototype 3	Not Started	15d	30.04.18	24.05.18	31	Kari;Rob;Adam	0%
34	Integration	Not Started	3d	25.05.18	29.05.18	33	Bjørn	0%
35	pre-testing	Not Started	1d	30.05.18	30.05.18	34	Sirsha	0%
36	Share With Users	Not Started	2d	31.05.18	01.06.18	35	Carol	0%
37	Review and agree on next step	Not Started	1d	04.06.18	04.06.18	36	Carol; Bjørn	0%
38	Update Requirements & risk Log	Not Started	1d	05.06.18	05.06.18	37	Carol; Bjørn	0%
39	Plan next stage	Not Started	1d	06.06.18	06.06.18	38	Jens; Carol; Bjørn	0%
40	Gate Review - Gate 3 - The Design	Not Started	1d	02.03.18	02.03.18		Jens	0%
41	**Deliver - Finalize and Produce**		**13d**	**05.10.16**	**21.10.16**			
42	Stage 4	Not Started	13d	05.10.16	21.10.16			
43	Sub-task 1	Not Started	9d	05.10.16	17.10.16			
44	Sub-task 2	Not Started	1d	21.10.16	21.10.16			
45	Gate Review - Gate 4 - The Solution	Not Started						

Source: Laerdal Medical Services Solution. Deliver. Laerdal Development Process: Youtube... (2018).

What remains is to prepare the organization to implement the solution in the market, where a large part of the organization, including marketing, sales, services, manufacturing, logistics, and quality control departments, is involved. In this stage, the detailed launch planning for the market will also be made, which includes the launch strategies, goals, and objectives (product, price, promotion, positioning, and distribution channel strategies). Relevant regulatory tests and approvals must also be carried out in the markets where the product will be launched (Figure 40).

Figure 40 - Product testing

Source: Laerdal Medical Services Solution. Deliver. Laerdal Development Process: Youtube... (2018).

In the last gate (4 - The Solution), the product is transferred to the production and the release of a marketable product to the market.

Once in the **Deliver** stage, the project moves to the engineering process, when there is no interaction with external stakeholders.

Ingrid Laerdal (LAERDAL MEDICAL SERVICES SOLUTION. DUALITY. LAERDAL DEVELOPMENT PROCESS: YOUTUBE..., 2018) reinforces that the first two stages are concentrated around finding the needs and concepts that meet the requirements, and the working methods are exploratory with many uncertainties and open questions. Here the contribution of external stakeholders is much more significant. In **Develop** and especially in **Deliver**, the process is now geared towards engineering, with the search for technical solutions.

4.2.4.5 Implement

The last stage, **Implement**, aims to achieve the company's mission - to help save lives. In this stage, it is verified if the product has the planned impact, and adjustments and adaptations are made for different markets.

To help users and partners achieve their goals with training and patient care, Laerdal supports users in the field with technical and educational services (Figure 41).

Figure 41 - User training

Source: Laerdal Medical Services Solution. Implement. Laerdal Development Process: Youtube... (2018).

In the last stages, designers interact with both marketing department and the market. EL6 explains that

> you would have marketing with graphic designers and then when something is implemented, if it's digital, then you still need to monitor market feedback and you know, learn from them and maybe do a little round of these, like okay. Based on this feedback of usage, what is it that we understand from doing to improve it? Basically, it can be the same with a much shorter cycle.

In this last stage, **Implement** is where users have questions and concerns and are open to giving feedback (Figure 42). It is thanks to the responsiveness to listen, learn, and act according to this relationship with the user that the implementation process is successful.

Figure 42 - Stakeholder participation in the Implement stage

Source: Laerdal Medical Services Solution. Implement. Laerdal Development Process: Youtube... (2018).

After the product has been implemented, several channels are used to maintain contact with customers and users, emphasizing listening. The interviewee EL10 specified that marketing and sales departments, social media, Customer Service Center (CSC), as well as conferences, are the main channels for listening to customers and users.

In many cases, the user contacts CSC to ask questions about guarantees, but also to report different uses of the product. This behavior is encouraged by Laerdal, which supports the client to be part of the process through a positive relationship. A point of note is that in cases of use other than what is recommended, the product warranty is not affected. This makes users more confident in developing new applications, knowing that they will not lose their warranty, or will incur extra costs.

Laerdal has a weekly routine (daily, if any urgency is identified), in which the information shared through CSC, shared through a "knowledge link" with the Research and Development (R&D) department. The demands are sent to the design and engineering teams, which check how many similar orders are made, how often, and what the impact of the change is. Feedback to customers is given through the same channel, informing whether the suggestion was accepted or not, to recognize the partnership.

In addition to the product, Laerdal is also concerned with sharing new ideas and creativity in training. The company engages those who carry out training through

simulation meetings, to share new ideas on how to make training more realistic, or how to prepare practice with fewer resources.

From the actions carried out in the last stage, implementation, it is possible to identify the processes and routines (Table 30).

Table 30 - Stakeholder inclusion processes and routines in the Implement stage

Processes and routines	**Representative data of Implement**
Dialog with users	"Our responsiveness to listen, learn and act on these supports a successful implementation process." (VL13) "Learnings from user behavior, partner feedback and market needs help us discover new needs and opportunities." (VL13) "Yes, we still have to talk to them, we don't get the complete picture, but we do get some numbers. Because we are very much out and talking to our customers all the time to really understand what they like, need and want." (EL4)
Observation of product use	"Learnings from user behavior, partner feedback and market needs help us discover new needs and opportunities." (VL13)
Participation, organization and exhibition in Congresses	""Learnings from user behavior, partner feedback and market needs help us discover new needs and opportunities." (VL13)
Attention to contacts made by customers and users through social networks, CSC	"Learnings from user behavior, partner feedback and market needs help us discover new needs and opportunities." (VL13)
Exploring the contact of employees in the marketing and sales areas	"Learnings from user behavior, partner feedback and market needs help us discover new needs and opportunities." (VL13)
Participation and organization of training and qualification events	"So we try to like in the conferences, we try to organize with that, with the local marketing team, so they help us engage the users upfront and we set aside a room and that's our plan for the next workshop and then we invite the participants upfront, we have a list of applicants with their profile for the conference, so we try to invite them personally or we just go to the conference and we hijack some sessions and ask the participants there if they are interested to get in touch with us." (L6) "And we are also instructors ourselves with the teams who make products for the community training like general public, they are all instructors, they can give classes themselves, so they aren't just observing users, but they can be users. So I've been giving a lot of classes myself, I've been training friends, family and group of people that ask really. And then just to get to do experience the life of an instructor, because those are the people that we try to serve. So it's really the ultimate way of having user insight is to do that." (EL4)

Registration and documentation of ideas and suggestions	We might be measuring the retention rate of new nurses after a newly implemented training program. We might be following research studies that look into the changes in newborn survival. We might be tracking the quality improvement of CPR performance or measuring to see if the assumptions in the business case were correct. (VL13)

Source: by the author.

The processes and routines in the **Implement** stage are the same as in the **Explore** stage. From a new product or version, communication is established with customers and users for their evaluation. At that moment, the channel opens up again for new ideas, suggestions, or problems that will be developed in a new stage of **Explore**. This demonstrates the continuity of the process established by Laerdal.

Although the literature suggests that inclusion occurs from the first stages of the innovation process (OWEN; MACNAGHTEN; STILGOE, 2012; STILGOE; OWEN; MACNAGHTEN, 2013), empirical cases describe inclusion only at the end of the process (SILVA et al., 2019). Contrary to these cases, Laerdal favors inclusion in several stages, from the first one, until the moment the product reaches the market.

Finally, some stakeholders, shown in Table 31, stand out:

Table 31 - Stakeholders included in the Implement stage

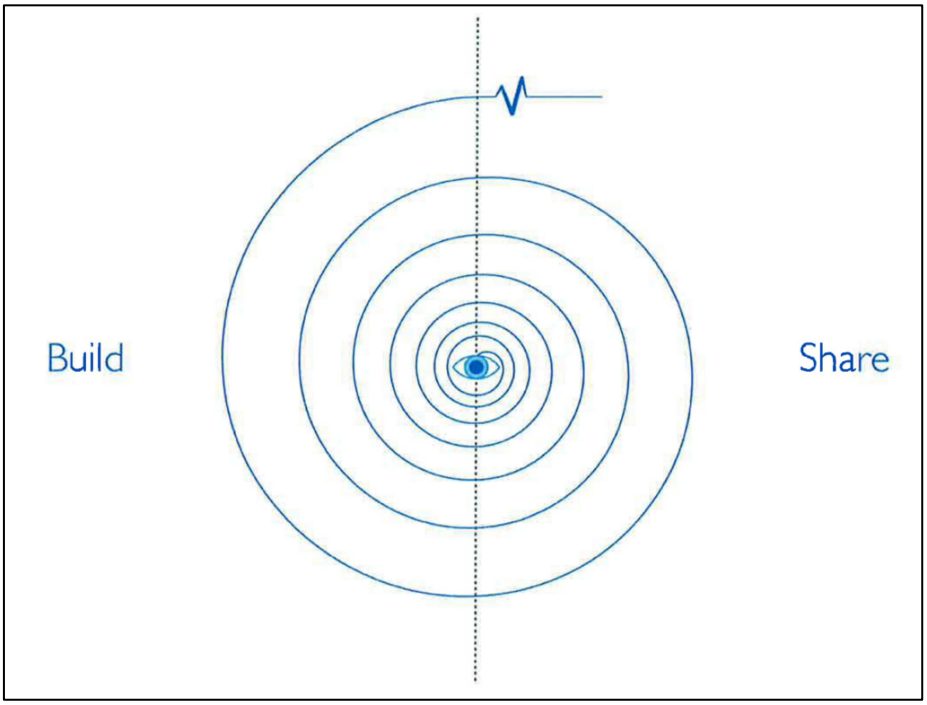
Phase	***Stakeholders***	
Implement	Institutional partners	• American Heart Association (AHA) • British Heart Foundation (BHF) • National Leaghe for Nursing (NLN) Stavanger Acute Medicine Foundation for Education and Research (SAFER)
	Healthcare professionals	• Medical doctors • Paramedics • Firemen • Nurses
	Common people	Employees of: • Swimming pools • Hotels • Gyms

Source: by the author.

Just as the processes and routines in the **Implement** stage are the same as in the **Explore** stage, the same occurs with stakeholders. During the research, it was not established whether Laerdal seeks, whenever possible, to call the same people to evaluate the evolution of the product.

The cycles previously mentioned by EL6 are represented graphically by the image that guides the essence of the project (The Core Process), shown in Figure 43.

Figure 43 - The Core Process



Source: Laerdal Medical Services Solution. Laerdal Development Process 00044432 Rev D.[2019?] Stavanger, 2019. Institutional document - internal use.

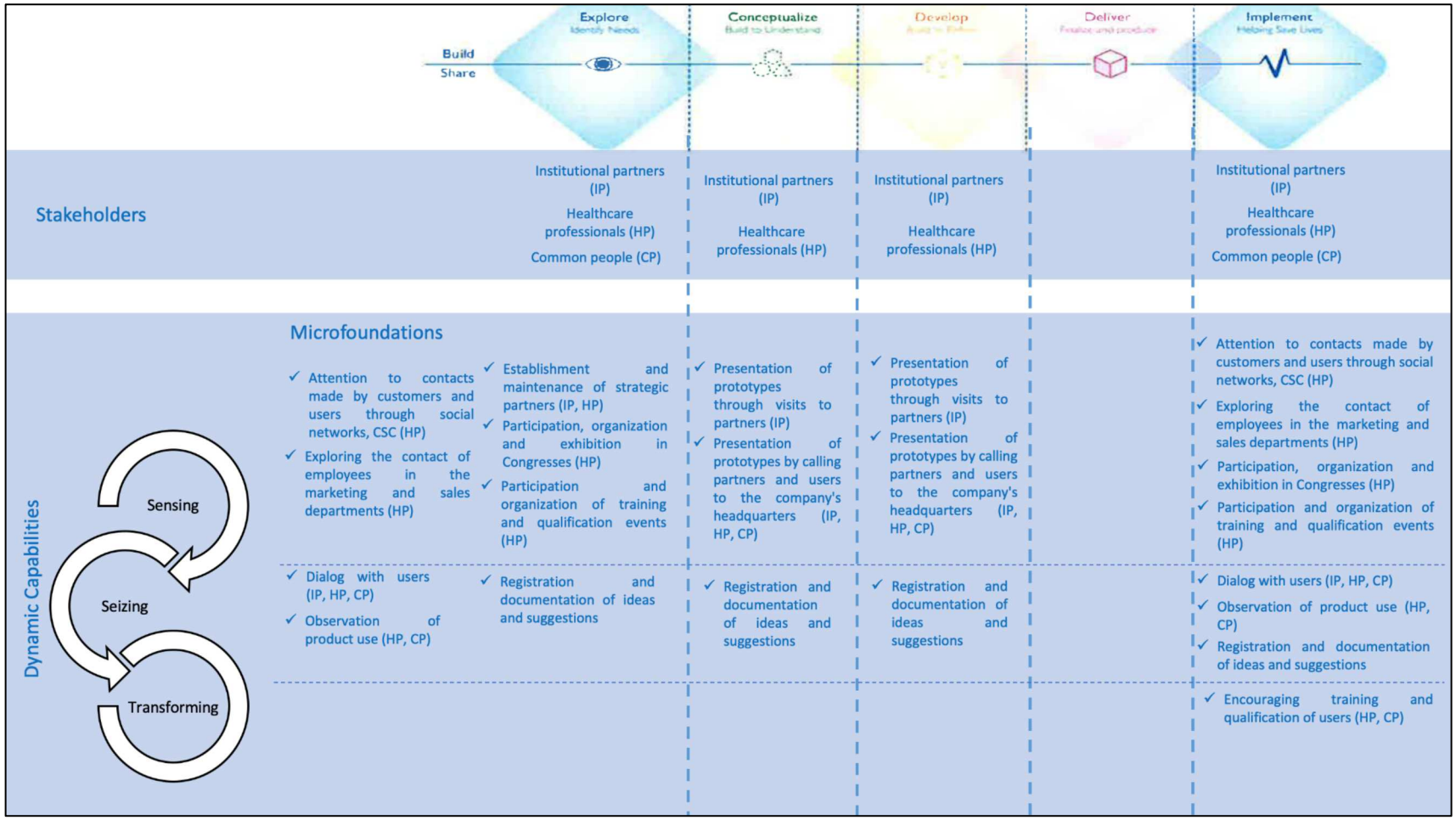
When represented in a spiral shape, it is clear that the company values, throughout the process, building and sharing, advancing from the first stage (Explore) until the achievement of its objective, which is to “Help save lives.”

4.2.5 Microfoundations of Laerdal's dynamic capabilities in the inclusion of stakeholders

By understanding that the microfoundations of DC are responsible for more stable explanations about the environment where the company operates (COLEMAN, 1990), the microfoundations identify processes, procedures, organizational structures, decision rules, among others, that support dynamic capabilities (TEECE, 2007). From the analysis of the inclusion of stakeholders in the innovation process, it is possible to identify stakeholder inclusion processes and routines. It is understood that for

integration to meet the precepts of the concept of RI, dynamic capabilities are needed to support the processes and routines (microfoundations of DCs) (Figure 44).

Figure 44 - Microfoundations of dynamic capabilities in the inclusion of stakeholders - Laerdal case



Source: by the author.

In the same way, as was highlighted in the previous case, the processes and routines identified for the inclusion of stakeholders in Laerdal can be considered microfoundations of DC as they contribute to the detection, apprehension, and transformation of knowledge during the inclusion process.

When considering that to innovate responsibly, it implies a collective and continuous commitment to anticipate, reflect, include and respond (OWEN et al., 2013), the list of DC microfoundations for the inclusion of stakeholders will be analyzed from the dimensions of anticipation, reflexivity, and responsiveness.

4.2.6 The Dimensions of Responsible Innovation at Laerdal

For Owen et al. (2013), a *framework* for responsible innovation can "accommodate the plurality of political and ethical considerations, as they are related to convenience and social acceptability" (p. 37). For the authors, for innovation to be truly responsible, it must be anticipatory, reflective, deliberative (inclusive), and responsive.

Anticipating means assessing what can be done or what else can be done. Anticipation, for Laerdal, does not occur at the micro-level. It is anchored in the philosophy of its founder, who stated (LAERDAL, 2016, p. 3):

> We believe that if we can create value to the society at large, and do our job well, satisfactory economic results will follow and allow us to build a stronger company with time.

Also, it is anchored in its mission (Helping to save lives) and the company's vision: "No one should die or be disabled unnecessarily during birth or from a sudden illness, trauma or medical errors." (ABOUT LAERDAL. LAERDAL MEDICAL SERVICES SOLUTION. STAVANGER... [2019?]).

Daily, questions such as "How might we train healthcare professionals to care for newborns confidently?" Or "How might we improve survival from sudden cardiac arrest in hospitals?" (LAERDAL MEDICAL SERVICES SOLUTION. EXPLORE. LAERDAL DEVELOPMENT PROCESS: YOUTUBE...,2018) are based on them. The search for an answer begins to be built. Laerdal is aligned with the idea that organizations should engage in activities that improve their long-term

vision, allowing them to be aligned with their decision-making processes for innovation (BARTLETT, 2009), in addition to understanding the innovation environment, social needs and problems to be solved (LUBBERINK et al., 2017).

Reflecting on what is known and what is not known, the risks associated with uncertainty, questions, and dilemmas is another dimension of RI. At Laerdal, some practices provide the necessary support, especially during the innovation process. The gates established between the stages stimulate reflection, by allowing the product to move to the next stage, if appropriate, do not proceed if there are still questions and, finally, be finalized, as it does not meet Laerdal's assumptions, or yet impracticable or feasible (LAERDAL MEDICLA SERVICES SOLUTION. LAERDAL DEVELOPMENT PROCESS 00044432 REV D.[2019?] STAVANGER, 2019. INSTITUTIONAL DOCUMENT - INTERNAL USE). For Laerdal, it is essential to minimize adverse effects:

> Business and industry policies and operations can play a major role in reducing impacts on use of natural resources and the environment. Laerdal is committed to doing business in an environmentally responsible manner throughout its entire manufacturing and distribution chain and network. Laerdal shall minimize adverse effects on the community, environment and natural resources by utilizing environmentally compatible materials and manufacturing processes wherever feasible thus safeguarding public health and safety. (Laerdal Medical Services Solution. Code of Conduct [2019?] Stavanger, 2019. Institutional document - internal use, p. 8).

Besides, the Code of Conduct establishes that Laerdal must, in partnership with government agencies, contractors, suppliers, and communities, continuously strive to improve its performance to benefit, as much as possible, its owners, employees, customers, business partners, communities, and the environment. One perceives the close relationship with partners and users and their influence on Laerdal's reflexivity dimension, creating a culture of employee empowerment (CHALMERS, 2013), in addition to critical evaluation by third parties (ANDERSSON; LUNDBLAD; JANSSON, 2012).

Including stakeholders is a natural consequence, since the company believes that the mission can only be achieved by working in partnership. Based on this macro view, the company establishes a series of processes and routines that make inclusion an essential part of its development process.

Table 32 summarizes the inclusion process, represented by the acronym 3W1H:

Table 32 - 3W1H of inclusion - Laerdal

WHO (agents)	**WHEN**
Employees in the departments of: • Design • Marketing • Sales	Stages • Explore • Conceptualize • Develop • Implement
WHO (stakeholders)	**HOW**
• Institutional partners • Health professionals • Common people	• Establishment and maintenance of strategic partners • Dialog with users • Observation of the use of products • Participation, organization and exhibition at congresses • Attention to contacts made by customers and users through social networks, CSC • Exploration of the contact of employees in the marketing and sales areas • Participation and organization of training and qualification events • Registration and documentation of ideas and suggestions • Presentation of several prototypes through visits to partners • Presentation of several prototypes by calling partners and users to the company's headquarters • Demonstration and testing of the prototype by visiting partners • Demonstration and testing of the prototype by calling partners and users • Incentive to training and qualification of users

Source: by the author.

Within the stakeholder categorization (STAHL, 2013), developed from the literature, it appears that Laerdal contemplates, in the **Explore** stage, three essential groups. The first one is representatives of society, through associations and organizations such as AHA and BHF. This group contributes by helping to circumvent the challenges inherent to health products (DEMERS-PAYETTE;

LEHOUX; DAUDELIN, 2016). Still having healthcare professionals (second group), who in this context, are the primary users of the products, reinforces the importance of the inclusion dimension in the RI. Finally, consultation with common people (third group), or laypeople, encourages the company to develop a more straightforward and more objective language. These groups follow along the innovation process, being responsible for checking and criticizing what was developed based on the knowledge generated in the previous stage.

The *How* dimension shows the microfoundations of DCs previously presented (Figure 44). As in the case of Siemens, many of these microfoundations are exploited by other companies, not necessarily contributing to genuinely responsible innovation.

Among the thirteen microfoundations listed, two stand out as those that effectively contribute to the responsibility for innovation, and that is intrinsically related to inclusion. The first of these is the establishment and *maintenance of strategic partners*. As previously described, international alliances contributed to the company's multicultural adaptation. These partnerships provide both to the suggestion of new lines of action or the validation of new products or features, as well as to the dissemination of knowledge, through the delivery of training kits or even in large-scale training and distribution, such as AHA (American Heart) Association), the British Heart Foundation (BHF) and the National League for Nursing (NLN). In product development, Laerdal has a partnership with the American Academy of Pediatrics (AAP), and with Jhpiego, affiliated with The Johns Hopkins University. From these partners, Laerdal establishes a differential in the appropriation of highly qualified knowledge.

The second microfoundation is the *Incentive for training and qualifying users*. The company was a pioneer in medical simulation. Simulation is, in short, the imitation of situations to prepare and learn about real situations. Laerdal understands that the development of simulators is not enough if its use is not disseminated and done correctly. To expand this spread, Laerdal created a global division, which aims to save lives in poorer countries. Based on a new business model, financed from the sale of products to developed countries, the value is invested in training and support for emerging countries. The exercises are

designed together or through their strategic partners. In this training, many in the fields of product testing, along with the primary users (for example, midwives and birth attendants), the main objective of the training is achieved by providing confidence for the real situations that will be faced. Besides, another gain in the relationship with users is the observation of use. On a visit to a testing ground in Ethiopia, the Product Development Manager was faced with an unusual situation. The product had been developed for users wearing pants, not skirts. A cultural factor in the country prevented the best use of the simulation (training).

From then on, the observation generated an improvement in the product to adapt to the type of clothing. This adjustment in the product demonstrates Laerdal's **responsiveness.** The company's responsiveness is not only focused on product improvements but also to ensure product compliance with new regulations. Strategic partners here also play a key role, disseminating information about possible changes in laws and market trends (L5). Laerdal's premise is to align stakeholder interests with the general objectives of innovation (BLOK, HOFFMANS, WUBBEN, 2015; JAMALI; YIANNI; ABDALLAH, 2011).

In short, it is evident that Laerdal not only develops its products but also responsibly directs its business model, generating a positive impact on the business environment, with social and environmentally sustainable practices (OWEN et al., 2013; VAN DE POEL et al., 2017).

To summarize Laerdal's RI dimensions, a summary table (Table 33) is presented, just as it was done in the analysis of the Siemens case.

Table 33 - RI dimensions – Laerdal

Laerdal	RESPONSIBLE INNOVATION DIMENSIONS		
WHO WE ARE? Mission, Vision or Purpose Help save lives. No one should die or be disabled unnecessarily during birth or from sudden illness, trauma or medical errors.	**INCLUSION** **WHO (agents)** Employees in the Departments of: Design Marketing Sales	**WHEN** Stages: Explore Conceptualize Develop Implement	**REFLEXION** What are you working on? Why are you working on this? The gates established between the product development phases stimulate reflection, by allowing the product to move to the next phase, if appropriate, do not proceed if there are still questions and, finally, be finalized, for not attending to Laerdal's assumptions, or still impracticable or feasible. In partnership with government agencies, contractors, suppliers and communities, continuously strive to improve their performance in order to benefit, as much as possible, their owners, employees, customers, business partners, communities and the environment.
ANTICIPATION Who can be affected in the future? We believe that if we can create value for society in general and do our job well, satisfactory economic results will follow and allow us to build a stronger company over time.	**WHO (stakeholders)** Institutional partners Healthcare professionals Common people	**HOW (como)** Establishment and maintenance of strategic partners Dialog with users Observation of product use Participation, organization and exhibition in congresses Attention to contracts made by customers and users through social networks and SAC Exploring the contact of employees in the marketing and sales areas Participation and organization of training and qualification events Registration and documentation of ideas and suggestions Presentation of various prototypes through visits to partners Presentation of several prototypes by calling partners and users to the company's headquarters Demonstration and testing of the prototype by visiting partners Demonstration and testing of the prototype by calling partners and users Encouraging training and qualification of users	**RESPONSIVINESS** How could you approach it differently? Product adjustments. Strategic partners here also play a key role, disseminating information about possible changes in regulations and market trends.

Source: by the author.

The application of the RI Canvas in the Laerdal case proves that the company meets the requirements to be considered responsible.

Upon concluding the analysis of the cases, individually, the next chapter presents the result comparatively, as well as analyzing the dynamic capabilities that enhance the inclusion of stakeholders in the RI process.

5 COMPARATIVE CASE ANALYSIS AND DISCUSSION

This chapter aims to analyze the cases comparatively, in addition to discussing the results obtained and establish certain propositions.

This thesis maintains that dynamic capabilities enhance the inclusion of stakeholders in the responsible innovation process. From the comparative analysis of the two studied cases, microfoundations were identified. They lead to specific dynamic capabilities, throughout the process of responsible innovation, which leverage the inclusion of stakeholders.

When initially analyzing the innovation process of both cases, we identified its approximation to the Stage-gate model (COOPER, 2008; 2016). This model, in addition to describing the stages of the process, stipulates gates between each one of those stages, stimulating the analysis of the knowledge generated, and making the decision to go to the next stage, or to give up (go/kill) (COOPER, 2008). Siemens presents a flexible and adaptable process for each need, which is consistent with the Stage-gate model (COOPER, 2008). It is important to point out that the evaluation was made considering only the OpenApps development process. The assessment cannot be extrapolated to other Siemens products.

Laerdal, which uses prototypes as early as the initial stages, thus obtaining quick feedback from users, has a model closer to the Agile-Stage-gate (COOPER, 2016). It is essential to highlight that both cases present construction-test-feedback-review interactions, which, according to Cooper (2016), make the system more adaptive.

The only difference between the Stage-gate and Agile-Stage-gate models and the models applied in companies is the *Business Case* stage, proposed by Cooper (2008; 2016) and not explicitly identified in both cases. In spite of this, the process established in this stage – that is, the construction of the business model regarding technical, marketing, and production aspects – is carried out by companies in other stages. Siemens develops the business model in the first stage (M120). In it, the company works on the development of new projects, product definitions, and the creation of a business plan. Laerdal, on the other hand, develops the business model in the Develop stage, detailing the solution and manufacturability, seeking to reduce

risk, and defining technical and regulatory requirements. They also maintain a dialogue with specialists, users, partners, and the supply chain.

From the description of the innovation process, it was possible to identify at which stage(s) of the innovation process there is the inclusion of stakeholders. This finding aligns companies with the RI governance precept, which provides for the inclusion of stakeholders in the early stages of innovation (BURGET; BARDONE; PEDASTE, 2017). When analyzing the cases simultaneously, it was found that only in the testing stage was there no inclusion of stakeholders. As already stated, late inclusion (in the latter stages) may reflect a management problem within organizations, which are unable to direct resources and establish processes for systematic participation (BLOK et al., 2015). The studied companies do not face this difficulty, because, in addition to including stakeholders since the beginning of the process, they maintain the relationship over time.

In the other stages, there is the active participation of stakeholders, either assisting in the development of new ideas (ideation stage) or contributing to the evaluation and testing of prototypes in various stages, such as in the concept and development stages. Stakeholder participation is again essential – only in the Laerdal case – in the launch stage. Here, in addition to validating the final product and pointing to possible flaws or improvements, the ideation process is also restarted, which can lead to new products or new versions. In addition to using the product, Laerdal uses this stage to get closer to the end-user, encouraging the use of products through training.

Based on the innovation development model, and the stages in which the inclusion of stakeholders takes place, the first proposition is presented:

Proposition 1: The inclusion of stakeholders occurs throughout the responsible innovation process, favored by the Stage-gate model.

One aspect that draws attention in both cases is the exclusive selection of “similar” *stakeholders*. In both companies, there was no indication of the encouragement and participation of *stakeholders* who, in some way, have divergent opinions (for example, against exams using X-rays or who discredit the potential for systematic training). The positive aspect of this selection of “similars” is that the *stakeholders* have a legitimate interest in participation (DONALDSON; PRESTON, 1995). This interest must be taken into account by companies. This choice reflects

positively on organizational activities (GREENWOOD, 2007), enabling access to information, stimulating mutual understanding, and promoting the development of shared collaboration (BLOK et al., 2015).

The type of *stakeholders* involved was also identified, considering Blok at al.' (2015) classification. In the innovation process of Siemens' OpenApps, software developers (economic stakeholders) who are interested in the profit of the OpenApps participate, as well as health professionals (non-economic stakeholders), who are not involved in the profit, but who are involved in the innovation contribution. Laerdal, on the other hand, has a broader group of stakeholders, including institutional partners, health professionals, and ordinary people. In this sense, these groups can be classified exclusively as non-economic (BLOK et al., 2015). The inclusion of multiple stakeholders, mainly civil society (ordinary people), further aligns the inclusion process to the context of RI (OWEN et al., 2013).

As already highlighted, the non-inclusion of *stakeholders* with divergent points of view was identified. It is assumed, therefore, that companies prefer to guard against contrary opinions, or are not yet prepared to deal with this model. Furthermore, the inclusion of "similars" already brings some risks.

The inclusion of *stakeholders* occurs based on processes and routines established by companies. Such processes and routines proved to be microfoundations of dynamic capabilities, which enhance inclusion. Herein lies one of the main contributions of this thesis. The researcher concluded that the capabilities of *sensing, seizing, and transforming* alone are not capable of leveraging the inclusion process. It was necessary to review the literature on dynamic capabilities, identifying specific DCs that strengthen inclusion. From then on, it was required to establish a dichotomy in the vocabulary of DCs. *sensing, seizing, and transforming* capabilities are considered **generic dynamic capabilities** since they can be identified and developed in different processes (environments). The DCs inherent to the inclusion of stakeholders in the responsible innovation process are considered to be **specific dynamic capabilities.**

Next, both types of DCs will be analyzed based on this dichotomy, with specific DCs that leverage the inclusion of stakeholders being presented.

5.1 GENERIC DYNAMIC CAPABILITIES

In both cases - Siemens and Laerdal – microfoundations of DCs that support the *sensing, seizing,* and *transforming* capabilities through the inclusion of stakeholders were identified.

Table 34 summarizes these microfoundations, without grouping them by stages of the innovation process. The objective here is merely to demonstrate what types of microfoundations contribute to the development of DCs (TEECE, 2007).

Table 34 - Nature of Stakeholders Inclusion Microfoundations

Nature of DCs	**Microfoundations**	**Siemens**	**Laerdal**
Sensing	Observation of the use to improve the integration of hardware and software Demonstration and testing of the prototype by visiting partners Demonstration and testing of the prototype by calling partners and users	X	X
	Search and selection of partners Establishment and maintenance of strategic partners	X	X
	Attention to contacts made by customers and users through social networks, CSC		X
	Exploring the contact of employees in the marketing and sales departments		X
	Participation, organization and exhibition in Congresses		X
	Presentation of prototypes through visits to partners		X
	Presentation of prototypes by calling partners and users to the company's headquarters		X
Seizing	Co-creation to choose the type of system to be integrated	X	
	Dialog with users		X
	Relationship with a partner to integrate the software into the system Observation of product use	X	X
	Establishment of partner selection criteria	X	
	Registration and documentation of ideas and suggestions	X	X
Transforming	Customer relationship for software integration testing	X	
	Encouraging training and qualification of users		X

Source: by the author.

When analyzing the microfoundations of the natures of DCs, one realizes that the most significant number is held by the *sensing* category. sensing capability is closely related to inclusion, since this nature provides for the development of analytical systems (and individual capabilities) to learn and capture, as well as to filter, shape, and calibrate opportunities (TEEECE, 2007), which support decision making about the innovation process and its results (LUBBERINK et al., 2017). Furthermore, *sensing* initiates the process of developing the other capabilities, observing a cumulative character of the *sensing, seizing,* and *transforming* capabilities. Sometimes, it causes overlap between these capabilities.

There are still some microfoundations focused on *seizing*, which are corporate structures, procedures, projects, and incentives to take advantage of opportunities (TEECE, 2007). Here, companies are organized internally to better explore what was previously *sensing*.

Fewer processes and routines are geared towards *transforming*, which concerns continuous alignment and realignment of specific tangibles and intangibles. This capability is frequently observed after the product launch, impacted by the participation of stakeholders.

It is also noticed that when listing the microfoundations of the two cases, that many of them are similar, or even identical, in their contexts. Some of these processes and routines are also similar to what is found in the literature, both concerning RI and in other settings, such as co-creation and open innovation. The most common, in all contexts, is participation in fairs and events, organization of workshops, visits to clients, and internal meetings for the dissemination of knowledge. Precisely because they are not exclusive to the RI context, the need for complementarity with other processes and routines is further reinforced, aligned with the RI perspective.

Thus, to advance in the analysis of the DCs, Table 35 establishes a unification of similar microfoundations.

Table 35 – Microfoundations of DCs

Innovation Process Stage	Nature of DC	Microfoundations	Description	Microfoundations Siemens/Laerdal
Discovery	Sensing	Establishment of multiple communication channels	Maintenance of several channels of contact with stakeholders, which serve as a way of better interaction, as well as a source of information about their desires and needs. Stimulate dialogue.	Attention to contacts made by customers and users through social networks, CSC
				Exploring the contact of employees in the marketing and sales departments
		Systematic observation of product use	Create events for the observation of the use of products, by customers, users and others who are interested and involved. These events should be frequent, at the various stages of product development and, whenever possible, after launch.	Observation of the use to improve the integration of hardware and software
		Strategic partnerships	Establishing partnerships with entities and associations that instigate new ideas, as well as serving as a link for other partnerships, customers and users.	Search and selection of partners
				Establishment and maintenance of strategic partners
		Active participation in events	Actively participate in congresses, training and qualifications, in order to identify trends, observe the use of products, and establish contact with current and new partners, customers and users.	Participation and organization of training and qualification events
				Participation, organization and exhibition in Congresses
	Seizing	Co-creation	Calling partners, users, customers and other interested parties for co-creation activities.	Co-creation to choose the type of system to be integrated

		Memory creation	Develop or use tools to record and document meetings and participation in events and contributions from communication channels, with the aim of internalizing knowledge and maintaining a memory.	Registration and documentation of ideas and suggestions
		Establishment of partner selection criteria	Clearly identify the profile of the partners. It may vary depending on the project or product, but they must follow clear definitions, so that participation is contributory for both sides.	Establishment of partner selection criteria
		Establishment of multiple communication channels	Maintenance of several channels of contact with stakeholders, which serve as a way of better interaction, as well as a source of information about their desires and needs. Stimulate dialogue.	Conversation with users
		Systematic observation of product use	Create events for the observation of the use of products, by customers, users and others who are interested and involved. These events should be frequent, at the various stages of product development and, whenever possible, after launch.	Observation of product use
	Transforming			
Scoping	Sensing	Systematic observation of product use	Create events for the observation of the use of products, by customers, users and others who are interested and involved. These events should be frequent, at the various stages of product development and, whenever possible, after launch.	Presentation of prototypes through visits to partners
				Presentation of prototypes by calling partners and users to the company's headquarters
	Seizing	Memory creation	Develop or use tools to record and document meetings and participation in events and contributions from communication channels,	Registration and documentation of ideas and suggestions

			with the aim of internalizing knowledge and maintaining a memory.	
		Strategic partnerships	Establishing partnerships with entities and associations that instigate new ideas, as well as serving as a link for other partnerships, customers and users.	Relationship with a partner to integrate the software into the OpenApps system
	Transforming			
Development	Sensing	Systematic observation of product use	Create events for the observation of the use of products, by customers, users and others who are interested and involved. These events should be frequent, at the various stages of product development and, whenever possible, after launch.	Demonstration and testing of the prototype by visiting partners
				Demonstration and testing of the prototype by calling partners and users
	Seizing	Memory creation	Develop or use tools to record and document meetings and participation in events and contributions from communication channels, with the aim of internalizing knowledge and maintaining a memory.	Registration and documentation of ideas and suggestions
	Transforming	Systematic observation of product use	Create events for the observation of the use of products, by customers, users and others who are interested and involved. These events should be frequent, at the various stages of product development and, whenever possible, after launch.	Customer relationship to test the integration of software embedded in OpenApps and the use of C-Arm
Testing	Sensing			
	Seizing			
	Transforming			
Launch	Sensing	Establishment of multiple	Maintenance of several channels of contact with stakeholders, which serve as a way of better interaction, as well as a source of	Attention to contacts made by customers and users through social networks, CSC

		communication channels	information about their desires, needs and desires. Stimulate dialog.	Exploring the contact of employees in the marketing and sales departments
		Active participation in events	Actively participate in congresses, training and qualifications, in order to identify trends, observe the use of products, and establish contact with current and new partners, customers and users.	Participation and organization of training and qualification events
				Participation, organization and exhibition in Congresses
	Seizing	Memory creation	Develop or use tools to record and document meetings and participation in events and contributions from communication channels, with the aim of internalizing knowledge and maintaining a memory.	Registration and documentation of ideas and suggestions
		Establishment of multiple communication channels	Maintenance of several channels of contact with stakeholders, which serve as a way of better interaction, as well as a source of information about their desires and needs. Stimulate dialogue.	Dialog with users
		Systematic observation of product use	Create events for the observation of the use of products, by customers, users and others who are interested and involved. These events should be frequent, at the various stages of product development and, whenever possible, after launch.	Observation of product use
	Transforming	Encouraging training and qualification of users	Encourage users and customers to be prepared for the use of products, through training and qualifications, with the aim of making them safer and more confident in their use.	Encouraging training and qualification of users

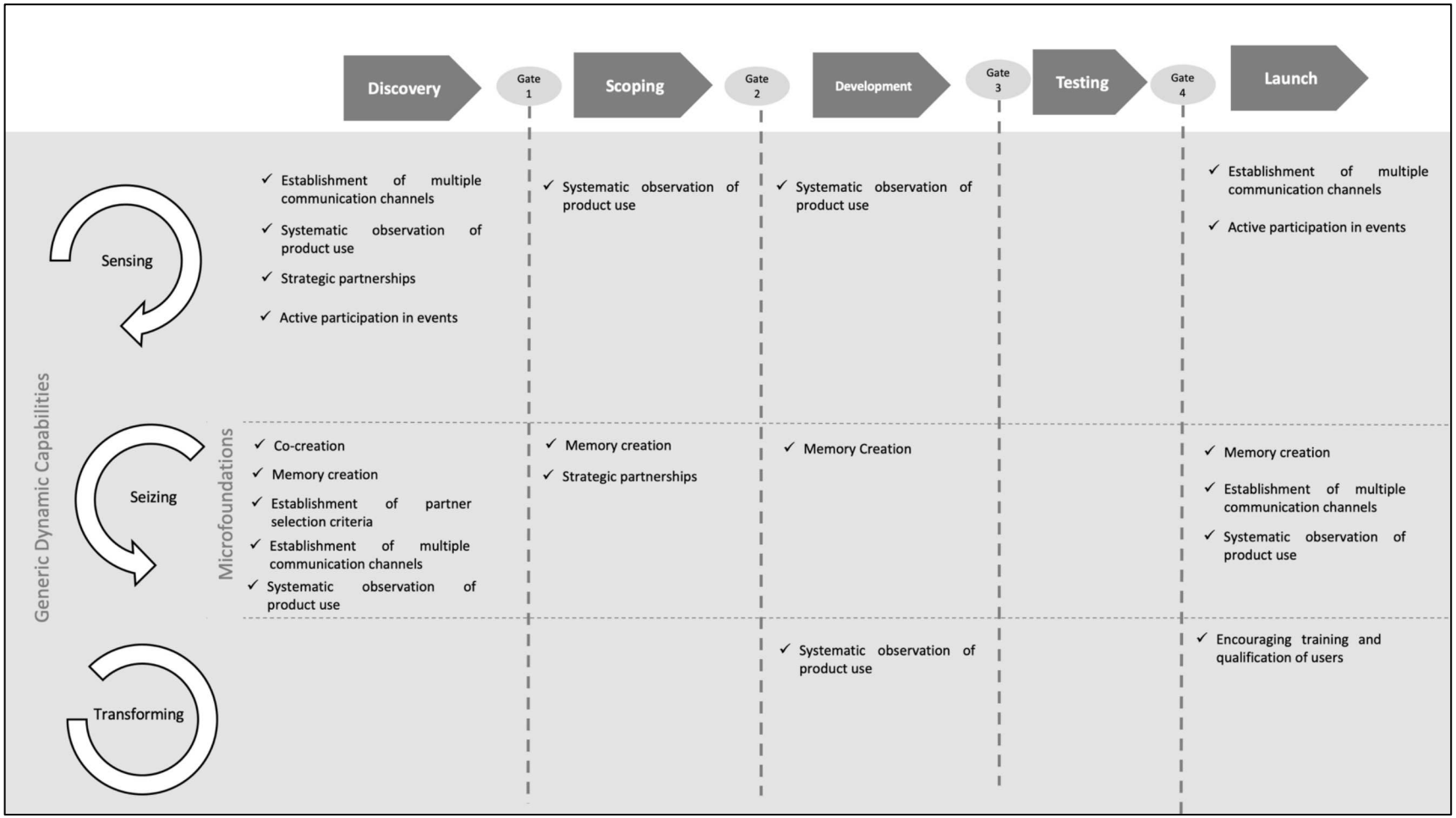
Source: by the author.

The identification of these microfoundations raises a second proposition:

Proposition 2: The inclusion of stakeholders in the responsible innovation process requires particular processes and routines.

From the grouping proposed above, Figure 45 presents the innovation process and its microfoundations, grouped from the generic DCs. Since each company has its nomenclature for the stages of the innovation process, the *Stage-gate* model was used in the unification (COOPER, 2008; 2016). An adaptation was made to the model, maintaining the five stages that both companies present. Cooper (2016) also presents his model in five stages, although he presents a business model stage, which ends up being developed in the development stage, in both cases.

Figure 45 - Microfoundations of generic dynamic capabilities in the inclusion of stakeholders



Source: by the author.

Although in several studies, DCs are presented as a one-dimensional system (LIAO; KICKUL; MA, 2009; CHENG; CHEN, 2013), they must be seen as a multidimensional construction (LIN et al., 2016), which serves different purposes and functions (ZAHRA; GEORGE, 2002).

Despite the contribution of generic DCs, as seen previously in each case, there are specific DCs that leverage the inclusion of stakeholders in the RI process. The microfoundations identified from the inclusion of stakeholders need to be classified not only from their nature, but also from these specific dynamic capabilities.

5.2 SPECIFIC DYNAMIC CAPABILITIES

When analyzing the two cases together, two specific dynamic capabilities are highlighted that leverage the inclusion of *stakeholders* in the RI process.

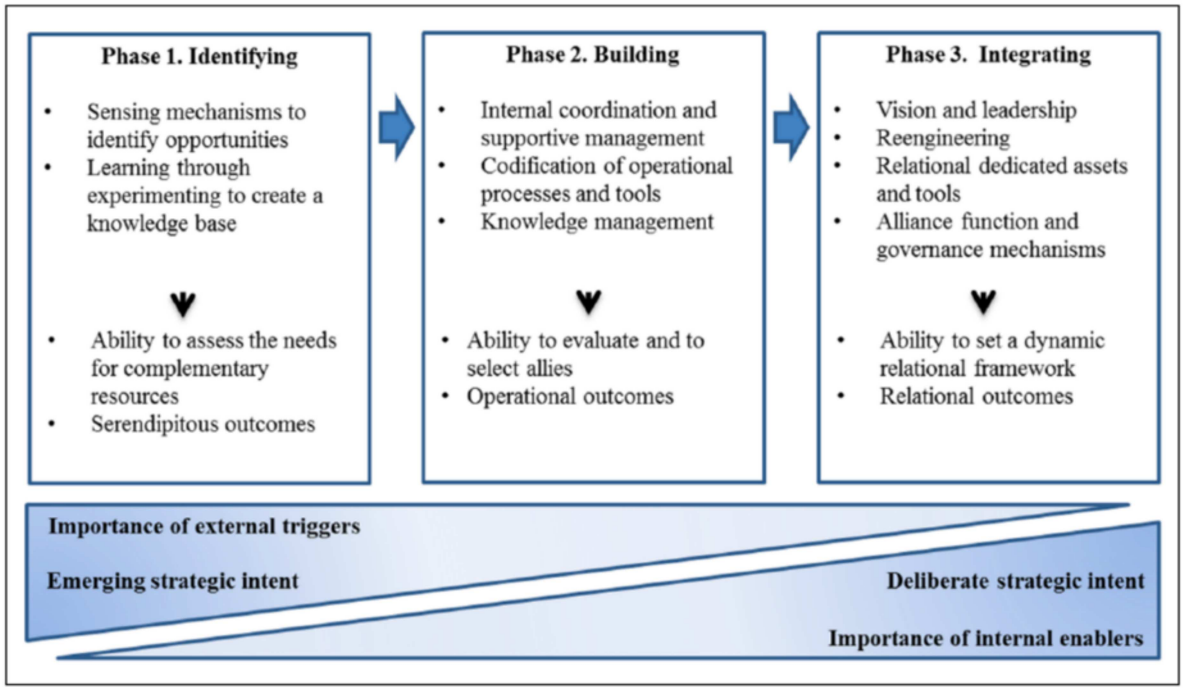
Relational DC refers to the company's ability to build relationships (BARRETO, 2010). To initiate and implement innovations, both companies complemented their current resources through links (LIN, 2016). Relational skills facilitate the ability to interact and share significant knowledge (LORENZONI; LIPPARINI, 1999). External relationships facilitate the acquisition of knowledge, improving efficiency, but it will only be possible through the formation of partnerships focused on learning and obtaining results (REZENDE DA COSTA et al., 2018).

Relational DC is a gradual process, which has an internal and external bias from the organization. It is from the external perspective that relational DC will be analyzed, considering the objective of this thesis, which deals with the inclusion of external stakeholders. Through this DC, companies expand their vision by establishing a range of social and economic relationships (alliances) with individuals and organizations (GULATI; GARGIULO, 1999; WEBSTER, 1992). The **relational** DC aimed at establishing partnerships helps companies to “identify the “right” partners” (DONADA et al., 2016, p. 95). The detection of opportunities occurs through communication with these relationships to obtain valuable information, preferably with diversified sources of knowledge (MOL; BIRKINSHAW, 2009; LIN; SU, 2014). Having established these relationships, the company acquires more knowledge and efficiency, with the gain of cost reduction due to efficiency (DE CAROLIS, 2006). It has, as critical factors, the commitment to relationships and the construction of trust and

communication, which requires the ability to coordinate internal and external activities, manage conflicts, foster trust and encourage the exchange of information (LIN; SU; HIGGINS, 2016).

The development of the **relational** DC takes place from a sequential three-stage process. Each stage concerns a level of strategic intent and a set of factors that evolve with the environment itself (Figure 46).

Figure 46 - Process of creating dynamic relational capacity



Source: DONADA; NOGATCHEWSKY; PEZET (2016).

The first stage is to raise awareness and detect weaknesses and deficiencies. It identifies new needs for complementary resources. External factors generate stimuli.

The second stage is considered to be more operational. It mobilizes external sources and internal facilitators, that contribute to the construction and coordination of relational skills. It aims to evaluate and select future partners with complementary resources.

In the third and final stage, internal facilitators become increasingly important, integrating skill sets, assets, and routines into dedicated organizational structures (alliance function). They also contribute to the implementation of effective relational governance.

The knowledge generated through alliances needs to be integrated by the company. This can be developed through integrative DC, which presents a dichotomy. When dealing with resource allocation routines that reconfigure and redeploy resources within the company to capture emerging opportunities (EISENHARDT; MARTIN, 2000; VERONA, 1999), the DC seeks to capitalize on opportunities (LIAO; KICKUL; MA, 2009). At the same time, when using existing routines to explore opportunities that generate revenue in external environments (EISENHARDT; MARTIN, 2000; VERONA, 1999), the DC seeks an acknowledgment of opportunities (LIAO; KICKUL; MA, 2009). Teece (2007) pointed out that the integrative capability (IC) may be more involved with the detection, identification, filtering, and calibration of market opportunities.

The discussion about IC is not recent (COHEN; LEVINTHAN, 1990; GRANT, 1996; PISANO, 1997). The integrative resource can be considered as both a dynamic and an operational capability, depending on whether it is directed to strategic changes or the maintenance of ongoing operations. In the scope of dynamic capabilities, this resource provides the capability for reliable and repeatable communication and coordination activities aimed at the introduction and modification of products, resources, and capabilities, as well as business models (HELFAT; RAUBITSCHEK, 2018).

Moeen (2017) highlights that integrative capabilities are measured in two ways. The first uses research and observation to measure constituent components of integrative capabilities, such as dedicated integration units, interdisciplinary teams, direct upstream and downstream contact, and connection with the scientific communities. In this vein, the studies of Henderson and Cockburn (1994) and Iansiti and Clark (1994) stand out. The latter refers to the history of vertical integration of a company, as highlighted in the studies conducted by Helfat and Campo-Rembado (2016), as well as in horizontal diversification (BALASUBRAMANIAN, 2011).

Deepening the perspective of integrative capability, the **integrative knowledge capability** (IKC) stands out. By allowing for the absorption of knowledge from external sources and the mixing of different technical skills developed internally by the company (LAWSON and SAMSON, 2001), IKC corresponds to the DC developed by both Siemens and Laerdal.

Since the knowledge generated can be given tacitly or explicitly, it is perceived that explicit instruction is available in documents, software, and technical reports, as well as procedures, methodologies, best practices, lessons learned, and patents. Tacit knowledge is available in the types of skills and competencies of employees. In this case, mechanisms such as meetings, workshops, and training courses are used to transfer tacit knowledge from experts to other employees.

The integration of knowledge is done through certain mechanisms, that is, formal processes and structures that make it possible to synthesize, integrate, reconfigure, and use different types of experiences among team members within a company (TSAI; LIAO; HSU, 2015). Some of these mechanisms are (ZAHRA et al., 2000; ZOLLO; WINTER, 2002; TSAI; LIAO; HSU, 2015):

- Regular formal reports and memos that summarize learning;
- Regular formal reports and memos that share information;
- Information sharing meetings;
- In-person discussions of cross-functional teams;
- Legal analysis of failed product development projects;
- Legal analysis of successful product development projects; and
- Use of specialists and consultants to synthesize knowledge.

Companies establish partnerships to gain access to partners' valuable resources and capabilities; however, the integrative knowledge capability is necessary to detect, transfer, and modify (TEECE; PISANO; SHUEN, 1997) these external resources and capabilities in their capability configuration, thus producing a superior performance of the company (JIANG; MAVONDO; MATANDA, 2015).

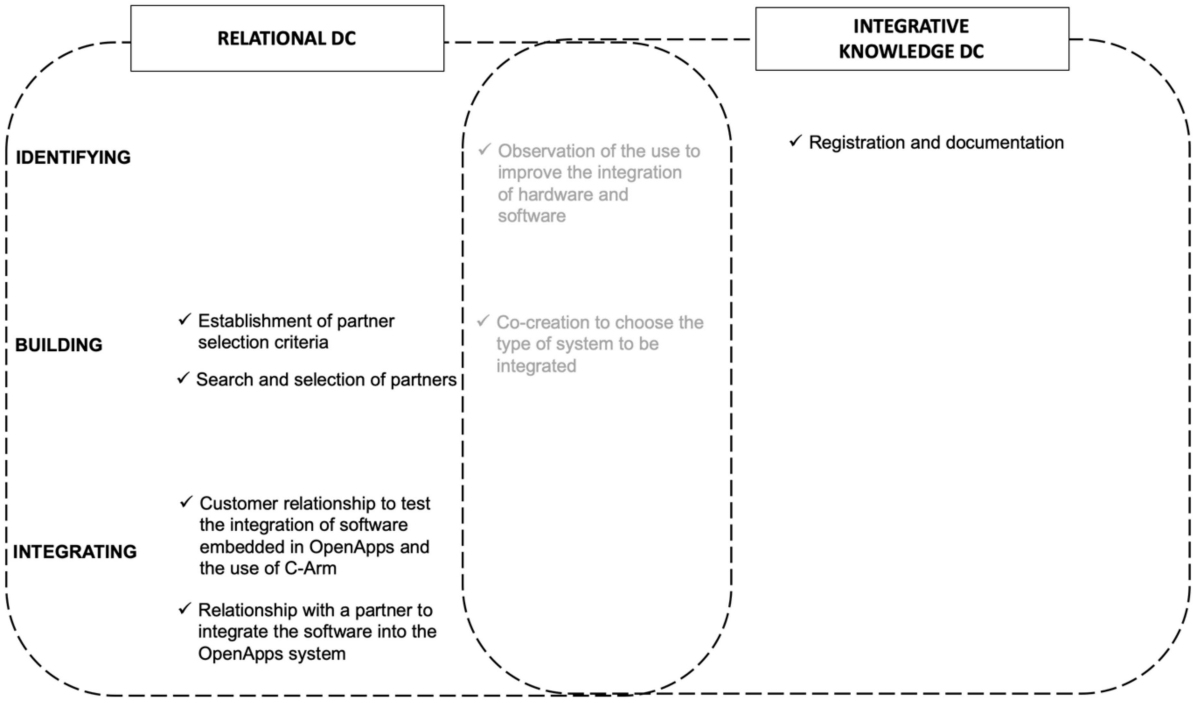
In addition to the **relational DC,** it is from the **integrative knowledge DC** that the company can establish lasting relationships with stakeholders that can contribute to the development of responsible innovations. After establishing the link, the company, through multiple processes and routines (DC microfoundations), detects, apprehends, and transforms knowledge throughout the development process, until it launches products (and services) that meet stakeholders’ needs. The demonstration of the **integrative knowledge DC** refers to a dynamic movement, which interacts with all stakeholders and agents that orchestrate this participation. This movement takes the knowledge learned throughout the innovation process, generating the transformation that emerges from that knowledge itself.

Since the OpenApps process is not yet mature, it was challenging to identify the specific dynamic capabilities in the Siemens case. However, when analyzing the microfoundations of generic capabilities, other dynamic capabilities were determined. In seeking to establish strategic partnerships, Siemens has developed **relational** capability, which aims to build relationships and acquire resources from these relationships (LIN et al., 2016). From these relationships, Siemens developed the **integrative knowledge capability**, which allows it to absorb knowledge from external sources and to mix with different technical competencies developed internally by the company (LAWSON; SAMSON, 2001).

The researcher understood that analyzing specific DCs based on the innovation process, in the same way as with generic DCs, would not result in a broader analysis of the process. This different view allowed for a less linear scan of the development of DCs.

Figure 47 shows the specific DCs based on the microfoundations identified above.

Figure 47 - Microfoundations of specific dynamic capabilities in the inclusion of stakeholders - Siemens case



Source: by the author.

From the stages proposed by Donada at al. (2016) about the construction of the **relational DC**, the microfoundations were classified. In the first stage, the identification of awareness and detection of weaknesses and deficiencies, as well as the observation of the use to improve the integration of hardware and software, contributes to the establishment and maintenance of the relationship with stakeholders. The construction stage consists of the establishment of criteria for the selection of partners, as well as the search for and selection of partners who contribute to the relationship. This stage also includes the co-creation process to choose the type of system to be interconnected. The last stage concerns integration, starting with the customer relationship to test the combination of software embedded in OpenApps and the use of C-Arm and the relationship with a partner to integrate the software into the OpenApps system.

The use of microfoundations to improve the integration of hardware and software and co-creation to choose the type of system to be interconnected simultaneously contribute to the **integrative knowledge DC**, along with registration and documentation. The DC enables the integration of tacit and explicit knowledge generated through documents and technical reports, as well as knowledge generation processes and methodologies (ZAHRA; IRELAND; HITT, 2000; ZOLLO; WINTER, 2002; TSAI; LIAO; HSU, 2015).

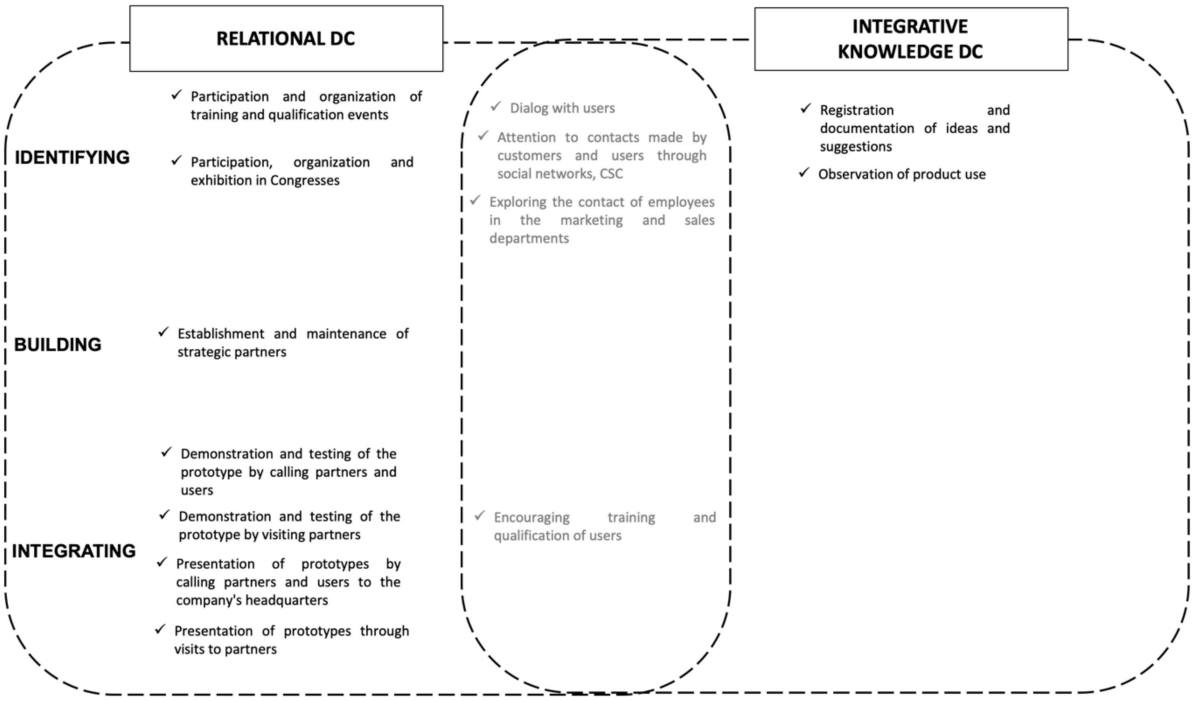
Laerdal's innovation process is more mature. In this sense, in addition to identifying, from the microfoundations, the generic dynamic capabilities of *seizing, sensing,* and *transforming*, other dynamic capabilities were identified. The establishment, and maintenance, of strategic partnerships with AHA, among others, which stimulates the search for innovations, in addition to contributing to the dialogue with users, demonstrate that Laerdal has a **relational** DC (LIN et al., 2016). From these relationships, like Siemens, Laerdal has developed the **integrative capability for knowledge**, which allows it to absorb knowledge from all external sources with which it relates and, together with other technical skills, develop innovations (LAWSON; SAMSON, 2001).

Figure 48 shows the specific DCs, based on the microfoundations identified previously.

As in the Siemens case, based on the stages proposed by Donada at al. (2016) about the construction of the **relational DC**, the microfoundations related to this DC

were classified. In the first stage, the identification of awareness and detection of weaknesses and deficiencies were microfoundations such as participation and organization of training and qualification events, as well as exposure in congresses, the exploration of contact of employees in marketing and sales departments, dialogue with users, and, finally, attention to communication made by customers and users through partner networks, CSC.

Figure 48 - Microfoundations of specific dynamic capabilities in the inclusion of stakeholders - Laerdal case



Source: by the author.

In the construction stage, focused on the construction and coordination of relational skills, the corresponding microfoundation is establishing and maintaining strategic partners. Finally, the integration stage aims to integrate skills, assets, and routines. Here, the prototype demonstration is highlighted, as well as testing microfoundations by calling partners and users to the company's headquarters, and visiting partners and presenting prototypes to partners and users at the company's office. Additionally, there is an incentive for the training and qualification of users.

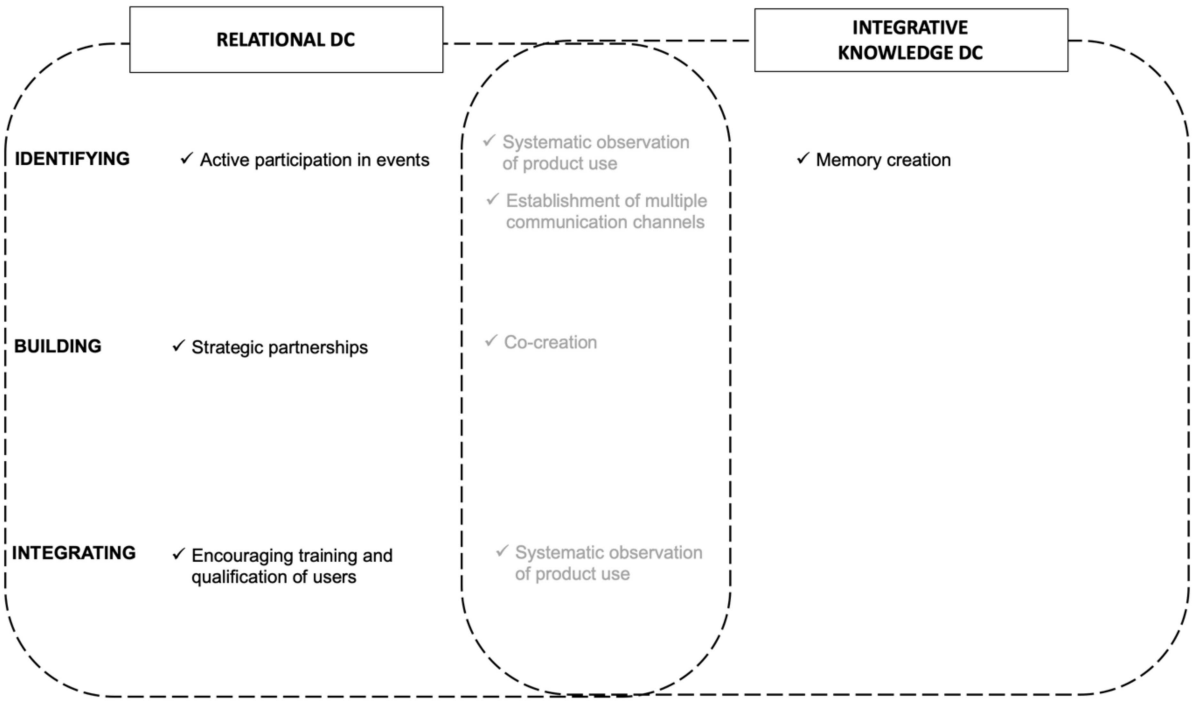
In all the microfoundations that reflect the **relational DC**, Laerdal's interest in maintaining close relationships is evidenced, strengthened by the construction-test-

feedback-review integration spiral, as well as the company's purpose in "building and sharing."

Concerning **integrative knowledge DC**, the microfoundations for registering and documenting ideas and suggestions, and observing the use of products, are exclusive to it. The microfoundations of dialogue with users, attention to contacts made by customers and users through social networks, CSC, the exploitation of communication of employees in marketing and sales departments, and the incentive to training and qualification of users share characteristics of the **relational DC**.

Specific DCs do not have linear characteristics, which can be identified at each stage of the innovation process. They go through the process more comprehensively. Thus, in the same way as it was presented in each case, Figure 49 shows the microfoundations that make up the specific dynamic capabilities.

Figure 49 - Microfoundations of specific dynamic capabilities in the inclusion of stakeholders



Source: by the author.

Relational DC requires three stages. The first stage, identification, is developed through the microfoundations of active participation in events, systematic observation of the use of products, and the establishment of multiple communication channels. In

this way, companies detect mechanisms to identify opportunities and learn through experimentation in creating a knowledge base (DONADA et al., 2016).

The second stage is focused on building relationships. In this stage, the microfoundations of establishing strategic partnerships and co-creation respond to the ability to evaluate and select partners, in addition to the operational structuring of companies (DONADA et al., 2016).

The third stage, of integration, requires the ability to define a dynamic relational structure (DONADA et al., 2016). It is the microfoundations that encourage the training and qualification of users and, again, the systematic observation of the use of products that enable the development of this capability.

In summary, it is perceived that the **relational** DC allows the companies to interact and share significant knowledge outwith the company's perimeter (LORENZONI; LIPPARINI, 1999).

The **integrative knowledge DC** is based on the microfoundation of creation of memory, which is exclusive to this DC. It is from the creation of memory (documentation and recording of meetings and ideas) that the knowledge generated through the interaction with stakeholders can be absorbed. The microfoundations of systematic observation of the use of products, the establishment of multiple communication channels, and co-creation share characteristics of the **relational** DC.

These findings constitute an essential contribution to the literature on DCs and RI, as this is the first study that deepens the relationship between both entities, in addition to addressing and specifying how DCs enhance the inclusion of stakeholders. Thus, we have the third proposition:

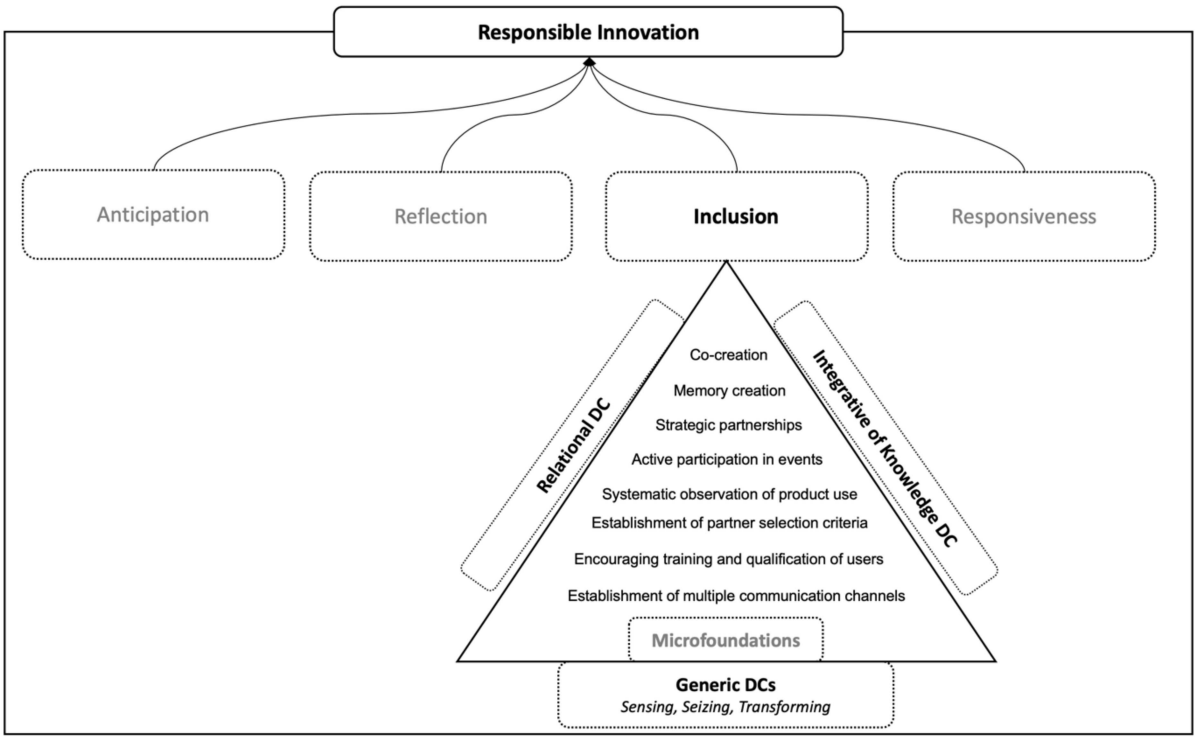
Proposition 3: The generic dynamic capabilities of *sensing, seizing,* and *transforming*, and the specific dynamic capabilities of Relational and Integrative Knowledge, based on particular processes and routines, leverage the inclusion of stakeholders in the responsible innovation process.

What was noticed in both cases analyzed is that the construction of the specific DCs was developed in such a way as to be absorbed by the companies. This causes the DCs to permeate the other flows and processes of the companies, representing significant learning (EISENHARDT; MARTIN, 2000).

The purpose of this thesis is to analyze how DCs leverage the inclusion of stakeholders in the RI process. It was evident, from the cases investigated, that specific

processes and routines are determined, elevated to the condition of microfoundations of generic dynamic capabilities (*sensing, seizing and transforming*), and linked with specific dynamic capabilities – relational and integrative of knowledge – which leverage this inclusion (Figure 50).

Figure 50 - Dynamic Capabilities that leverage the inclusion of Stakeholders in the RI process



Source: by the author.

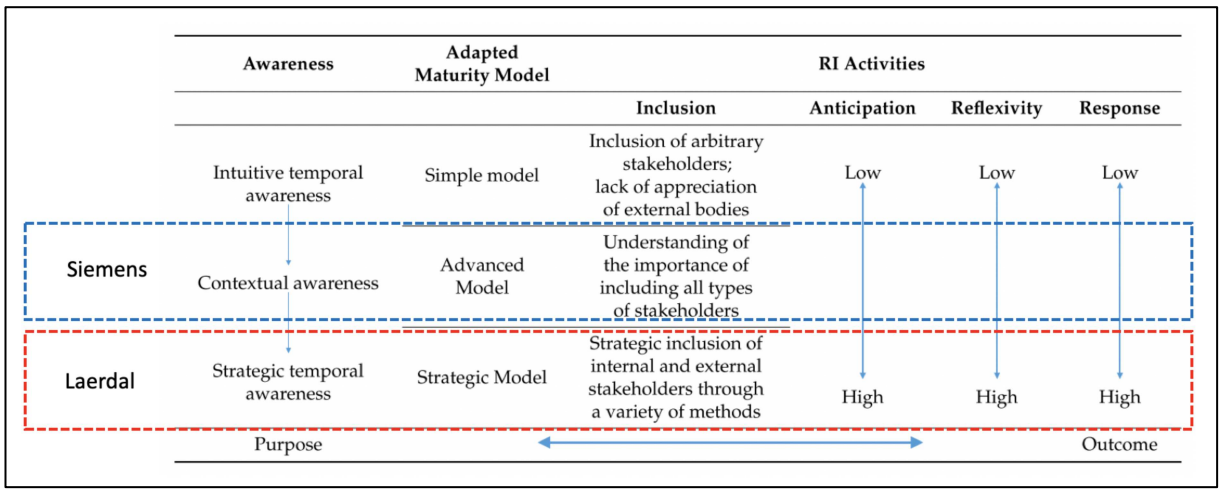
Although case studies are not subject to generalization, since the analysis was developed from the theory and analysis of the two cases, analytical generalization is possible (YIN, 2003). Other studies can be carried out to confirm or refute the propositions raised here.

Before moving on to the final considerations, and seeking to meet criterion 4, of maturity in the inclusion of stakeholders, the next section analyzes the level of RI maturity of the companies under study, based on the model developed by Oftedal, Foss and Iakovleva (2019).

5.3 RI MATURITY

Relational and **integrative knowledge** DCs will influence each company differently, since each has developed its individual microfoundations, which effectively make them responsibly innovative – some to a higher degree, others to a lesser extent. From the maturity model proposed by Oftedal, Foss, and Iakovleva (2019), Figure 51 presents the levels and their relationship with the dimensions of the RI. At the first level, there is an intuitive temporal perception, with which the company has an innate understanding of responsibility and how to achieve it. The second level concerns contextual awareness when the company knows the concept of RI. The third level occurs when there is a full of strategic awareness. It shows that there is a balance between intuitive and contextual knowledge, addressing strategic RI issues.

Figure 51 - RI maturity model



Source: adapted from Oftedal, Foss and Iakovleva (2019).

When analyzing the two cases in light of the RI maturity model, it is clear that companies are at different levels. The dotted line shows that leveling is not static, and may, in different contexts or processes, permeate the other levels.

Based on the analysis of Cios Alpha OpenApps, Siemens demonstrates its vocation for responsibility, which is shown in its corporate statements. Despite this, when analyzing it more deeply from the perspective of inclusion, there is still more ground to be covered, seeking to expand the scope of stakeholders involved, including the patient. It is important to emphasize that this observation is made based on the analysis of a single project and cannot be generalized to other products of the

company. But it is also important to note that Siemens works very well in consulting specialists, doctors, and nurses, obtaining relevant and sufficient knowledge for the development of the project.

Laerdal, on the other hand, demonstrates a higher level of maturity, including a range of stakeholders at various stages of the innovation process. Also, the company developed microfoundations that strengthen the other dimensions of RI, such as the establishment and maintenance of strategic partners, which contributes to the aspects of anticipation and reflexivity. The incentive to train and qualify users, on the other hand, actively contributes to responsiveness.

The different level between the two companies can be explained by the degree of complexity of the businesses. It is assumed that a sizeable technology-driven company like Siemens may not be able to get closer to patients, even considering the degree of contribution of this group of stakeholders. Laerdal, on the other hand, being a smaller company with a lower degree of complexity, has more flexibility and potential for this approach. The same analysis can be conducted based on the level of complexity of the products, not only of the companies.

A criticism that can be made in both cases is the level of disruption of innovations. Iakovleva and Bessant (2019) note that despite the numerous sophisticated medical technologies introduced every year, the degree of disruption is not significant. According to the authors, this is because technology has almost always been implemented sustainably in the health area – mainly to help hospitals and doctors to solve the most complex problems. The result of this goes against what is expected in innovations in the health area, which is to generate lower costs, higher quality, and greater accessibility (CHRISTENSEN et al., 2017).

The maturity level of the RI can also be associated with the level of openness of the information. One of the risks inherent in the inclusion of stakeholders is that this movement occurs in two ways. Just as stakeholder knowledge is somehow absorbed by the company, relevant (and often sensitive) information is shared with these stakeholders. For companies like Siemens, which are highly complex and operate in highly competitive markets, security is established through patents. The challenge is how to keep the information confidential, while sharing is necessary to generate more qualified knowledge. Laerdal, on the other hand, is not so concerned with secrecy in the production process, as it does not aim to patent products.

From the analysis of the RI maturity level, the fourth and last proposition arises:

Proposition 4: Specific dynamic capabilities contribute to greater RI maturity.

At the end of the discussion, the next chapter presents the final considerations.

6 FINAL CONSIDERATIONS

In this last chapter, the theoretical and empirical contributions of the study are presented, as well as the limitations and suggestions for future studies.

6.1 THESIS CONTRIBUTIONS

In seeking to achieve the main objective that guided this research, that is to analyze how dynamic capabilities enhance the inclusion of stakeholders in the responsible innovation process, specific goals were established that contribute to achieving the general objective.

The first specific objective was to relate the stages of the innovation process to the Stage-gate model. From the analysis of the cases, and the cross-analysis with the theory, the contribution of the model proposed by Cooper (2008; 20016) (Table 36) was verified.

Table 36 – Specific objective: To relate the stages of the innovation process to the Stage-gate model

Stage-gate model	**Siemens**	**Laerdal**	**Comparative analysis**
Plan to manage the new product development process (NPD) to improve effectiveness and efficiency (COOPER, 2008, p. 214)	It presents a flexible process that is adaptable to each need.	The company's development process consists of five stages of the life cycle (stages) and five screens (gates).	Both cases present construction-test-feedback-review interactions, which, according to Cooper (2016), make the system more adaptive.

Source: by the author.

Based on the identification of the innovation model, it was possible to respond to the second specific objective, which was to identify the stage(s) of the innovation process where stakeholders are included. The literature on RI predicts that stakeholder participation should be a given from the first stages of the innovation process (OWEN et al., 2013). Table 37 presents the stages in each case.

Table 37 – Specific objective: To identify the stage (s) of the innovation process where stakeholders are included

Stages of the innovation process	Siemens	Laerdal	Comparative analysis
Discovery Scoping Business plan Development Testing Launch (COOPER, 2008)	Ideation Engineering Implementation	Explore Conceptualize Develop Implement	Only in the development stage, in both cases, is there no inclusion of stakeholders. This is because it is a product development stage, after the tests validated in prototypes, and before the final testing, for the launch.

Source: by the author.

By identifying that both companies include stakeholders from the initial stages, it was possible to respond to the third specific objective: to identify and describe the processes and routines that underlie the practices of inclusion of stakeholders involved in the innovation process. Each company developed individual processes and routines, although some of them are common in both cases. Table 38 presents the processes and routines.

Table 38 – Specific objective: Identify and describe the processes and routines that support the inclusion practices of the stakeholders involved in the innovation process

Processes and routines for including stakeholders	Siemens	Laerdal	Comparative analysis
Co-creation	X	X	Both companies use the same processes and routines to include stakeholders. The only exception is the “incentive for training and qualification of users.”
Memory creation	X	X	
Establishment of partner selection criteria	X	X	
Establishment of multiple communication channels	X	X	
Encouraging training and qualification of users		X	
Systematic observation of product use	X	X	
Strategic partnerships	X	X	
Active participation in events	X	X	

Source: by the author.

When identifying the processes and routines developed for the inclusion of stakeholders, it was found that all of them can be considered microfoundations of dynamic capabilities. In this way, it moved towards the fourth, and last, specific objective, which was to identify and analyze the dynamic capability (or capabilities) that enhance the inclusion of stakeholders. From the microfoundations, the *sensing*, *seizing*, and *transforming* capabilities were explained. It was found that they were not sufficient to leverage the inclusion of stakeholders, requiring specific dynamic capabilities, shown in Table 39.

Table 39 – Specific objective: To identify and analyze the dynamic capabilities that enhance the inclusion of stakeholders

Dynamic Capability	**Generic**	**Specific**
To build and reconfigure internal and external competencies to deal with rapidly changing environments (TEECE; PISANO; SHUEN, 1997, p. 516)	sensing seizing transforming	Relational Knowledge integrative

Source: by the author.

In this way, it was possible to answer the question that guided this research: “How do dynamic capabilities leverage the inclusion of stakeholders in the responsible innovation process?” From the analysis of the Siemens and Laerdal cases, certain processes and routines were identified that were elevated to the condition of microfoundations of generic dynamic capabilities (*sensing*, *seizing*, and *transforming*), which together with specific dynamic capabilities – relational and integrative of knowledge – leverage inclusion of stakeholders.

By connecting the context of RI to the theoretical lens of DC, this thesis established theoretical and empirical contributions, described below.

6.1.1 Theoretical Contributions

The main theoretical contribution of the thesis is the connection established between the context of RI and the theoretical lens of DC. Until now, few studies have proven this connection (PANDZA; ELLWOOD, 2013; VAN de POEL et al., 2017).

For the theoretical lens of dynamic capabilities, first of all, we respond to the criticisms that DCs are tautological and not operational (WILLIAMSON, 1999; PRIEM; BUTLER, 2001). The thesis demonstrated that dynamic capabilities are developed from individual processes and routines, specific to the analyzed context, explaining its operationalization. In the present thesis, the operationalization of DCs occurs through processes and methods for including stakeholders during the responsible innovation process. But the main contribution lies in the dichotomous classification of DCs. In establishing the capabilities of *sensing, seizing,* and *transforming*, Teece (2007) considered dynamic contexts broadly. Due to the breadth of application of these capabilities, DCs are considered here as **generic dynamic capabilities**. Otherwise, when analyzing a specific part of a process – in this case, the inclusion of stakeholders – the nature of the DCs was unable, alone, to explain how this process (of inclusion) can be enhanced. It was necessary to analyze other DCs that effectively enhanced the inclusion of stakeholders. These DCs are referred to as **specific dynamic capabilities**.

For the context of RI, the main contribution concerns the identification of specific processes and routines for the inclusion of stakeholders. The literature predicts that the inclusion must be made from the first stages of the innovation process (OWEN et al., 2013); however, there are no studies that describe how this process is done in the business context (BLOK et al., 2015; SILVA, 2019; SILVA et al., 2019). The identification of **Relational** and **Integrative Knowledge** DCs as enhancing the inclusion of stakeholders is also an essential contribution to the context of RI, since, despite the participation of DCs in RI, no other study has deepened this analysis (LUBBERINK et al., 2017). Finally, progress is made in relating the dimension of inclusion and its influence on other dimensions of RI governance, demonstrating its integration ((VAN DE POEL et al., 2017). As already noted, RI governance does not occur procedurally, and specific actions will be loaded with one or more dimensions. When analyzing the cases studied, it was noticed that processes and routines established for inclusion generate the necessary knowledge to feed the other dimensions, whenever required.

This study also contributes to the establishment of four propositions, developed from the responses to specific objectives. Proposition 1 highlights that: “The inclusion of stakeholders occurs throughout the process of responsible innovation, favored by

the Stage-gate model.” The theory emphasizes that inclusion must occur from the first stages of the innovation process (OWEN et al., 2013), which was verified in both cases. Furthermore, it was found that their participation occurs throughout the process, not only in specific stages. There is only one stage in which there is no direct stakeholder participation. Also, we identified that both companies mirrored their innovation processes in the Stage-gate model (COOPER, 2008; 2016). Since the model was developed considering the participation of users throughout the process, it was confirmed that the model effectively favors inclusion.

Proposition 2 states that: “the inclusion of stakeholders in the responsible innovation process requires particular processes and routines." Such processes and routines can be considered microfoundations of dynamic capabilities, and contribute to the capabilities of *sensing*, *seizing*, and *transforming*. Some of them are common in co-creation and open innovation processes, but when combined with others, they contribute to the inclusion of stakeholders.

Proposition 3 highlights that: "The generic dynamic capabilities of *sensing*, *seizing*, and *transforming*, and the specific dynamic capabilities of Relational and Integrative Knowledge, based on specific processes and routines, enhance the inclusion of stakeholders in the responsible innovation process." Herein lies one of the main contributions of the thesis, based on the findings of the cases. DCs are capable of leveraging the inclusion of stakeholders in the responsible innovation process. But it’s not just the *sensing*, *seizing*, and *transforming* capabilities that are responsible. Other capabilities are needed to make this happen. **Relational DC** makes it possible to interact and share significant knowledge, outside the limits of the company (LORENZONI; LIPPARINI, 1999). The **integrative knowledge** DC enables the knowledge generated through these interactions with stakeholders to be absorbed.

Finally, Proposition 4 reflects that: “Specific dynamic capabilities contribute to greater RI maturity.” By analyzing the levels of RI maturity, and considering that inclusion permeates the other dimensions, DCs can contribute to a full strategic awareness.

In addition to theoretical contributions, this thesis offers empirical contributions, presented below.

6.1.2 Empirical Contributions

In addition to the theoretical advancements, this study offers empirical contributions related to both RI and the development of DCs.

The detailing of the inclusion process, as well as the identification and description of processes and routines, at each stage of the innovation process, can serve as inspiration and as a model for other companies. When analyzing the cases, eight processes and routines were highlighted that facilitate the inclusion of stakeholders. At the beginning of the innovation process, active participation in events, as well as the establishment of multiple communication channels, contribute to the selection and establishment of strategic partnerships. Therefore, it is necessary to establish criteria for selecting these partners. After that, co-creation strategies and systematic observation of the use of products are strategies for acquiring and generating new knowledge. The creation of memory is also important, that is, the documentation and registration of meetings, interactions, and ideas, with the objective of dissemination within the company, such as the registration for improvements and product improvement. Finally, encouraging training and qualification for users is a way to be close to users, understanding their difficulties and disseminating technical knowledge for better use of products. Strategic partners, software developers, and users are the stakeholders that stood out in the analyzed cases. It is perceived that companies seek out the collaboration of more than one group of stakeholders, recognizing that the diversity of opinions and points of view is essential.

The result of the analysis of global companies in the health sector, recognized for their responsibility for innovation, also serves as inspiration for entrepreneurs and managers. Such examples demonstrate that innovations in this area can generate benefits for the company and for society.

A critical methodological stage for the choice of cases resulted in a diagnostic tool for the dimensions of RI. A model was developed, inspired by the Canvas model, of the four dimensions of RI governance. This model helps companies to evaluate themselves and achieve the responsible development of innovations.

6.2 RESEARCH LIMITATIONS

This study has certain limitations, which are pointed out below.

In the Siemens case, the fact that the interviews were scheduled over two days, with the interviewees being defined by SE1, contributed to the impossibility of deepening the collected data and refining the selection of the interviewees.

In the Laerdal case, one limitation was the difficulty, in the interviewees' statements, in separating what refers exclusively to the product and what concerns the company. Although it demonstrates that the company is in line with the precepts of responsible innovation, more considerable attention was required in the collection and analysis of data to highlight what was related to specific production processes or macro processes.

6.3 SUGGESTIONS FOR FUTURE STUDIES

Although the inclusion of stakeholders is the most studied dimension, in the context of RI (LUBBERINK et al., 2018), it is still possible to deepen other aspects such as the degree of stakeholder contribution, as well as the reason why stakeholders who do not share the vision are not included.

Also, inclusion is only one of several aspects relevant to RI. In this sense, it is suggested to analyze in-depth the other dimensions of RI using the theoretical lens of DCs, pointing out, for example, which the microfoundations are capable of enhancing anticipation, responsiveness, and reflexivity.

It is also suggested to analyze the level of maturity of companies further to corroborate or refute the analysis made in this research.

Finally, it is suggested to evaluate how tools such as ISO (mainly ISO 56.0002) and EMAS respond adequately to responsible innovation.

REFERENCES

About Laerdal. **Laerdal Medicla Services Solution. Stavanger,** [2019?]. Available in: https://www.laerdal.com/us/about-us/. Acess in: 23 apr 2019.

ADAMS, Richard et al. Sustainability-oriented innovation: a systematic review. **International Journal of Management Reviews**, v. 18, n. 2, p. 180-205, 2016.

ADNER, Ron. Match your innovation strategy to your innovation ecosystem. **Harvard business review**, v. 84, n. 4, p. 98, 2006.

AFUAH, A.; TUCCI, C. L. Crowdsourcing as a solution to distant search. **Academy of Management Review,** v.37, n.3, p: 355–75, 2012.

ALOISE, Pedro Gilberto. Relações entre ética organizacional, inovações ambientais e sustentabilidade. **Revista de Administração FACES Journal**, v. 16, n. 2, 2017.

ANDERSEN, Alexander Kjćr et al. The frame network of interdisciplinary stakeholder compositions in the early phases of new product development. In: **DS 87-1 Proceedings of the 21st International Conference on Engineering Design (ICED 17) Vol 1: Resource Sensitive Design, Design Research Applications and Case Studies, Vancouver, Canada, 21-25.08. 2017**. 2017. p. 339-348.

ANDERSSON, E. Roland; LUNDBLAD, Jan; JANSSON, Bjarne. A public arena for sustainable health and safety innovation: guidelines for research and practice. **International Journal of Innovation and Sustainable Development**, v. 6, n. 3, p. 324-343, 2012.

ARNDT, Felix; PIERCE, Lamar. The behavioral and evolutionary roots of dynamic capabilities. **Industrial and Corporate Change**, v. 27, n. 2, p. 413-424, 2017.

ARNOLD, Marlen. Corporate strategies for sustainable innovations. In: **Facilitating sustainable innovation through collaboration**. Springer, Dordrecht, 2010. p. 217-232.

AYUSO, Silvia; RODRÍGUEZ, Miguel Ángel; RICART, Joan Enric. Using stakeholder dialogue as a source for new ideas: a dynamic capability underlying sustainable innovation. **Corporate Governance: The international journal of business in society**, v. 6, n. 4, p. 475-490, 2006.

BALASOPOULOU, Angeliki et al. Advancing global precision medicine: An overview of genomic testing and counseling services in Malaysia. **Omics: a journal of integrative biology**, v. 21, n. 12, p. 733-740, 2017.

BALASUBRAMANIAN, Natarajan. New plant venture performance differences among incumbent, diversifying, and entrepreneurial firms: the impact of industry learning intensity. **Management Science**, v. 57, n. 3, p. 549-565, 2011.

BALKA, Kerstin; RAASCH, Christina; HERSTATT, Cornelius. The effect of selective openness on value creation in user innovation communities. **Journal of Product Innovation Management**, v. 31, n. 2, p. 392-407, 2014.

BARDIN, Laurence. **Content analysis**. São Paulo: Edições, v. 70, p. 279, 2016.

BARGE-GIL, Andrés. Cooperation-based innovators and peripheral cooperators: An empirical analysis of their characteristics and behavior. **Technovation**, v. 30, n. 3, p. 195-206, 2010.

BARNEY, Jay. Firm resources and sustained competitive advantage. **Journal of management**, v. 17, n. 1, p. 99-120, 1991.

BARNEY, Jay.; FELIN, Teppo. What are microfoundations?. **Academy of Management Perspectives**, v. 27, n. 2, p. 138-155, 2013.

BARON, Robert A. Opportunity recognition as pattern recognition: How entrepreneurs “connect the dots” to identify new business opportunities. **Academy of management perspectives**, v. 20, n. 1, p. 104-119, 2006.

BARRETO, Ilídio. Dynamic capabilities: A review of past research and an agenda for the future. **Journal of management**, v. 36, n. 1, p. 256-280, 2010.

BARTLETT, Dean. Embedding corporate responsibility: the development of a transformational model of organizational innovation. **Corporate Governance: The international journal of business in society**, v. 9, n. 4, p. 409-420, 2009.

BECHTOLD, Ulrike; CAPARI, Leo; GUDOWSKY, Niklas. Futures of ageing and technology–comparing different actors’ prospective views. **Journal of Responsible Innovation**, v. 4, n. 2, p. 157-176, 2017.

BERKER, Thomas. Dealing with uncertainty in sustainable innovation: mainstreaming and substitution. **International Journal of Innovation And Sustainable Development**, [s.l.], v. 5, n. 1, p.65-79, 2010. Inderscience Publishers. http://dx.doi.org/10.1504/ijisd.2010.034558.

BERKHOUT, Guus; HARTMANN, Dap; TROTT, Paul. Connecting technological capabilities with market needs using a cyclic innovation model. **R&d Management**, v. 40, n. 5, p. 474-490, 2010.

BESSANT, J. Innovation in the 21st Century. **Responsible Innovation. Chichester, UK: Wiley**. 2013.

BESSANT, John et al. Responsible Innovation In Healthcare—The Case Of Health Information Tv. **International Journal of Innovation Management**, v. 21, n. 08, p. 1740012, 2017.

BESSANT, John; TIDD, Joe. **Innovation and entrepreneurship**. John Wiley & Sons, 2007.

BHANJI, Farhan et al. Part 14: education: 2015 American Heart Association guidelines update for cardiopulmonary resuscitation and emergency cardiovascular care. **Circulation**, v. 132, n. 18_suppl_2, p. S561-S573, 2015.

BIONDI, Vittorio; IRALDO, Fabio; MEREDITH, Sandra. Achieving sustainability through environmental innovation: the role of SMEs. **International Journal of Technology Management**, v. 24, n. 5-6, p. 612-626, 2002.

BLOK, Vincent. Look who's talking: responsible innovation, the paradox of dialogue and the voice of the other in communication and negotiation processes. **Journal of Responsible Innovation**, v. 1, n. 2, p. 171-190, 2014.

BLOK, Vincent; HOFFMANS, Linda; WUBBEN, E. F. M. Stakeholder engagement for responsible innovation in the private sector: Critical issues and management practices. **Journal on Chain and Network Science**, v. 15, n. 2, p. 147-164, 2015.

BLOK, Vincent; LEMMENS, Pieter. The emerging concept of responsible innovation. Three reasons why it is questionable and calls for a radical transformation of the concept of innovation. In: **Responsible Innovation 2**. Springer, Cham, 2015. p. 19-35.

BOCKEN, N. M. P. et al. The front-end of eco-innovation for eco-innovative small and medium sized companies. **Journal of Engineering and Technology Management**, v. 31, p. 43-57, 2014.

BRYMAN, Alan; BELL, Emma. The nature of qualitative research. **Social research methods**, p. 365-399, 2001.

BURGET, Mirjam; BARDONE, Emanuele; PEDASTE, Margus. Definitions and conceptual dimensions of responsible research and innovation: a literature review. **Science and engineering ethics**, v. 23, n. 1, p. 1-19, 2017.

CALLON, M.; LASCOUMES, P.; BARTHE, Y. **Acting in an uncertain world: An essay on technical democracy** (G. Burchell, Trans.). 2009.

CHADHA, Avrath. Overcoming competence lock-in for the development of radical eco-innovations: the case of biopolymer technology. **Industry and innovation**, v. 18, n. 03, p. 335-350, 2011.

CHALMERS, Dominic M.; BALAN-VNUK, Eva. Innovating not-for-profit social ventures: Exploring the microfoundations of internal and external absorptive capacity. routines. **International Small Business Journal**, v. 31, n. 7, p. 785-810, 2013.

CHENG, C.; CHEN, J. Breakthrough innovation: The roles of dynamic innovation capabilities and open innovation activities. **Journal of Business and Industrial Marketing**, v.28, n.5, 444–454, 2013.

CHESBROUGH, Henry William. **Open innovation: The new imperative for creating and profiting from technology**. Harvard Business Press, 2003.

CHESBROUGH, Henry; VANHAVERBEKE, Wim; WEST, Joel (Ed.). **Open innovation: Researching a new paradigm**. Oxford University Press on Demand, 2006.

CHRISTENSEN, Clayton; WALDECK, Andrew; FOGG, Rebecca. How disruptive innovation can finally revolutionize healthcare. **Industry Horizons**, p. 1-28, 2017.

CIOS ALPHA BROCHURE. In: Siemens Site, [2019?]. Available in: https://www.healthcare.siemens.com/surgical-c-arms-and-navigation/mobile-c-arms/cios-alpha-cmos. Access in: 20 set. 2019.

CIOS ALPHA. In: Siemens Site, [2019?]. Available in: https://www.siemens-healthineers.com/surgical-c-arms-and-navigation/mobile-c-arms/cios-alpha-cmos. Access in: 20 set. 2019.

COECKELBERGH, Mark et al. A survey of expectations about the role of robots in robot-assisted therapy for children with ASD: Ethical acceptability, trust, sociability, appearance, and attachment. **Science and engineering ethics**, v. 22, n. 1, p. 47-65, 2016.

COHEN, Wesley M.; LEVINTHAL, Daniel A. Absorptive capacity: A new perspective on learning and innovation. **Administrative science quarterly**, v. 35, n. 1, p. 128-152, 1990.

COLEMAN, J., **Foundations of social theory**. Boston: Harvard University Press. 1990.

COOPER, Robert G. Agile–Stage-Gate Hybrids: The Next Stage for Product Development Blending Agile and Stage-Gate methods can provide flexibility, speed, and improved communication in new-product development. **Research-Technology Management**, v. 59, n. 1, p. 21-29, 2016.

COOPER, Robert G. et al. The stage-gate idea-to-launch process–update, what's new and NexGen systems. **Journal of Product Innovation Management**, v. 25, n. 3, p. 213-232, 2008.

COOPER, Robert G.; SOMMER, Anita F. Agile-Stage-Gate: New idea-to-launch method for manufactured new products is faster, more responsive. **Industrial Marketing Management**, v. 59, p. 167-180, 2016.

CORLEY, Kevin G.; GIOIA, Dennis A. Identity ambiguity and change in the wake of a corporate spin-off. **Administrative science quarterly**, v. 49, n. 2, p. 173-208, 2004.

DA MOTA PEDROSA, Alex; VÄLLING, Margus; BOYD, Britta. Knowledge related activities in open innovation: managers' characteristics and practices. **International Journal of Technology Management 12**, v. 61, n. 3/4, p. 254-273, 2013.

DAVIDSON, E. Jane. **Evaluation methodology basics: The nuts and bolts of sound evaluation**. Sage, 2005.

DE ANA, F. J. et al. Value driven innovation in medical device design: a process for balancing stakeholder voices. **Annals of biomedical engineering**, v. 41, n. 9, p. 1811-1821, 2013.

DE BAKKER, Erik et al. Responsible research and innovation in miniature: Information asymmetries hindering a more inclusive 'nanofood'development. **Science and Public Policy**, v. 41, n. 3, p. 294-305, 2014.

DE CAROLIS, Donna Marie; SAPARITO, Patrick. Social capital, cognition, and entrepreneurial opportunities: A theoretical framework. **Entrepreneurship theory and practice**, v. 30, n. 1, p. 41-56, 2006.

DE JONG, Jeroen PJ; FREEL, Mark. Absorptive capacity and the reach of collaboration in high technology small firms. **Research Policy**, v. 39, n. 1, p. 47-54, 2010

DE VISSER, Matthias et al. Structural ambidexterity in NPD processes: A firm-level assessment of the impact of differentiated structures on innovation performance. **Technovation**, v. 30, n. 5-6, p. 291-299, 2010.

DECKER, Michael et al. Imagined technology futures in demand-oriented technology assessment. **Journal of Responsible Innovation**, v. 4, n. 2, p. 177-196, 2017.

DEMERS-PAYETTE, Olivier; LEHOUX, Pascale; DAUDELIN, Geneviève. Responsible research and innovation: a productive model for the future of medical innovation. **Journal of Responsible Innovation**, v. 3, n. 3, p. 188-208, 2016.

DENFORD, James S. Building knowledge: developing a knowledge-based dynamic capabilities typology. **Journal of Knowledge Management**, v. 17, n. 2, p. 175-194, 2013.

DI GIULIO, Gabriela et al. Communicating through vulnerability: knowledge politics, inclusion and responsiveness in responsible research and innovation. **Journal of Responsible Innovation**, v. 3, n. 2, p. 92-109, 2016.

DIGITAL HEALTH SOLUTIONS MARKETPLACE. In: Siemens Site, [2019?]. Available in: https://www.siemens-healthineers.com/de/digital-health-solutions/digital-solutions-overview/partner-solutions/digital-marketplace-partner-applications. Access in: 21 set 2019.

DIGITAL MARKETPLACE SIEMENS, 2019 Available in: <https://www.siemens-healthineers.com/de/digital-health-solutions/digital-solutions-overview/partner-solutions/digital-marketplace-partner-applications>. Access in: 22 mar. 2019.

DONADA, Carole; NOGATCHEWSKY, Gwenaelle; PEZET, Anne. Understanding the relational dynamic capability-building process. **Strategic Organization**, v. 14, n. 2, p. 93-117, 2016.

DONALDSON, Thomas; PRESTON, Lee E. The stakeholder theory of the corporation: Concepts, evidence, and implications. **Academy of management Review**, v. 20, n. 1, p. 65-91, 1995.

DONG, Andy; GARBUIO, Massimo; LOVALLO, Dan. Generative sensing: A design perspective on the microfoundations of sensing capabilities. **California Management Review**, v. 58, n. 4, p. 97-117, 2016.

DOSSA, Zahir; KAEUFER, Katrin. Understanding sustainability innovations through positive ethical networks. **Journal of Business Ethics**, v. 119, n. 4, p. 543-559, 2014.

D'SILVA, Joel; ROBINSON, Douglas KR; SHELLEY-EGAN, Clare. A game with rules in the making–how the high probability of waiting games in nanomedicine is being mitigated through distributed regulation and responsible innovation. **Technology analysis & strategic management**, v. 24, n. 6, p. 583-602, 2012.

DUGGAL, Rishi; BRINDLE, Ingrid; BAGENAL, Jessamy. Digital healthcare: regulating the revolution. **BMJ: British Medical Journal (Online)**, v. 360, 2018.

EDEN, Grace; JIROTKA, Marina; STAHL, Bernd. Responsible research and innovation: Critical reflection into the potential social consequences of ICT. In: **Research Challenges in Information Science (RCIS), 2013 IEEE Seventh International Conference on**. IEEE, 2013. p. 1-12.

EDWARDS-SCHACHTER, Mónica E.; MATTI, Cristian E.; ALCÁNTARA, Enrique. Fostering quality of life through social innovation: A living lab methodology study case. **Review of Policy Research**, v. 29, n. 6, p. 672-692, 2012.

EISENHARDT, Kathleen M.; FURR, Nathan R.; BINGHAM, Christopher B. CROSSROADS—Microfoundations of performance: Balancing efficiency and flexibility in dynamic environments. **Organization science**, v. 21, n. 6, p. 1263-1273, 2010.

EISENHARDT, Kathleen M.; MARTIN, Jeffrey A. Dynamic capabilities: what are they?. **Strategic management journal**, v. 21, n. 10-11, p. 1105-1121, 2000.

ELMQUIST, Maria; SEGRESTIN, Blanche. Sustainable development through innovative design: lessons from the KCP method experimented with an automotive firm. **International Journal of Automotive technology and management**, v. 9, n. 2, p. 229-244, 2009.

EL-SAYED, Tamer et al. Radiation-induced DNA damage in operators performing endovascular aortic repair. **Circulation**, v. 136, n. 25, p. 2406-2416, 2017.

EUROPEAN COMMISSION. **INNOVATION AND SPACE RESEARCH ACTIVITIES.** London: GHK, 2008. 106 p. Final Report Submitted by GHK and Technopolis within the framework of ENTR/04/093-FC-Lot 1. Available at: <http://ec.europa.eu/research/evaluations/pdf/archive/fp6-evidence-base/evaluation_studies_and_reports/evaluation_studies_and_reports_2008/ex_post_evaluation_dg_entr_innovation_and_space_research_report_2008.pdf>. Access in: 20 jun. 2018.

EVANS, Stagehen; PARTIDÁRIO, Paulo J.; LAMBERT, Joanna. Industrialization as a key element of sustainable product-service solutions. **International Journal of Production Research**, v. 45, n. 18-19, p. 4225-4246, 2007.

FELIN, T., FOSS, N.J., HEIMERIKS, K.H., MADSEN, T.L. Microfoundations of routines and capabilities: individuals, processes, and structure. **J. Manage. Stud.** v. 49, n.8., p. 1351–1374, 2012.

FELIN, Teppo et al. Microfoundations of routines and capabilities: Individuals, processes, and structure. **Journal of Management Studies**, v. 49, n. 8, p. 1351-1374, 2012.

FLICK, U. **Uma introdução à pesquisa qualitativa**. 2 ed. Porto Alegre: Bookman, 2004.

FOSS, Nicolai Juul; PEDERSEM, Torben. Microfoundations in Strategy Research. **Strategic Management Journal**, vol. 37, no. 13, 2016.

FOUAD, Fatimaezzahra; TOURABI, Amina; LAKHNATI, Ghizlane. The innovation process impact on the new product performance: a case study. **International Journal of Innovation Science**, 2018.

FRANKE, Nikolaus; KEINZ, Peter; KLAUSBERGER, Katharina. “Does this sound like a fair deal?”: Antecedents and consequences of fairness expectations in the individual’s decision to participate in firm innovation. **Organization Science**, v. 24, n. 5, p. 1495-1516, 2013.

FREEMAN, R. Edward. The politics of stakeholder theory: Some future directions. **Business ethics quarterly**, p. 409-421, 1994.

FREEMAN, R. Edward. **Strategic management: A stakeholder approach**. Pitman, Boston, MA, 1984.

FRIEDMAN, Andrew L.; MILES, Samantha. Developing stakeholder theory. **Journal of management studies**, v. 39, n. 1, p. 1-21, 2002.

FUNG, Archon. Varieties of participation in complex governance. **Public administration review**, v. 66, p. 66-75, 2006.

GARCIA, Rosanna; CALANTONE, Roger. A critical look at technological innovation typology and innovativeness terminology: a literature review. **Journal of Product**

Innovation Management: An International Publication of The Product Development & Management Association, v. 19, n. 2, p. 110-132, 2002.

GASSMANN, Oliver; ENKEL, Ellen; CHESBROUGH, Henry. The future of open innovation. **R&d Management**, v. 40, n. 3, p. 213-221, 2010.

GAVETTI, G. Cognition and hierarchy: rethinking the microfoundations of capabilities'development. **Organization Science**, v. 16, n.6, p. 599 -617, 2005.

GEMEN, R. et al. Stakeholder engagement in food and health innovation research programming–key learnings and policy recommendations from the INPROFOOD project. **Nutrition bulletin**, v. 40, n. 1, p. 54-65, 2015.

GIL, Antonio Carlos. **Métodos e técnicas de pesquisa social**. 6. ed. Ediitora Atlas SA, 2008.

GIOIA, Dennis A. A renaissance self: Prompting personal and professional revitalization. **Renewing research practice**, p. 97-114, 2004.

GIOIA, Dennis A.; CHITTIPEDDI, Kumar. Sensemaking and sensegiving in strategic change initiation. **Strategic management journal**, v. 12, n. 6, p. 433-448, 1991.

GRANT, Robert M. Prospering in dynamically-competitive environments: Organizational capability as knowledge integration. **Organization science**, v. 7, n. 4, p. 375-387, 1996.

GREENWOOD, Michelle. Stakeholder engagement: Beyond the myth of corporate responsibility. **Journal of Business ethics**, v. 74, n. 4, p. 315-327, 2007.

GUDOWSKY, Niklas; PEISSL, Walter. Human centred science and technology—transdisciplinary foresight and co-creation as tools for active needs-based innovation governance. **European Journal of Futures Research**, v. 4, n. 1, p. 8, 2016

GUIMARÃES, Hélio Penna et al. Uma breve história da ressuscitação cardiopulmonar. **Rev Bras Clin Med**, v. 7, n. 3, p. 177-87, 2009.

GULATI, Ranjay; GARGIULO, Martin. Where do interorganizational networks come from?. **American journal of sociology**, v. 104, n. 5, p. 1439-1493, 1999.

GURZAWSKA, Agata; MÄKINEN, Markus; BREY, Philip. Implementation of Responsible Research and Innovation (RRI) practices in industry: Providing the right incentives. **Sustainability**, v. 9, n. 10, p. 1759, 2017.

GUSTON, David H. Understanding 'anticipatory governance'. **Social studies of science**, v. 44, n. 2, p. 218-242, 2014.

HALILA, Fawzi; RUNDQUIST, Jonas. The development and market success of eco-innovations: A comparative study of eco-innovations and "other" innovations in

Sweden. **European Journal of Innovation Management**, v. 14, n. 3, p. 278-302, 2011.

HALSKE X-RAY UNIT (1986). In: Siemens Site [2019?]. Available in: https://www.siemens-healthineers.com/br/about. Access in: 17 set. 2019.

HAX, Arnoldo; WILDE, Dean. **The Delta Project: Discovering new sources of profitability in a networked economy**. Springer, 2001.

HEIDINGSFELDER, Marie et al. Shaping future—Adapting design know-how to reorient innovation towards public preferences. **Technological forecasting and social change**, v. 101, p. 291-298, 2015.

HELFAT, Constance E. et al. **Dynamic capabilities: Understanding strategic change in organizations**. John Wiley & Sons, 2009.

HELFAT, Constance E.; CAMPO-REMBADO, Miguel A. Integrative capabilities, vertical integration, and innovation over successive technology lifecycles. **Organization Science**, v. 27, n. 2, p. 249-264, 2016.

HELFAT, Constance E.; MARTIN, Jeffrey A. Dynamic managerial capabilities: Review and assessment of managerial impact on strategic change. **Journal of management**, v. 41, n. 5, p. 1281-1312, 2015.

HELFAT, Constance E.; PETERAF, Margaret A. Managerial cognitive capabilities and the microfoundations of dynamic capabilities. **Strategic Management Journal**, v. 36, n. 6, p. 831-850, 2015.

HELFAT, Constance E.; RAUBITSCHEK, Ruth S. Dynamic and integrative capabilities for profiting from innovation in digital platform-based ecosystems. **Research Policy**, v. 47, n. 8, p. 1391-1399, 2018.

HEMPHILL, Thomas A. Responsible innovation and patent assertion entities. **Journal of Responsible Innovation**, v. 1, n. 3, p. 314-320, 2014.

HENDERSON, Rebecca; COCKBURN, Iain. Measuring competence? Exploring firm effects in pharmaceutical research. **Strategic management journal**, v. 15, n. S1, p. 63-84, 1994.

HINDE, Robert A. **Bending the Rules: the flexibility of absolutes in modern life**. OUP Oxford, 2008.

HISTORY of CPR. [2019?]. Available at: https://cpr.heart.org/en/resources/history-of-cpr#1960s. Access in: 20 out. 2019.

IAKOVLEVA, T.; OFTEDAL, E. M.; BESSANT, J. (ORG.). Responsible innovatin in digital health. IN: **Responsible Innovation in Digital Health Empowering the Patient.** 1ed.: Edward Elgar Publishing, 2019, v., p. 1-288.

IANSITI, Marco; CLARK, Kim B. Integration and dynamic capability: evidence from product development in automobiles and mainframe computers. **Industrial and corporate change**, v. 3, n. 3, p. 557-605, 1994.

IBGE, Coordenadoria da Indústria. **Pesquisa de inovação: 2014.** Rio de Janeiro: IBGE, 2016. 105 p. Available at: <https://www.ibge.gov.br/estatisticas/multidominio/ciencia-tecnologia-e-inovacao/9141-pesquisa-de-inovacao.html?edicao=9142&t=destaques>. Access in: 17 jun. 2017.

ILLIES, Christian; MEIJERS, Anthonie. Artefacts without agency. **The Monist**, v. 92, n. 3, p. 420-440, 2009.

JAMALI, Dima; YIANNI, Mary; ABDALLAH, Hanin. Strategic partnerships, social capital and innovation: accounting for social alliance innovation. **Business Ethics: A European Review**, v. 20, n. 4, p. 375-391, 2011.

JEPPESEN, L. B.; LAKHANI, K. R. Marginality and problem- solving effectiveness in broadcast search. **Organization Science,** v.21, n.5, p. 1016–33, 2010.

JIANG, Wei; MAVONDO, Felix Tinoziva; MATANDA, Margaret Jekanyika. Integrative capability for successful partnering: a critical dynamic capability. **Management Decision**, v. 53, n. 6, p. 1184-1202, 2015.

KAZADI, Kande; LIEVENS, Annouk; MAHR, Dominik. Stakeholder co-creation during the innovation process: Identifying capabilities for knowledge creation among multiple stakeholders. **Journal of business research**, v. 69, n. 2, p. 525-540, 2016.

KHANAGHA, Saeed; VOLBERDA, Henk; OSHRI, Ilan. Customer co-creation and exploration of emerging technologies: the mediating role of managerial attention and initiatives. **Long Range Planning**, v. 50, n. 2, p. 221-242, 2017.

KEEYS, Lynn A.; HUEMANN, Martina. Project benefits co-creation: Shaping sustainable development benefits. **International Journal of Project Management**, v. 35, n. 6, p. 1196-1212, 2017.

KIEFER, H."Birth Control Essure Pulled From Market Prior to Release of Netflix Doc The Bleeding Edge". **Vulture**. 2018. Access in: 15 november 2019.

KIRON, David et al. The benefits of sustainability-driven innovation. **MIT Sloan Management Review**, v. 54, n. 2, p. 69, 2013.

KLEINSCHMIDT, Elko J.; COOPER, Robert G. The impact of product innovativeness on performance. **Journal of Product Innovation Management: An International Publication Of The Product Development & Management Association**, v. 8, n. 4, p. 240-251, 1991.

KRETZER, Jucélio. Sistemas de inovação: as contribuições das abordagens nacionais e regionais ou locais. **Ensaios FEE**, v. 30, n. 2, 2010.

KUZMA, Jennifer; ROBERTS, Pat. Cataloguing the barriers facing RRI in innovation pathways: a response to the dilemma of societal alignment. **Journal of Responsible Innovation**, v. 5, n. 3, p. 338-346, 2018.

LAERDAL. **Laerdal Report on Sustainability.** Stavanger: Laerdal Global Health, 2016. 32 p.

LAERDAL MEDICAL SERVICES SOLUTION. **Conceptualize**. Laerdal Development Process: Youtube, 2018. (3 min 15s). Available in: https://www.youtube.com/watch?v=qpnrHLMvOr0&list=PLneKGZujojT3zn3YiUfgpMY6Vk0QHSMmw&index=4 Access in: 20 may 2019.

LAERDAL MEDICAL SERVICES SOLUTION. **Deliver**. Laerdal Development Process: Youtube, 2018. (2 min 26s). Available in: https://www.youtube.com/watch?v=Uss5ZHe7NwU&list=PLneKGZujojT3zn3YiUfgpMY6Vk0QHSMmw&index=6 Access in: 20 may 2019.

LAERDAL MEDICAL SERVICES SOLUTION. **Develop**. Laerdal Development Process: Youtube, 2018. (1 min 56s). Available in: https://www.youtube.com/watch?v=onLZ6gMHpMc&list=PLneKGZujojT3zn3YiUfgpMY6Vk0QHSMmw&index=5 Access in: 20 may 2019.

LAERDAL MEDICAL SERVICES SOLUTION. **Duality**. Laerdal Development Process: Youtube, 2018. (1 min 14s). Available in: https://www.youtube.com/watch?v=WAyazEot4PM&list=PLneKGZujojT3zn3YiUfgpMY6Vk0QHSMmw&index=7 Access in: 20 may 2019.

LAERDAL MEDICAL SERVICES SOLUTION. **Explore**. Laerdal Development Process: Youtube, 2018. (2 min 33s). Available in: https://www.youtube.com/watch?v=MtCxbQkSfn0&list=PLneKGZujojT3zn3YiUfgpMY6Vk0QHSMmw&index=3 Access in: 30 apr. 2019.

LAERDAL MEDICAL SERVICES SOLUTION. **Implement**. Laerdal Development Process: Youtube, 2018. (1 min 40s). Available in: https://www.youtube.com/watch?v=sRwBKScBUoI&list=PLneKGZujojT3zn3YiUfgpMY6Vk0QHSMmw&index=8 Access in: 20 may 2019.

LAERDAL MEDICAL SERVICES SOLUTION. **Intro Ingrid**. Laerdal Development Process: Youtube, 2018. (1 min 23s). Available in: https://www.youtube.com/watch?v=v8JELyJvOe8&list=PLneKGZujojT3zn3YiUfgpMY6Vk0QHSMmw&index=1. Access in: 24 apr. 2019.

LAERDAL MEDICLA SERVICES SOLUTION. **Código de Conduta [2019?]** Stavanger, 2019. Institutional document - internal use.

LAERDAL MEDICLA SERVICES SOLUTION. **Laerdal Development Process 00044432 Rev D.[2019?]** Stavanger, 2019. Institutional document - internal use.

LAMPIKOSKI, Tommi et al. Green innovation games: Value-creation strategies for corporate sustainability. **California Management Review**, v. 57, n. 1, p. 88-116, 2014.

LANGLEY, Ann. Strategies for theorizing from process data. **Academy of Management review**, v. 24, n. 4, p. 691-710, 1999.

LAURSEN, Keld; SALTER, Ammon. Open for innovation: the role of openness in explaining innovation performance among UK manufacturing firms. **Strategic management journal**, v. 27, n. 2, p. 131-150, 2006.

LAWSON, Benn; SAMSON, Danny. Developing innovation capability in organisations: a dynamic capabilities approach. **International journal of innovation management**, v. 5, n. 03, p. 377-400, 2001.

LEONARD-BARTON, Dorothy. Core capabilities and core rigidities: A paradox in managing new product development. **Strategic management journal**, v. 13, n. S1, p. 111-125, 1992.

LETTICE, Fiona; PAREKH, Menka. The social innovation process: themes, challenges and implications for practice. **International Journal of Technology Management**, v. 51, n. 1, p. 139-158, 2010.

LIAO, Jianwen; KICKUL, Jill R.; MA, Hao. Organizational dynamic capability and innovation: an empirical examination of internet firms. **Journal of small business management**, v. 47, n. 3, p. 263-286, 2009.

LIGARDO-HERRERA, Ivan et al. Addressing Climate Change in Responsible Research and Innovation: Recommendations for Its Operationalization. **Sustainability**, v. 10, n. 6, p. 1-20, 2018.

LIN, Haifen; SU, Jingqin. A case study on adoptive management innovation in China. **Journal of Organizational Change Management**, v. 27, n. 1, p. 83-114, 2014.

LIN, Hai-Fen; SU, Jing-Qin; HIGGINS, Angela. How dynamic capabilities affect adoption of management innovations. **Journal of Business Research**, v. 69, n. 2, p. 862-876, 2016.

LIN, Ru-Jen, et al. Turning Knowledge Management into Innovation in the High-tech Industry. **Industrial Management and Data Systems**, vol. 112, no. 1, 2012, pp. 42–63.

LINDEN, Ane Isabel; BITENCOURT, Claudia; NETO, Hugo Fridolino Muller. Contribution of knowing in practice to dynamic capabilities. **The Learning Organization**, 2019.

LINDGREEN, Adam; WYNSTRA, Finn. Value in business markets: What do we know? Where are we going?. **Industrial marketing management**, v. 34, n. 7, p. 732-748, 2005.

LIS, Andrzey; SUDOLSKA, Agata. Absorptive capacity and its role for the company growth and competitive advantage: the case of Frauenthal Automotive Toruń company. **Journal of Entrepreneurship, Management and Innovation**, v. 11, n. 4, p. 63-91, 2015.

LORENZONI, Gianni; LIPPARINI, Andrea. The leveraging of interfirm relationships as a distinctive organizational capability: a longitudinal study. **Strategic Management Journal**, v. 20, n. 4, p. 317-338, 1999.

LUBBERINK, Rob et al. Lessons for responsible innovation in the business context: A systematic literature review of responsible, social and sustainable innovation practices. **Sustainability**, v. 9, n. 5, p. 721, 2017.

MAHLOUJI, Hossein; ANARAKI, Nahid Kalbasi. Corporate social responsibility towards social responsible innovation: a dynamic capability approach. **International Review of Business Research Papers**, v. 5, n. 6, p. 185-194, 2009.

MAHONEY, James. Path dependence in historical sociology. **Theory and society**, v. 29, n. 4, p. 507-548, 2000.

MARTÍN-DE CASTRO, Gregorio. Knowledge management and innovation in knowledge-based and high-tech industrial markets: The role of openness and absorptive capacity. **Industrial Marketing Management**, v. 47, p. 143-146, 2015.

MAVROEIDIS, Vasileios; TARNAWSKA, Katarzyna. Toward a New Innovation Management Standard. Incorporation of the Knowledge Triangle Concept and Quadruple Innovation Helix Model into Innovation Management Standard. **Journal of the Knowledge Economy**, v. 8, n. 2, p. 653-671, 2017.

MAY, Brian. Bohemian Rhapsody. Direção: Bryan Singer. Intérpretes: Rami Malek, Ben Hardy, Gwilym Lee, Joseph Mazzello, Allen Leech e Lucy Boynton. [S.l]: 20th Century Fox, 2018. (134 min), son., color.

MEIRELLES, Dimária Silva; CAMARGO, Álvaro Antônio Bueno. Capacidades dinâmicas: O que são e como identificá-las?. **Revista de Administração Contemporânea**, v. 18, n. SPE, p. 41-64, 2014.

MEJLGAARD, Niels; BLOCH, Carter. Science in society in Europe. **Science and Public Policy**, v. 39, n. 6, p. 695-700, 2012.

MOEEN, Mahka. Entry into nascent industries: disentangling a firm's capability portfolio at the time of investment versus market entry. **Strategic Management Journal**, v. 38, n. 10, p. 1986-2004, 2017.

MOL, Michael J.; BIRKINSHAW, Julian. The sources of management innovation: When firms introduce new management practices. **Journal of business research**, v. 62, n. 12, p. 1269-1280, 2009.

MOORE, James F. Predators and prey: a new ecology of competition. **Harvard business review**, v. 71, n. 3, p. 75-86, 1993.

MORATIS, Lars. Signalling Responsibility? Applying Signalling Theory to the ISO 26000 Standard for Social Responsibility. **Sustainability**, v. 10, n. 11, p. 4172, 2018.

MULLOTH, B.; WILLIAMS, M. D. University of Virginia health system's MyTable: supporting patient care and research. In: Tatiana Iakovleva; Elin M. Oftedal; John Bessant. (Org.). **Responsible Innovation in Digital Health Empowering the Patient.** 1ed.: Edward Elgar Publishing, 2019, v, p. 1-288.

NELSON, Richard R.; WINTER, Sidney G. Evolutionary theorizing in economics. **Journal of Economic Perspectives**, v. 16, n. 2, p. 23-46, 2002.

NELSON, Richard R.; WINTER, Sidney G. The Schumpeterian tradeoff revisited. **The American Economic Review**, v. 72, n. 1, p. 114-132, 1982.

NICKERSON, J.A.; ZENGER, T.R. 'A knowledge-based theory of the firm – the problem- solving perspective', **Organization Science**. v. 15, n. 6, pp.617–632, 2004.

NUDURUPATI, Sai Sudhakar et al. Strategic sourcing with multi-stakeholders through value co-creation: An evidence from global health care company. **International Journal of Production Economics**, v. 166, p. 248-257, 2015.

NUNES, Ana Raquel; LEE, Kelley; O'RIORDAN, Tim. The importance of an integrating framework for achieving the Sustainable Development Goals: the example of health and well-being. **BMJ global health**, v. 1, n. 3, p. e000068, 2016.

OCDE Gabinete Estatístico. Manual de Oslo Diretrizes para coleta e interpretação de dados sobre inovação. **Traduzido para FINEP**, v. 3.

O'CONNOR, Gina Colarelli. Market learning and radical innovation: A cross case comparison of eight radical innovation projects. **Journal of Product Innovation Management: An International Publication Of The Product Development & Management Association**, v. 15, n. 2, p. 151-166, 1998.

OFTEDAL, Elin Merethe; FOSS, Lene; IAKOVLEVA, Tatiana. Responsible for Responsibility? A Study of Digital E-health Startups. **Sustainability**, v. 11, n. 19, p. 5433, 2019.

OPERAÇÃO ENGANOSA. Director: Kirby Dick. Actors: Angie Firmalino, Rita F. Redberg, Robert Bridges, Stagehen Tower. [S.l]. Netflix original documentary, 2018. (100 min), son., color.

ORNETZEDER, Michael. Old technology and social innovations. Inside the Austrian success story on solar water heaters. **Technology Analysis & Strategic Management**, v. 13, n. 1, p. 105-115, 2001.

OSTERWALDER, Alexander; PIGNEUR, Yves. **Business model generation: a handbook for visionaries, game changers, and challengers**. John Wiley & Sons, 2010.

OWEN, Richard et al. A framework for responsible innovation. **Responsible innovation: managing the responsible emergence of science and innovation in society**, v. 31, p. 27-50, 2013.

OWEN, Richard et al. Beyond regulation: risk pricing and responsible innovation. 2009.

OWEN, Richard; GOLDBERG, Nicola. Responsible innovation: a pilot study with the UK Engineering and Physical Sciences Research Council. **Risk analysis: An international journal**, v. 30, n. 11, p. 1699-1707, 2010.

OWEN, Richard; MACNAGHTEN, Phil; STILGOE, Jack. Responsible research and innovation: From science in society to science for society, with society. **Science and public policy**, v. 39, n. 6, p. 751-760, 2012.

PANDZA, Krsto; ELLWOOD, Paul. Strategic and ethical foundations for responsible innovation. **Research Policy**, v. 42, n. 5, p. 1112-1125, 2013.

PARKHILL, Karen et al. Deliberation and responsible innovation: a geoengineering case study. **Responsible innovation**, p. 219-240, 2013.

PAUTLER, Michelle; BRENNER, Sara. Nanomedicine: promises and challenges for the future of public health. **International journal of nanomedicine**, v. 5, p. 803, 2010.

PAVIE, Xavier; CARTHY, Daphne. Leveraging uncertainty: a practical approach to the integration of responsible innovation through design thinking. **Procedia-Social and Behavioral Sciences**, v. 213, p. 1040-1049, 2015.

PAYNE, Adrian F.; STORBACKA, Kaj; FROW, Pennie. Managing the co-creation of value. **Journal of the academy of marketing science**, v. 36, n. 1, p. 83-96, 2008.

PELAEZ, V. et al. Fundamentos e Microfundamentos da Capacidade Dinâmica da Firma. **RBI- Revista Brasileira de Inovação**. v. 7, n. 1, jan/jun., 2008.

PELLÉ, Sophie; REBER, Bernard. Responsible Innovation Models Report. 2014.

PENROSE, E. A Teoria do Crescimento da Firma. (2006) Campinas, SP: Editora da UNICAMP. (Edição original: 1959)

PETERAF, Margaret; DI STEFANO, Giada; VERONA, Gianmario. The elephant in the room of dynamic capabilities: Bringing two diverging conversations together. **Strategic management journal**, v. 34, n. 12, p. 1389-1410, 2013.

PISANO, Gary P. **The development factory: unlocking the potential of process innovation**. Harvard Business Press, 1997.

POINTER TELEGRAPH. In: Siemens Site, [2019?]. Available in: https://assets.new.siemens.com/siemens/assets/api/uuid:38754e5ae3933ce8038e2d78293aa98317335cea/version:1506341881/094-shi-siemens-at-170-years-the-siemens-narrative-2017-e.pdf Access in: 18 set 2019.

POLITIS, Yurgos et al. People with disabilities leading the design of serious games and virtual worlds. **International Journal of Serious Games**, v. 4, n. 2, p. 63-73, 2017.

PORTER, Michael E. Competitive advantage: Creating and sustaining superior performance. 1985.

PORTER, Michael E. The contributions of industrial organization to strategic management. **Academy of management review**, v. 6, n. 4, 609-620, 1981.

PORTER, Michael E.; KAPLAN, Robert S.; FRIGO, Mark L. Managing healthcare costs and value. **Strategic Finance**, v. 98, n. 7, p. 24, 2017.

PORTER, Michael E.; LEE, Thomas H. From volume to value in health care: the work begins. **Jama**, v. 316, n. 10, p. 1047-1048, 2016.

PRASAD, S. **Improving access to high- quality care.** 19/03/2018. Available at: <https://www.healthcare.siemens.com.br/news/mso-challenges-adressed-in-india.html>. Access in: 02 may 2018.

PRIEM, Richard L.; BUTLER, John E. Is the resource-based “view” a useful perspective for strategic management research?. **Academy of management review**, v. 26, n. 1, p. 22-40, 2001.

PUJARI, Devashish. Eco-innovation and new product development: understanding the influences on market performance. **Technovation**, v. 26, n. 1, p. 76-85, 2006.

PYKA, Andreas; SCHARNHORST, Andrea (Ed.). **Innovation networks: new approaches in modelling and analyzing**, **understanding complex systems**. Springer Science & Business Media, 2009.

RAMASWAMY, Venkat; GOUILLART, Francis. Building the co-creative enterprise. **Harvard business review**, v. 88, n. 10, p. 100-109, 2010.

RESUSCI- ANNE QCPR. In: Institutional Laerdal Site, [2019?]. Available in: https://www.simulife.com.br/produto/58416/manequim-de-rcp-avancado-resusci-anne-qcpr. Access in: 23 apr. 2019.

RESUSCI-ANNE. In: EMS Museum, [2019?]. Available in: https://archive.fo/20141227115243/http://www.emsmuseum.org/virtual-museum/Equipment/articles/399766-Annie-Annie-Are-You-OK-Resusci-Anne. Access in: 24 apr. 2019

RESUSCITATION- TRAINING. In: Institutional Laerdal Site, [2019?]. Available in: https://www.laerdal.com/br/products/simulation-training/resuscitation-training/resusci-anne-qcpr-previous-versions/. Access in: 23 apr. 2019.

REZENDE DA COSTA, Priscila et al. Relational capability and strategic alliance portfolio configuration: A study of Brazilian technology firms. **International Journal of Emerging Markets**, v. 13, n. 5, p. 1026-1049, 2018.

RIBEIRO, Barbara et al. Introducing the dilemma of societal alignment for inclusive and responsible research and innovation. **Journal of responsible innovation**, v. 5, n. 3, p. 316-331, 2018.

RICHARDSON, Roberto Jarry et al. Social research: methods and techniques. **São Paulo: Atlas**, 1999.

ROBINSON, Douglas KR. Co-evolutionary scenarios: An application to prospecting futures of the responsible development of nanotechnology. **Technological Forecasting and Social Change**, v. 76, n. 9, p. 1222-1239, 2009.

RODRIGUEZ, Miguel A.; RICART, Joan E.; SANCHEZ, Pablo. Sustainable development and the sustainability of competitive advantage: A dynamic and sustainable view of the firm. **Creativity and innovation management**, v. 11, n. 3, p. 135-146, 2002.

ROWE, Gene; FREWER, Lynn J. A typology of public engagement mechanisms. **Science, Technology, & Human Values**, v. 30, n. 2, p. 251-290, 2005.

RUSSO SPENA, Tiziana; DE CHIARA, Alessandra. CSR, innovation strategy and supply chain management: toward an integrated perspective. **International Journal of Technology Management**, v. 58, n. 1/2, p. 83-108, 2012.

SAREN, Michael A. A classification and review of models of the intra-firm innovation process. **R&d Management**, v. 14, n. 1, p. 11-24, 1984.

SCHAARSCHMIDT, Mario; KILIAN, Thomas. Impediments to customer integration into the innovation process: A case study in the telecommunications industry. **European Management Journal**, v. 32, n. 2, p. 350-361, 2014.

SCHERER, Andreas Georg; PALAZZO, Guido; BAUMANN, Dorothée. Global rules and private actors: Toward a new role of the transnational corporation in global governance. **Business Ethics Quarterly**, v. 16, n. 4, p. 505-532, 2006.

SCHOLTEN, V. E.; VAN DER DUIN, P. A. Responsible innovation among academic spin-offs: how responsible practices help developing absorptive capacity. **Journal on Chain and Network Science**, v. 15, n. 2, p. 165-179, 2015.

SCHON, Donald A. **Technology and change: The new Heraclitus**. Seymour Lawrence, 1967.

SCHRAMM, Wilbur. Notes on Case Studies of Instructional Media Projects. **Eric**, California, v. 145, n. 92, p.01-43, dez. 1971.

SCHROEDER, Doris et al. Responsible, inclusive innovation and the nano-divide. **NanoEthics**, v. 10, n. 2, p. 177-188, 2016.

SCHUMACHER, E. Günter; WASIELESKI, David M. Institutionalizing ethical innovation in organizations: An integrated causal model of moral innovation decision processes. **Journal of Business Ethics**, v. 113, n. 1, p. 15-37, 2013.

SCHUMPETER, Joseph A. The theory of economic development: An inquiry into profits, capital, credit, interest, and the business cycle (1912/1934). **Transaction Publishers.–1982.–January**, v. 1, p. 244, 1982.

SHORTALL, O. K.; RAMAN, Sujatha; MILLAR, Kate. Are plants the new oil? Responsible innovation, biorefining and multipurpose agriculture. **Energy Policy**, v. 86, p. 360-368, 2015.

SIEMENS COMPANY PRESENTATION. In: Siemens Site, [2019?]. Available in: https://www.siemens.com/press/pool/de/homepage/Siemens-company-presentation.pdf. Access in: 17 set. 2019.

SIEMENS' HISTORY. In: Siemens Site, [2019?]. Available in: https://assets.new.siemens.com/siemens/assets/api/uuid:38754e5ae3933ce8038e2d78293aa98317335cea/version:1506341881/094-shi-siemens-at-170-years-the-siemens-narrative-2017-e.pdf. Access in: 19 set 2019.

SIEMENS. The Intelligent Dose Efficiency Algorithm – IDEAL, [2020?]. Available in: https://www.siemens-healthineers.com/en-us/medical-imaging/low-dose/low-dose-information-by-clinical-specialty/approaches-to-dose-reduction-in-surgery / dose-reduction Access in: 05 jan. 2020.

SILVA, Hudson Pacifico et al. Introducing responsible innovation in health: a policy-oriented framework. **Health research policy and systems**, v. 16, n. 1, p. 90, 2018.

SILVA, Luciana Maines da et al. The Role of Stakeholders in the Context of Responsible Innovation: A Meta-Synthesis. **Sustainability**, v. 11, n. 6, p. 1766, 2019.

SILVA, Luciana Maines da. Needles in a Haystack: Identification of Microfoundations of Dynamic Capabilities for the Inclusion of External Stakeholders in the Innovation Process. **XXII SEMEAD - Seminários em Administração**. Universidade de São Paulo. Nov. 2019.

SIMMEL, G., **Individuality and social forms**. Chicago: University of Chicago Press, 1971.

SIRMON, David G. et al. Resource orchestration to create competitive advantage: Breadth, depth, and life cycle effects. **Journal of management**, v. 37, n. 5, p. 1390-1412, 2011.

Sistemas de Gerenciamento de Qualidade (SGS). ISO 9001 - **CERTIFICAÇÃO - SISTEMAS DE GESTÃO DA QUALIDADE.** SÃO PAULO, 2015. Available in**:** https://www.sgsgroup.com.br/pt-br/industrial-manufacturing/quality-health-safety-and-environment/quality/quality-management-systems/iso-9001-certification-quality-management-systems?gclid=CjwKCAiAjMHwBRAVEiwAzdLWGIBbWXJerqdDZjJrgL-MRoiNkJjmKMKPiTFR1OqGnmPLPUgCxzQRlhoClnAQAvD_BwE. Access in: 25 set 2019.

SLATER, Stanley F. Developing a customer value-based theory of the firm. **Journal of the Academy of marketing Science**, v. 25, n. 2, p. 162, 1997.

SONG, X. Michael; MONTOYA-WEISS, Mitzi M. Critical development activities for really new versus incremental products. **Journal of Product Innovation Management: An International Publication of the Product Development & Management Association**, v. 15, n. 2, p. 124-135, 1998.

SPINELLO, Richard A. The future of intellectual property. **Ethics and information technology**, v. 5, n. 1, p. 1-16, 2003.

STAHL, Bernd Carsten. Responsible research and innovation: The role of privacy in an emerging framework. **Science and Public Policy**, v. 40, n. 6, p. 708-716, 2013.

STEEN, Marc; BUIJS, Jan; WILLIAMS, Doug. The role of scenarios and demonstrators in promoting shared understanding in innovation projects. **International Journal of Innovation and Technology Management**, v. 11, n. 01, p. 1440001, 2014.

STILGOE, Jack; OWEN, Richard; MACNAGHTEN, Phil. Developing a framework for responsible innovation. **Research Policy**, v. 42, n. 9, p. 1568-1580, 2013.

STIRLING, Andy. “Opening up” and “closing down” power, participation, and pluralism in the social appraisal of technology. **Science, Technology, & Human Values**, v. 33, n. 2, p. 262-294, 2008.

STRAUSS, A.; CORBIN, J.. **Pesquisa Qualitativa**: técnicas e procedimentos para o desenvolvimento de teoria fundamentada. Porto Alegre: Artmed, 2008. 288 p

STUERMER, Matthias; SPAETH, Sebastian; VON KROGH, Georg. Extending private-collective innovation: a case study. **R&D Management**, v. 39, n. 2, p. 170-191, 2009.

SUN. [2019?]. Available at: <https://laerdal.com/br/learn/sun/>. Access in: 22 mar. 2019.

SUTCLIFFE, H. A report on responsible research & innovation. Prepared for DG Research and Innovation. **European Commission**. 2011. Available at: http://ec.europa.eu/research/science-society/ document_library/pdf_06/rri-report-hilary-sutcliffe_en.pdf. Access in: 28 oct. 2019.

SYKES, Kathy; MACNAGHTEN, Phil. Responsible innovation–opening up dialog and debate. **Responsible innovation: Managing the responsible emergence of science and innovation in society**, p. 85-107, 2013.

TADDEO, Mariarosaria. On the risks of relying on analogies to understand cyber conflicts. **Minds and Machines**, v. 26, n. 4, p. 317-321, 2016.

TE KULVE, Haico; RIP, Arie. Constructing productive engagement: Pre-engagement tools for emerging technologies. **Science and Engineering Ethics**, v. 17, n. 4, p. 699-714, 2011.

TEECE, David J. et al. Firm organization, industrial structure, and technological innovation'. 1996.

TEECE, David J. Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance. **Strategic management journal**, v. 28, n. 13, p. 1319-1350, 2007.

TEECE, David J.; PISANO, Gary; SHUEN, Amy. Dynamic capabilities and strategic management. **Strategic management journal**, v. 18, n. 7, p. 509-533, 1997.

TEECE, David; LEIH, Sohvi. Uncertainty, innovation, and dynamic capabilities: An introduction. **California Management Review**, v. 58, n. 4, p. 5-12, 2016.

THAPA, Raj, IAKOVLEVA, Tatiana and FOSS, Lene. Responsible research and innovation: A systematic review of conceptual papers and future research agenda. **XXIX ISPIM Innovation Conference**, Stockholm, Sweden, 17-20 June 2018.Innovation the name of the game, ISBN 978-952-335-18-6, (Eds) I Bitran, S. Konn, K.R.E. Huizingh, O. Kokshagina, M. Torkelli, M, Tunnhamarm 2018.

THOMAS, E.; SILVA, L. M.. Patient-initiated innovation - Evidence and research agenda. In: Tatiana Iakovleva; Elin M. Oftedal; John Bessant. (Org.). **Responsible Innovation in Digital Health Empowering the Patient.** 1ed.: Edward Elgar Publishing, 2019, v, p. 1-288.

THOMAS, James B.; CLARK, Shawn M.; GIOIA, Dennis A. Strategic sensemaking and organizational performance: Linkages among scanning, interpretation, action, and outcomes. **Academy of Management journal**, v. 36, n. 2, p. 239-270, 1993.

TIDD, Joe. A review of innovation models. **Imperial College London**, v. 16, 2006.

TIDD, Joe. Innovation management in context: environment, organization and performance. **International journal of management reviews**, v. 3, n. 3, p. 169-183, 2001.

TIDD, Joe; BESSANT, John. **Strategic innovation management**. John Wiley & Sons, 2014.

TJOMSLAND, Nina. **Saving more lives – together: the vision for 2020.** Stavanger, Norway: Laerdal., 2018.

TONDOLO, Vilmar Antonio Gonçalves; BITENCOURT, Cláudia Cristina. Compreendendo as capacidades dinâmicas a partir de seus antecedentes, processos e resultados. **Brazilian Business Review**, v. 11, n. 5, p. 124, 2014.

TOUR 360. In: Siemens Site, [2019?]. Available in: https://health.siemens.com/AX/tour/360tour/Berlin/index.html. Access in: 22 set. 2019.

TREADWELL, Marsha J. et al. Stakeholder Perspectives on Public Health Genomics Applications for Sickle Cell Disease: A Methodology for a Human Heredity and Health in Africa (H3Africa) Qualitative Research Study. **OMICS: A Journal of Integrative Biology**, v. 21, n. 6, p. 323-332, 2017.

TROTT, Paul. **Innovation management and new product development**. Pearson education, 2012. 5ª edição.

TSAI, Kuen-Hung; LIAO, Yi-Chuan; HSU, Teresa Tiaojung. Does the use of knowledge integration mechanisms enhance product innovativeness?. **Industrial Marketing Management**, v. 46, p. 214-223, 2015.

UNITED NATIONS. transforming our world: The 2030 agenda for sustainable development. **Resolution adopted by the General Assembly**, 2015.

VAN DE KERKHOF, Marleen. Making a difference: On the constraints of consensus building and the relevance of deliberation in stakeholder dialogues. **Policy Sciences**, v. 39, n. 3, p. 279-299, 2006.

VAN DE POEL, Ibo et al. Company Strategies for Responsible Research and Innovation (RRI): A Conceptual Model. **Sustainability**, v. 9, n. 11, p. 2045, 2017.

VAN OUDHEUSDEN, Michiel. Where are the politics in responsible innovation? European governance, technology assessments, and beyond. **Journal of Responsible Innovation**, v. 1, n. 1, p. 67-86, 2014.

VAQUERO MARTÍN, María; REINHARDT, Ronny; GURTNER, Sebastian. Stakeholder integration in new product development: a systematic analysis of drivers and firm capabilities. **R&D Management**, v. 46, n. S3, p. 1095-1112, 2016.

VERONA, Gianmario. A Resource-Based View of Product Development. **Academy of Management Review**, vol. 24, no. 1, pp. 132–142, 1999.

VON SCHOMBERG, Rene. A vision of responsible research and innovation. **Responsible innovation: Managing the responsible emergence of science and innovation in society**, p. 51-74, 2013.

VON SCHOMBERG, Rene. The quest for the “right” impacts of science and technology. An outlook towards a framework for responsible research and innovation. **Les nanotechnologies: vers un changement d’échelle éthique?**, p. 269, 2012.

VON WELTZIEN HOIVIK, Heidi. Embedding CSR as a learning and knowledge creating process: The case for SMEs in Norway. **Journal of Management Development**, v. 30, n. 10, p. 1067-1084, 2011.

WATSON, I. **IBM Watson on Health**: IBM 2017.

WAGNER, Marcus. The links of sustainable competitiveness and innovation with openness and user integration: an empirical analysis. **International Journal of Innovation and Sustainable Development**, v. 4, n. 4, p. 314-329, 2009.

WEBER, M., **The methodology of the social sciences**. New York: Free Press, 1949.

WEBSTER JR, Frederick E. The changing role of marketing in the corporation. **Journal of marketing**, v. 56, n. 4, p. 1-17, 1992.

WELCOMER, Stagehanie A. et al. Constructing a web: Effects of power and social responsiveness on firm-stakeholder relationships. **Business & Society**, v. 42, n. 1, p. 43-82, 2003.

WERNERFELT, Birger. A resource-based view of the firm. **Strategic management journal**, v. 5, n. 2, p. 171-180, 1984.

WEST, Joel; BOGERS, Marcel. Leveraging external sources of innovation: a review of research on open innovation. **Journal of Product Innovation Management**, v. 31, n. 4, p. 814-831, 2014.

WHAT IS THE FRAMEWORK FOR INNOVATION? Design Council´s evolved Double Diamond.[2019??] https://www.designcouncil.org.uk/news-opinion/what-framework-innovation-design-councils-evolved-double-diamond. Access in: 28 dez. 2019.

WHEELER, David; COLBERT, Barry; FREEMAN, R. Edward. Focusing on value: Reconciling corporate social responsibility, sustainability and a stakeholder approach in a network world. **Journal of general management**, v. 28, n. 3, p. 1-28, 2003.

WHO, World Health Organization. **HEALTH SYSTEMS FINANCING:** The path to universal coverage. Geneve: Who Press, 2010. 20 p. Available at <https://www.who.int/whr/2010/10_summary_en.pdf>. Access in: 20 jun. 2017.

WICKSON, Fern; CAREW, Anna L. Quality criteria and indicators for responsible research and innovation: Learning from transdisciplinarity. **Journal of Responsible Innovation**, v. 1, n. 3, p. 254-273, 2014.

WICKSON, Fern; FORSBERG, Ellen-Marie. Standardising responsibility? The significance of interstitial spaces. **Science and Engineering Ethics**, v. 21, n. 5, p. 1159-1180, 2015.

WILLIAMSON, Oliver E. Strategy research: governance and competence perspectives. **Strategic management journal**, v. 20, n. 12, p. 1087-1108, 1999.

WINTER, Sidney G. The satisficing principle in capability learning. **Strategic management journal**, v. 21, n. 10-11, p. 981-996, 2000.

WINTER, Sidney G. Understanding dynamic capabilities. **Strategic management journal**, v. 24, n. 10, p. 991-995, 2003.

WOODRUFF, Robert B. Customer value: the next source for competitive advantage. **Journal of the academy of marketing science**, v. 25, n. 2, p. 139, 1997.

YENICIOGLU, Baskin; SUERDEM, Ahmet. Participatory new product development–A framework for deliberately collaborative and continuous innovation design. **Procedia-Social and Behavioral Sciences**, v. 195, p. 1443-1452, 2015.

YIN, Robert et al. Case study research: design and methods. **Sage Publications, Inc ISBN 0**, v. 761, n. 92553, p. 8, 2003.

ZAHRA, Shaker A.; GEORGE, Gerard. Absorptive capacity: A review, reconceptualization, and extension. **Academy of management review**, v. 27, n. 2, p. 185-203, 2002.

ZAHRA, Shaker A.; IRELAND, R. Duane; HITT, Michael A. International expansion by new venture firms: International diversity, mode of market entry, technological learning, and performance. **Academy of Management journal**, v. 43, n. 5, p. 925-950, 2000.

ZOLLO, Maurizio; WINTER, Sidney G. Deliberate learning and the evolution of dynamic capabilities. **Organization science**, v. 13, n. 3, p. 339-351, 2002.

APPENDIX A - COMPANY IDENTIFICATION QUESTIONNAIRE FOR CASE STUDY

This questionnaire seeks to identify the company (ies) that can serve as a case study for my doctoral thesis. The objective is to understand the influence of the participation of various actors (external to the company) in the process of developing digital products aimed at health. Your participation will help to identify a company that has this practice. There are six questions and it will take you only 2 minutes to answer.

Any person or group that influences or is influenced by the developed product is considered a participant. They can be internal to the organization (for example: partners, employees, board members) or external (for example: customers, users, suppliers).

For questions or suggestions, you can contact me at l_____@gmail.com or 51 99972xxxx.

Thank you!

Luciana Maines

1) Company size, by number of employees:

a) Up to 9 employees (Microenterprise)
b) From 10 to 49 employees (Small)
c) From 50 to 99 employees (medium size)
d) More than 100 employees (Large)

2) Company operating time:

a) Up to 2 years
b) Between 2 and 5 years
c) Over 5 years

3) Type of product developed by the company:

a) Robotic surgery
b) Telemedicine
c) Electronic Medical Records
d) Wearable health support technology
e) Connected medicine (internet of things)
f) Health education and information
g) Others (specify)

4) Participants in the product development process (check as many as needed):

a) Users (example: patients, family members, hospital staff)
b) Research ethics committees (example: hospital ethics council)
c) Research organizations (example: National Council for Scientific and Technological Development - CNPQ)
d) Individual researchers (example: master students, doctoral students)
e) Public agencies (example: Ministry of Health, Secretariat of Education
f) Educational organizations (example: universities, technical schools)
g) Legislators (example: Councilors, State and Federal Deputies)
h) Professional bodies (example: Professional Council, Professional Union)
i) Civil society (example: Non-governmental organization, community in general)
j) Other (specify)

5) Stage of product development that participants are involved in:

a) Idea generation
b) the development
c) Testing
d) Marketing

6) If you are interested in participating in the survey, please enter your details. They will only be used for contact and will not be disclosed.

the name

a) Company
b) City / Municipality

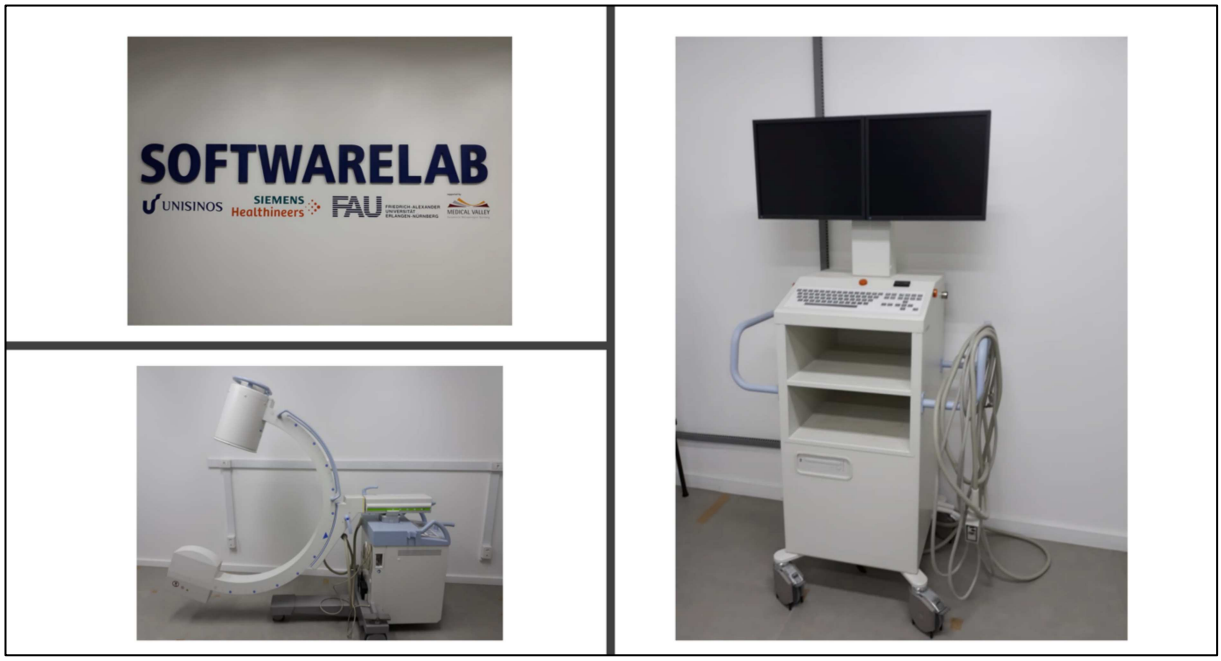
c) the state
d) Email address
e) Phone number

Note: Questions 1 to 5 had the following references:

1) Company size - SEBRAE base: https://m.sebrae.com.br/Sebrae/Portal%20Sebrae/UFs/SP/Pesquisa/MPE_conceito_empregados.pdf
2) Time of operation - http://www.brasil.gov.br/economia-e-emprego/2012/02/sobrevivencia-e-mortalidade
3) Type of product - Bessant (2017)
4) Actors - Stahl (2013)
5) Stages of participation - TIDD; BESSANT (2014)

APPENDIX B - PHOTOS OF THE PRODUCTS OF LAERDAL AND SIEMENS AT UNISINOS LABS

Research project carried out in partnership between Siemens, UNISINOS and FAU



Nursing Course Laboratory - Unisinos Porto Alegre