Rohit Sood

KEY DRIVING FACTORS IN OPEN INNOVATION-LED DIGITAL HEALTH INNOVATION ECOSYSTEM

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Abstract

Digital health is a multi-disciplinary domain using digital technologies in the health and wellness sector, with the ultimate goal of making healthcare precise and personalized. A revolution in healthcare is led by digital technology. The rise of the Open Innovation (OI) paradigm in the last decade has contributed to the development of inter-organizational collaborative innovation networks and ecosystems. Helsinki University Hospital (HUS) has fully integrated digital data and brainpower into a unique, forward-thinking innovation ecosystem called Clever Health Network (CHN). Fourteen world-class technology companies and world-leading healthcare professionals have joined hands to develop efficient and targeted patient care solutions by using health data.

This research aimed at studying key driving factors which might help organizations to innovate faster when working in a collaborative innovative ecosystem environment. The main research approach of this thesis is the case study. Primary data was collected using 8 in-depth semi-structured interviews of industry leaders with open-ended questions and participant observation. Secondary data and literature study supported the primary data. All collected data was analyzed using content analysis, grounded analysis, and computer-aided analysis.

The main findings of the study outline the five key driving factors that could play a significant role in the success of any innovation ecosystem. These success factors are i) new rules demand new skills, ii) trust and mobility, iii) winning by sharing not closing, iv) users and industry collaboration, and v) collaborative and co-creative culture. In conclusion, to accelerate the scalability and create new markets and services all involved stakeholders need to co-create the innovative solutions.

Keywords

Digital health, open innovation, Open Innovation 2.0, open innovation ecosystems, digital health innovation ecosystem.

CONTENTS

1 INTRODUCTION

Research background - Digital Health and Open Innovation: Digital health is a multi-disciplinary domain using digital technologies (such as information and communication) in the health & wellness sector with the ultimate goal of making healthcare precise and personalized (Best 2019). Different stakeholders with specialization in healthcare, engineering, social sciences, public health, health economics and data management are part of digital health (Ronquillo et al. 2020).

The broad scope of digital health includes four distinct categories: telehealth & telemedicine, remote patient monitoring (RPM), Health analytics, and smart home as a carer (Figure 1). Some of the leading technologies involved in digital health are mobile health (mHealth), AI, health information technology (IT), wearable and sensors, and personalized medicine.

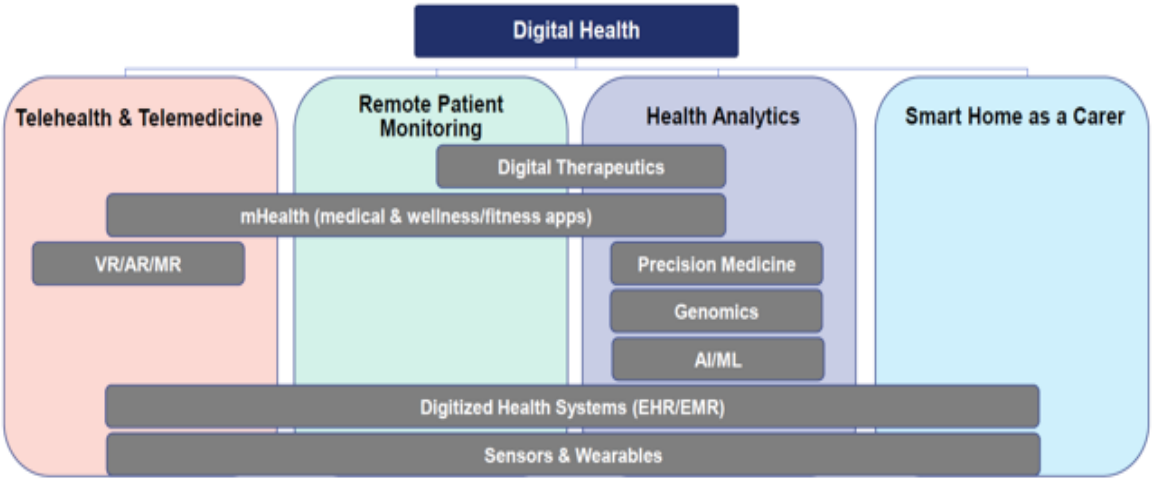

Figure 1. The scope of digital health (Mathur 2019)

With these technologies, consumers can make better-informed decisions about their health (European Society of Cardiology 2020). These technologies further provide novel options for facilitating prevention, intervention, early diagnosis, and management of chronic conditions (U.S. Food & Drug Administration 2020). According to medical tourism magazine (trends in digital healthcare revolution 2020) a revolution in healthcare is being led by digital technology. With digital

health tools, doctors can step in earlier to shorten the length of the disease. Digital tools give healthcare providers a more holistic view of patient health through access to data. It enables patients more control over their health. In 2030, digitalization will be common in our society and will bring healthcare from clinical centers into the everyday life of the citizen (Castañeda 2020, 85). The development of digital health ecosystems (comprising digital health platforms, health monitoring wearables and devices, mobile applications, and online services) will empower individuals to monitor against a norm, manage, track, and improve their health (Iyawaa et al. 2016, 244). It will open new markets of solutions and services directly targeted at healthy and patient individuals, and positively impact preventive healthcare practices.

Open innovation: Open innovation (OI) is a relatively new concept which has made a paradigm shift in how research and development (R&D) activities are conducted by the companies today (Chesbrough 2003a, 33-58; 2003b, 35-41; 2003c, 2006 and 2007, 22-28). Traditionally, companies have focused on internal R&D activities in order to be first on the market. However, nowadays open innovation networks (or ecosystems) enable different external actors in the value chain including suppliers, customers, and end-users, to collaboratively develop innovations that combine and meet the user needs more efficiently (Chesbrough & Bogers 2014). Advantages of OI have been confirmed and substantiated in many

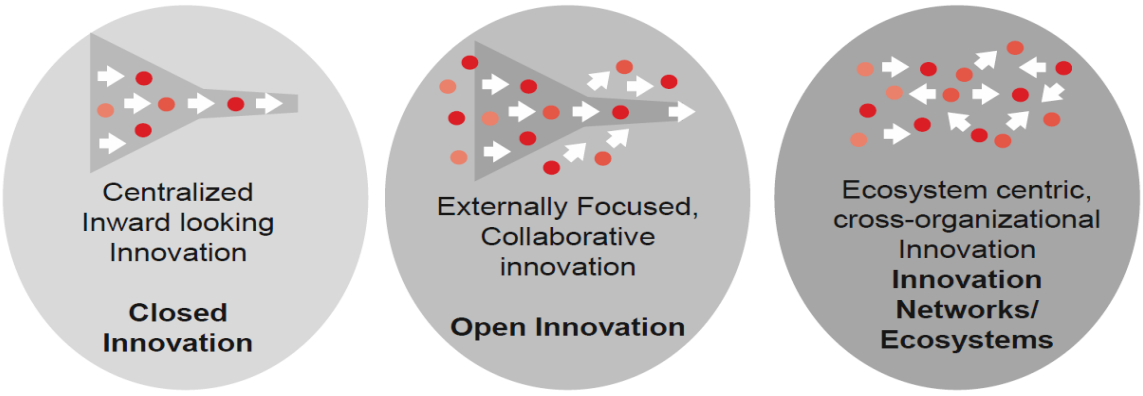

Figure 2. From closed innovation to ecosystem centric innovation (Curley & Salmelin 2013)

studies; however, researchers still suggest that organizations need to be aware of the challenges and complexities which arise from the involvement of external partners in innovation activities (Keskin & Diehl 2013, 50-60). In the past two decades, OI phenomenon has attracted great attention both from the academicians and users in the industry (Trott & Hartmann 2009, 715-736; Marques 2014, 196-203).

Open innovation 2.0: A few years ago, open innovation 2.0 (OI2.0) was introduced. OI2.0 has encouraged the development of an ecosystem approach. Ecosystem-centric, cross-organizational innovation involves both technical and societal aspects (Figure 2). Actors involved in OI2.0 ecosystems collaborate and innovate based on common purposes, aligned efforts, shared vision, and shared value co-creation (Curley & Salmelin 2013, 1-8).

Ideas to products – a long expensive journey: It has been shown that (Figure 3) from the conceptualization of an idea to commercialization (within an ecosystem framework in which several partners are involved) of a product/service can take minimum 8-10 years (CBIRC, 2020). High costs are associated with such a long-time frame, and if the process goes wrong, then the whole investment is at risk.

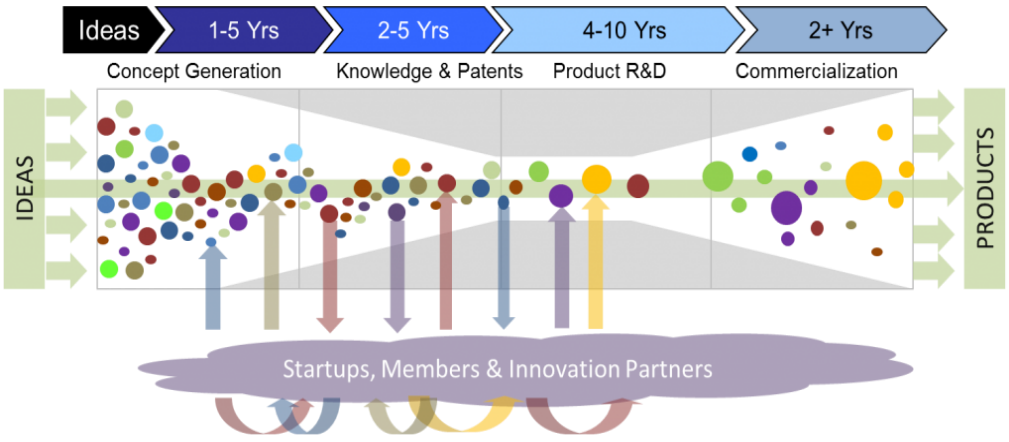

Figure 3. Time-line from ideas to commercialization Adapted from CBiRC's open innovation ecosystem (CBIRC, 2020)

Hence it is highly crucial to define key success factor as a metrics for the complete process - from idea generation to commercialization – in open innovation ecosystems. Different business models and innovation strategies play a central role in open innovation ecosystems as mechanisms establishing trustworthy collaboration between partners leading to successful commercial exploitation of the products/services (Chesbrough et al. 2014, 805). It is crucial to understand how innovation strategies, innovation partnerships, innovation in the value chain, business models and commercial exploitation can be aligned solving bigger problems with joint vision.

Research aim, objectives, and questions: The ever-rising costs of R&D and ever-increasing timeframe for products to reach the market, causing companies to be under constant pressure to innovate. Even though noticeable efforts and investments was made worldwide to encourage innovation ecosystems, it was seen that most of the attempts have either failed or the achieved final results are far less impactful than expected (Jackson 2011, 1-10; Durst et al. 2013, 111-131). The search for key success factors for continuous growth creates a need to understand better the role of collaborative innovation for organizations while working in an ecosystem environment. Along the same lines, this research work has been planned.

Aim of this work is to study key factors which might help organizations to innovate faster while working in a collaborative, innovative ecosystem. An innovative digital health ecosystem coordinated by HUS called Clever Health Network (CHN) has been studied for this purpose. The objective of this study to implement these driving factors in real-world so that organizations work together, innovate faster, and create business opportunities by providing profitable products and/or services in the market. The research question of this study is **–** how these factors can impact the success of collaboration while working in an ecosystem environment (where several players/partners are involved).

International aspect of this work: Ecosystems are inherently international, and the outcome of this research work can easily be implemented to study any ecosystem in the world. Ecosystems help to improve companies' opportunities to innovate, grow and succeed in the international competition. Specifically, SMEs get a push for growth, whereas large enterprises often act as growth engines to accelerate their renewal. Nowadays problems are so huge, for instance, fighting cancers, solving climate change or solving the food problem in the world that one needs a huge network to solve such problems.

For example, the human genome project is a big ecosystem; no one could have solved that alone. No single institute was big enough or capable enough to solve it. There was a clear need to have a global network to solve the problem of such a scale. By participating in a network/ecosystem, different stakeholders have the possibility to access the future ideas (or innovative solutions) which might lie somewhere else that they cannot even think about it by themselves.

Research scope: Limited research has been done addressing the key success factors which can speed up the process of value creation from multiparty collaborative open innovation projects. Hence, the expected result from this research work is to create a better understanding of key success factors which can help generate business opportunities born out of the open innovation ecosystems. These factors can also help to understand how open innovation ecosystems can reduce the time to market (speeding up the commercialization phase).

In the search for key success factor of collaborative and/or commercial innovation in an ecosystem environment, the research work presented in this thesis highlights the importance of OI, OI2, open innovation ecosystem, digital health ecosystem, open innovation framework in an innovation ecosystem, and inter-organizational collaboration.

Conceptual framework of the thesis: The conceptual framework for this research work aimed to describe the role of open innovation in digital health innovation ecosystem (Figure 4). It has been used to describe the theoretical findings related to the digital health innovation ecosystem. It underlies the key factors which might help organizations to innovate faster while working in a digital health innovation ecosystem.

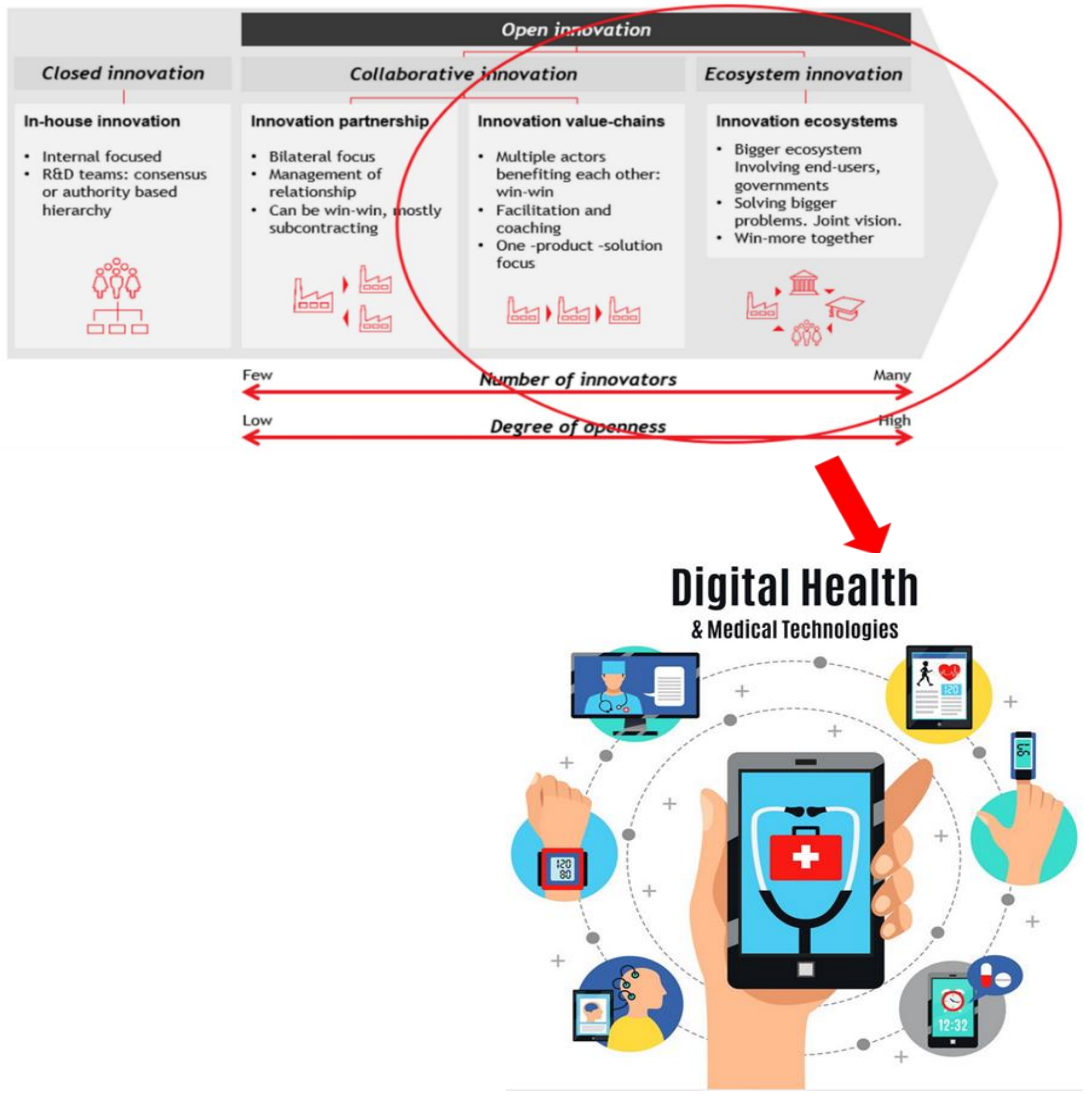

Figure 4. A framework describing a systematic shift from closed innovation to open innovation and its application to digital health (Curley & Salmelin 2013)

It will influence on developing new products and/or services which might exceed the customer needs and eventually have very strong competitive advantage, which would lead to better profitability. The developed conceptual framework of this work serves two functions. Firstly, the conceptual framework acts as a foundation for the empirical research study and in particular, the design of the interviews. Secondly, the conceptual framework provides an analytical tool for the interpretation of the data collected during the interviews. The analytical tool constitutes the possibility to compare and categorize the statements given by the respondents with the theoretical knowledge base of the study.

Commission company – Spinverse Oy: Spinverse Oy, specializing in driving open innovation ecosystems, is the commission company (Figure 5). Spinverse is also the leader in innovation consulting in Nordics. Spinverse has in-depth expertise in raising public and/or private funding as well as commercialising emerging technologies. Spinverse believe in innovative solutions in various industries and diverse range of customers (large enterprises and SMEs) in Europe (Spinverse Oy 2020) to tackle the global challenges.

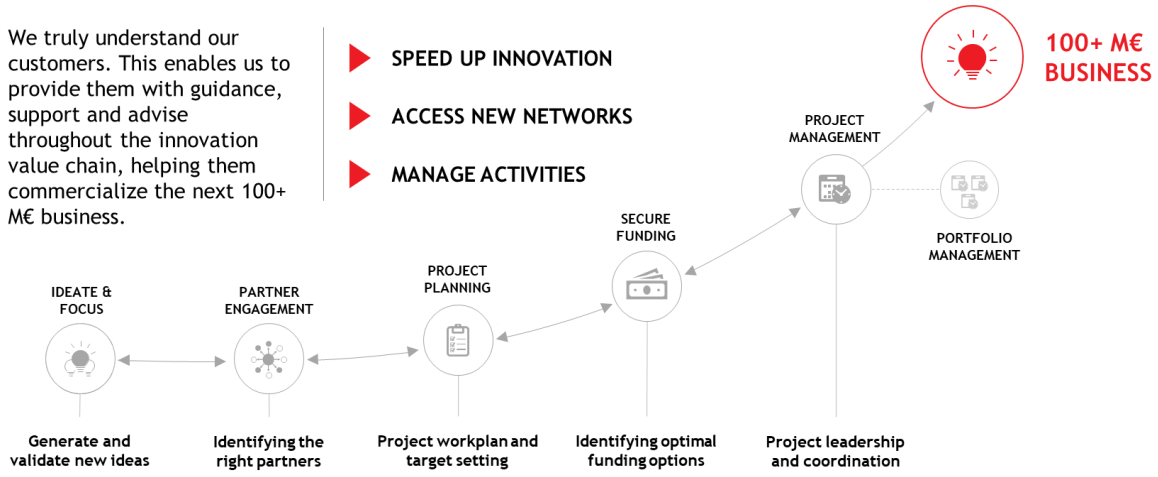

Figure 5. Spinverse helps customers turn radical innovations into 100+ M€ businesses (adapted from Spinverse Oy).

Spinverse has been working with OI and innovation ecosystems since 2014. Spinverse published a series of whitepapers in 2018 outlining ***i)*** its findings to the

leadership of open innovation ecosystems (Ropponen 2018a), ***ii)*** the role of service design in building the open innovation ecosystems (Ropponen 2018b), and ***iii)*** collaboration capabilities boosting open innovation ecosystem (Ropponen 2018c). Spinverse has been gaining momentum in the continually growing health tech industry. Spinverse has assisted Helsinki University hospital (HUS) in planning and setting up Clever Health Network (CHN) ecosystem (Spinverse Oy, CleverHealth Network 2019). The CHN ecosystem opens up new opportunities for the partners involved and also generate new employment opportunities in the field of digital healthcare solutions.

Research methods: The methodology used in this thesis is based on constructive research approach. The main idea behind constructive research is solving a domain-specific problem. To do so, it constructs an artefact (models, diagrams, plans, organizational charts). The methodology selected has been based on qualitative research methods as the latter provide in-depth solutions to a particular problem. Qualitative methods of data collection, such as interviewing, observation, and document analysis, have been included under the umbrella term of "ethnographic methods" in recent years (Figure 6). The main research approach of this thesis is the case study. Data collection methods used were data triangulation method and participating observation method. Data was collected using interviews with open-ended questions, secondary data, literature study, and observations.

Case study approach: Case study approach falls under the category of qualitative methods classified into five groups: ethnography, narrative, phenomenological, grounded theory, and case study. Data collection techniques used by these methods is similar such as observation, interviews, and reviewing text (Creswell 2012). A case study is a research approach which has been used to have deep understanding of complex issues in its real-life context. It is an established research design that is used extensively in a wide variety of disciplines. A central tenet of the case study approach is the need to explore an event or phenomenon in-depth and in its natural context. Due to this, it is often referred to as a

"naturalistic" design approach. Case studies can be used to *explain, describe,* or *explore* events/phenomena in their everyday contexts (Yin 1994). In other words, case studies can be explanatory, exploratory, or describing an event (Crowe et al. 2011, 100-110). The value of the case study approach is well recognized in the fields of business, law and policy, but somewhat less so in health services research (Sauro 2015).

Figure 6. Ethnography research work carried out via qualitative interviews, case study, participant observation, and direct observation (QuestionPro blog 2020)

Semi-structured interviews: Semi-structured interviews (SSIs) are in-depth interviews where the respondents have to answer preset open-ended questions and thus, are widely employed by different healthcare professionals in their research (Jamshed 2014, 87). Different steps involved in SSIs are ***i)*** designing and conducting SSIs, ***ii)*** selecting respondents and arranging Interviews, ***iii)*** drafting the questions and interview guide, ***iv)*** techniques for this interviewing, and ***v)*** analyzing the information gathered. SSIs has been utilized substantially as interviewing format. SSIs are usually conducted once either with an individual or

with a group (DiCicco-Bloom & Crabtree 2006, 314-321). SSIs are suited for several valuable tasks including in a situation specifically where a few of the open-ended questions require follow-up queries. SSIs uses a fusion of closed- and open-ended questions, followed mostly by *why* or *how* questions. The discussion in the interview can be around the topics on the agenda rather than adhering strictly to verbatim questions as in a standardized survey. It's totally possible that during SSI the discussion might delve into totally unforeseen issues. About one hour is considered a reasonable maximum length for SSIs. Recording the interview helps to capture data effectively compared to handwritten notes. The recording also enables the transcriptionist to generate "verbatim transcript" of the interview. SSIs usually require the exhausting task of analyzing a huge volume of notes and generally several hours of transcripts.

Semi-structured qualitative study (SSQS): SSQS involves interviews and observations, having an obvious structure for both theory and/ or method (Blandford 2013). Such studies usually involve logical, systematic, iterative coding of collected (verbal) data, often supported by data gathered via other modalities.

Data triangulation: For this case study, data collection was based on triangulation, where interviews, documents, and observations are often combined (Flick 2009; Mason 2002; Eisenhardt 1989, 532-550). Triangulate data approach is often used by case study researchers as part of the data collection strategy (Figure 7). Triangulation (primary, secondary and sources information) data results in a detailed case description (Burns 2000; Dooley 2002, 335–354; Eisenhardt 1989, 532-550; Ridder 2016; Stake 2005; Fiss 2009, 424–440). Benefits of a single case study have been documented to gain a better understanding of ‘‘how’’ and ‘‘why’’ things happen. In a single case study, multiple sources of data help in looking at different aspects of the same phenomenon. Such an approach helps in narrowing down the problems of construct validity. Several data analysis strategies

and analytic techniques have been described in detail which are appropriate to compare the proposed relationships with empirical patterns (Yin 2014).

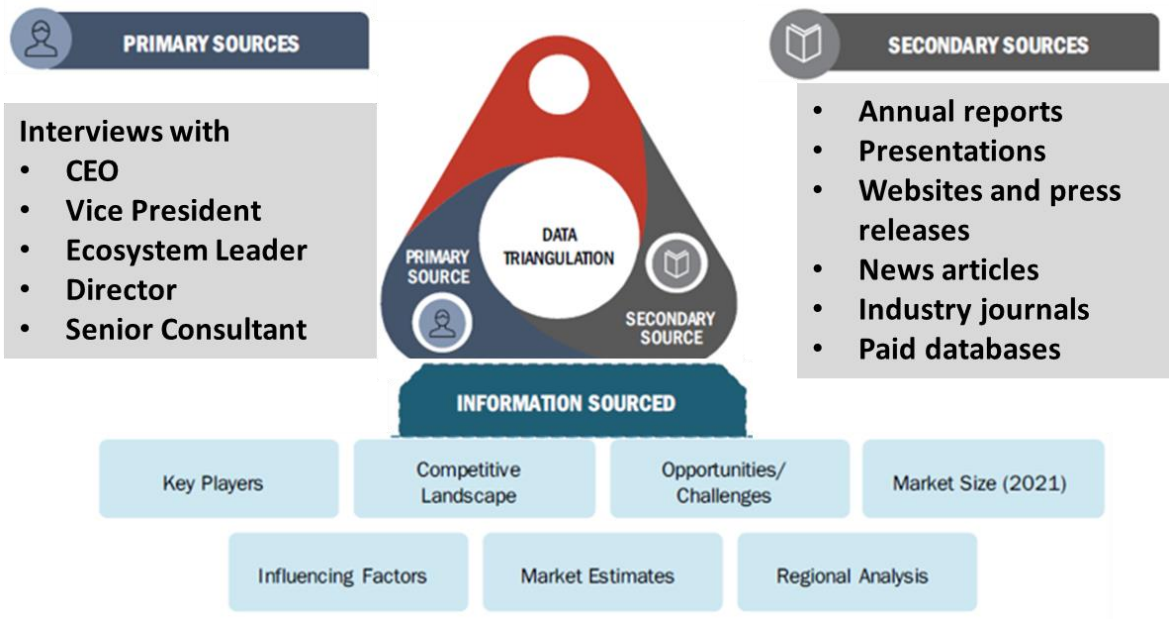

Figure 7. Sources of information gathered in this study using data triangulation (Flick 2009)

Participant observation method: Participant observation is another qualitative data collection whose objective is to help researchers learn the study populations' perspectives. This method (along with qualitative interviews, case study, and direct observation) has its roots in traditional ethnographic research. Data collection with this method is done in two ways. Either via observation alone or by both observing and participating in the targeted study group's day to day activities. By observing study participants researcher can discover factors which are crucial for a detailed understanding of the research problem. Most of the time it happens that many of these factors discovered by observation are actually not planned while planning the study at the very beginning (Allen 2017, 13). This method not only helps to understand data collected through other qualitative methods but also to design questions for those methods. Strengths and weaknesses of the participant observation method are described below.

Table 1: Strengths and weaknesses of the participant observation method

Strengths	Weaknesses
This method allows for insight into contexts, relationships, and behavior	Time-consuming
Can provide information previously unknown to researchers that is crucial for project design, data collection, and interpretation of other data	Documentation relies on memory, personal discipline, and diligence of researcher, and
Participants can be approached in their environment. In general, researcher using this method intends to learn what life is like for an “insider” while remaining, surely, an “outsider.”	This method is intrinsically subjective, so it requires keen effort at objectivity.

2 OPEN INNOVATION AND OPEN INNOVATION ECOSYSTEMS

Open innovation (OI) is a comparatively a new concept in the field of business. During the past decade, OI has made an exemplary change in how R&D activities are conducted by companies today. Traditionally, organizations have focused primarily on internal R&D activities to reach the market first compared to their competitors. However, nowadays with the advent of OI open innovation networks (or ecosystems) facilitate different value chain (suppliers, customers, and end-users) to collaboratively develop innovations (e.g. products, services and business models) that meet the user needs (Chesbrough & Bogers 2014). During the past decade, the concept of OI has been growing steadily in academia and the industrial sector (Figure 8). Both sectors have been shifting from closed innovation approach to open way of innovation. By pursuing open innovation model cooperation between different players generates greater value for an entire collection of

organizations rather than one key player. OI brings in several advantages such as, less (or shared) R & D costs, shared risks, shorter time to market for all the partners involved, increased quality of products and services, and flexibility. Companies can push their technology faster in the market, with increased chances of commercialization of non-core business expertise, producing more innovations over the course of time.

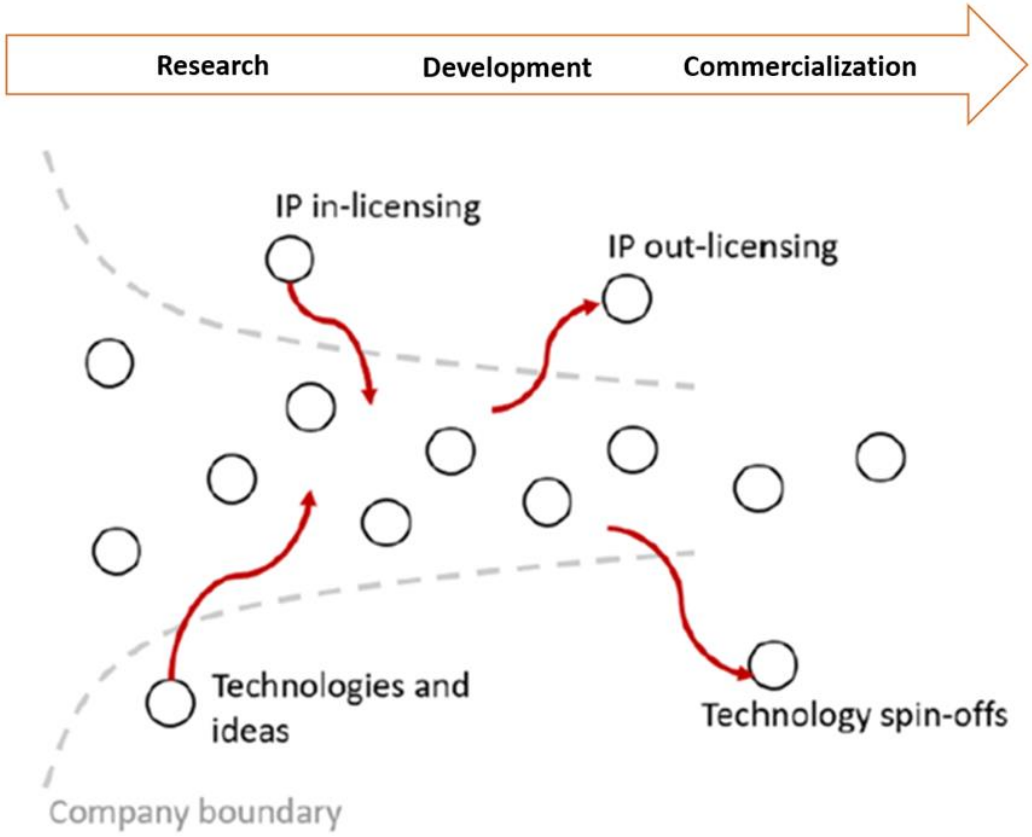

Figure 8. Process of open innovation (Chesbrough and Bogers 2014)

Several positive factors which are driving a drastic shift towards open innovation are ***i)*** changing dynamics of the world, ***ii)*** globalization and fierce competition, ***iii)*** increased customer awareness/activeness, ***iv)*** technological advancement, ***v)*** technology fusion and global connectivity, ***vi)*** increased access to private venture capital, and ***vii)*** increased product and service complexity.

In this research work, current concepts within OI, open innovation ecosystem and collaborative capabilities of an ecosystem are presented. A comprehensive review of the existing literature enables the thesis to be positioned in relation to central theories and previous findings and to outline a conceptual framework for the study.

Key parameters which form the basis of theoretical and/or conceptual framework has been explained in sequential order in the review of literature: such as closed and open innovation models, comparison between closed vs open innovation, open innovation framework, value proposition of open innovation, Open Innovation 2 (OI2), Open innovation ecosystems, and digital health innovation ecosystem.

Closed innovation model: Closed innovation model (conceptualized as do-it-yourself was adopted by several leading industrial corporations in the 20th century) argues the concept of self-reliance in R&D operations (Figure 9). Industrial corporations which follow this model believes in the philosophy that successful innovation requires full control on R&D operations (Chesbrough 2003b, 35-41 & Elmquist et al. 2009, 326-345). Therefore, companies had to produce their ideas because they were responsible for the development, manufacturing, marketing, distribution, and services (Docherty 2006, 13). Innovation, according to “do-it-yourself” concept, means idea generation for organizational development. To provide new ideas for the corporate sector, some implicit rules on development and in-house research are needed. Such a scenario must assure more R&D investment than the competitors, for which, companies hire smart and highly professional people. These investments enable them to gain more profits and maintain control over intellectual property rights of their innovations, which prevents competitors from exploiting their R&D gains. They can later re-invest profits in more R&D, which in turn leads to the discoveries of additional breaches and this creates a virtuous innovation cycle (Chesbrough 2003b, 35-41). By the end of the 20th century, closed innovation lost its vigor. Now the focus has shifted from old, closed model of innovation to new opportunities, foreign ideas and new techniques (Inauen & Schenker-Wicki 2012, 212-231). This new OI requires new cooperation systems

between business organizations at the same time while competing against each other (Du Preez & Louw 2008, 27-31).

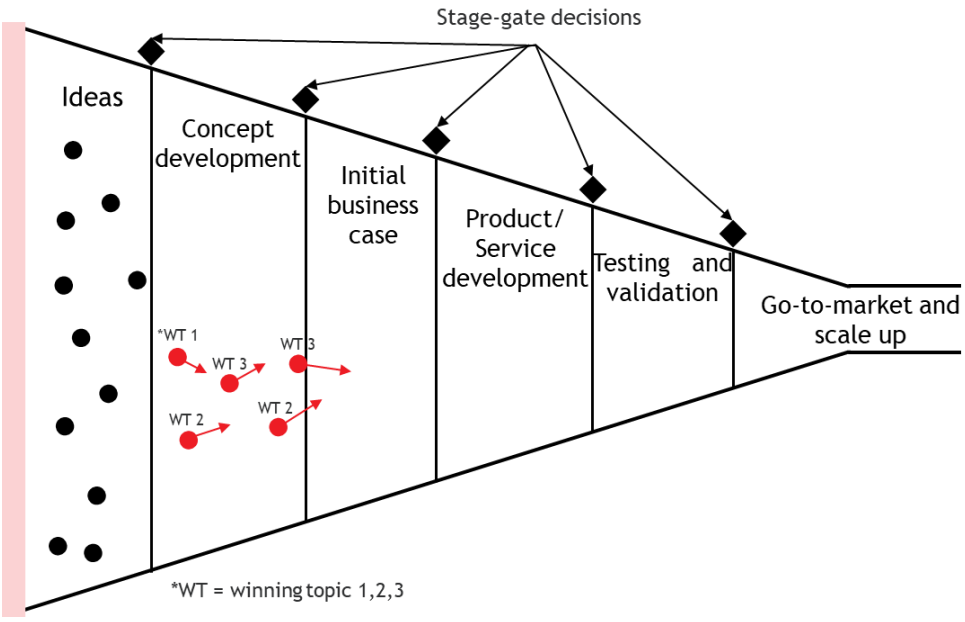

Figure 9. Closed innovation model (adapted from Spinverse Oy)

Open Innovation model: In past two decades, OI phenomenon (Figure 10) has attracted great attention both from the academicians and users in the industry (Trott & Hartmann 2009, 715-736; Marques 2014, 196-203). The OI model focuses on interactive processes, became popular without much evidence or critical analysis. This model entails globalization of innovation process, outsourcing of R&D, early integration of suppliers, users of innovation and external commercial environment related to technology (Gassman 2006, 223-228; Inauen & Schenker-Wicki 2012, 212-231). This model has three main phases (Docherty 2006, 13). During the *first phase* known as "co-development" phase, a peer-to-peer or supplier/client's agreements are signed by external partners, helping develop new products and/or services. The *second phase*, often known as "development phase" contains other factors such as formal networks & consortia which work together in

a stage called “collaborative stage”. The third phase, known as “joint venture” phase between partners/stakeholders, entails working together in joint development and formally negotiating risks and rewards as a part of the formal legal arrangement.

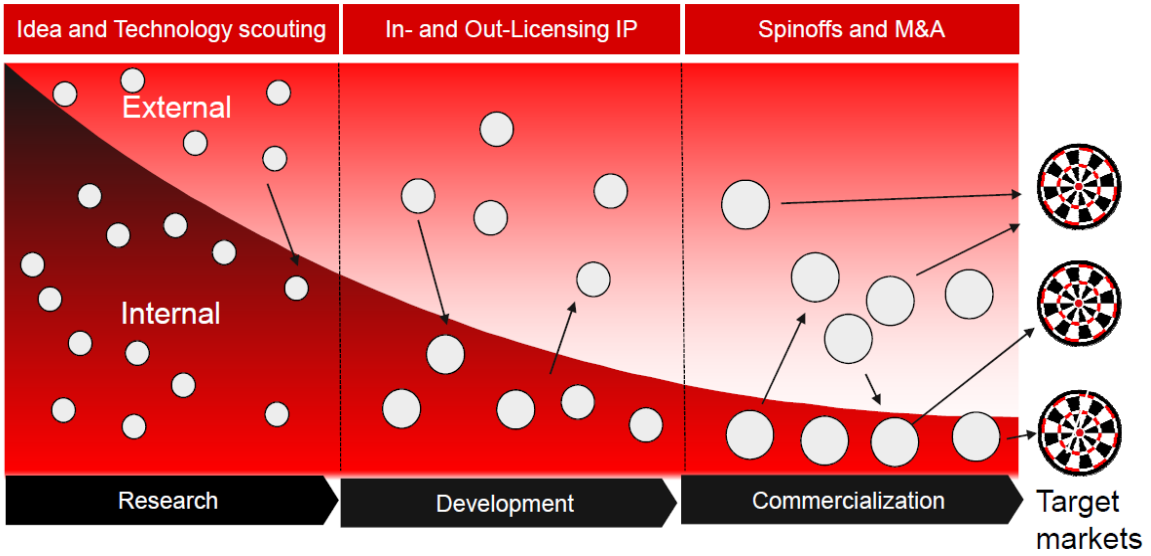

Figure 10. Open innovation model (adapted from Spinverse Oy)

Types of open innovation: According to Inauen et al. (2012, 216), open innovation can be classified into two types as the exploration of technology (“**outside-in**”) and technological exploitation (“**inside-out**”). Outside-in approach is based on searching and adopting new ideas and technology from outside the organization. Inside-out approach is based on how innovation can be made marketable through external funding. Lazzarotti et al. (2009, 622-623) identified the degree of openness in open innovation model and divided them into four areas (such as closed innovators, specialized collaborators, open innovators, and integrated innovators) as shown in Figure 11. Closed innovators comprise a group of companies that access external knowledge sources such as access to external prototyping services for developing a new product.

Specialized collaborators are related to companies willing to work with other partners; however, focusing on their collaborations on a single point in the innovation funnel. Integrated collaborators are related to companies which open their innovation funnel. The innovative process of the companies in this type contains contributions from some partners. Open innovators are related to companies which manage a wide spectrum of technological relationships.

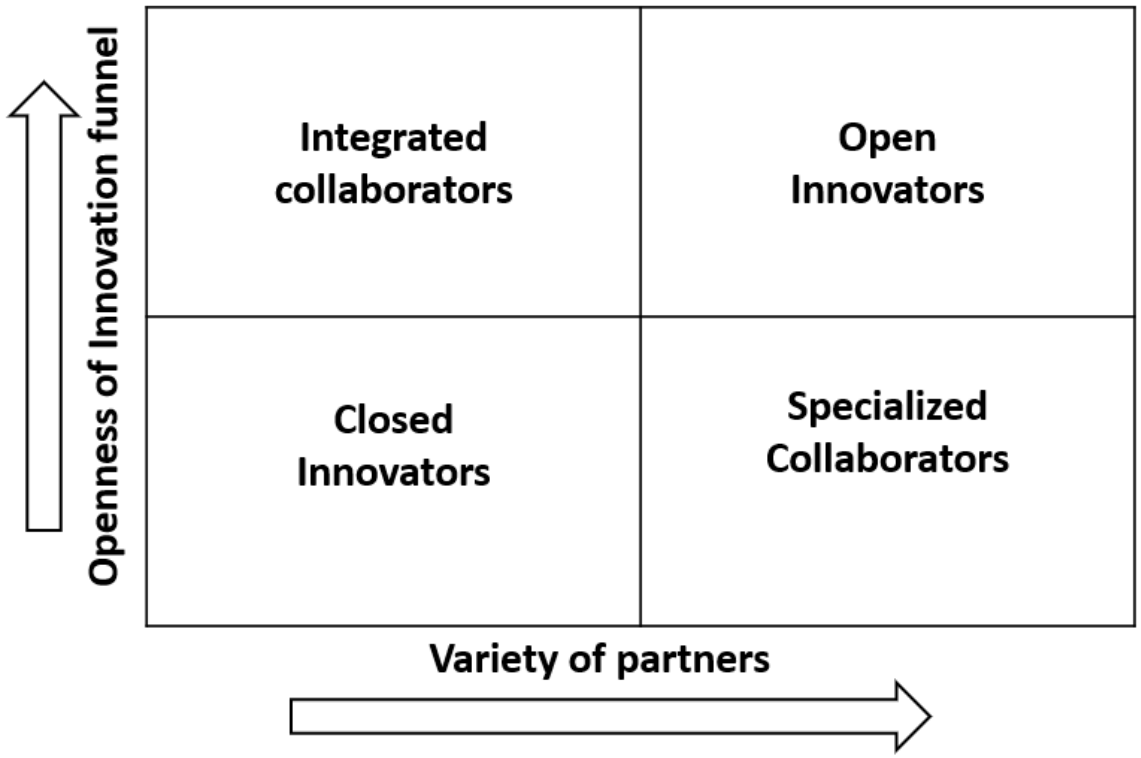

Figure 11. Four types of Open Innovation (Inauen et al. 2012)

Comparison between Closed vs Open Innovation: OI is laying the foundation for the competitive advantage of all the partners involved. The traditional approach of having a competitive advantage based on closed innovation is being replaced by OI model in which cooperation between different players generates greater value for an entire collection of organizations rather than one key player (Tables 2

and 3). Accordingly, five key elements for OI process are; ***i)*** networking, ***ii)*** collaboration between different partners, ***iii)*** corporate entrepreneurship, ***iv)*** proactive IPR management, ***v)*** R&D. Comparison between closed innovation (centralized or inward-looking innovation) and Open innovation (externally focused and collaborative innovation) is presented in Table 3.

Table 2: Comparison between Closed vs Open Innovation*

Closed innovation **Centralized, inward looking innovation**	**Open innovation** **Externally focused, collaborative innovation**
We must innovate, develop, and sell by ourselves	We innovate and develop with the help of both external as well as internal R&D
The organization who gets innovation to market first will win.	Building a better business model is more important than getting to market first.
If we create the most and the best ideas in the industry, we will win.	If we make the best use of internal and external ideas, we will win
We should control all our IP, so that our competitors cannot profit from it.	We should profit from others use of our IP (license-out) and we should license in other's IP whenever it advances our business model
We will own all results from contract research with universities	We will partner with universities to create knowledge and encourage use outside our field.

* *A*dapted from *Chesbrough, 2003.*

Open Innovation framework: Three processes which underlie the open innovation framework are ***i*)** outside-in, ***ii*)** inside-out, and ***iii*)** the coupled process. The coupled process is linking outside-in and inside-out by working in alliances with complementary companies during which are crucial for success. Consequent

thinking along the whole value chain and new business models enables this core process. Different aspects of OI types such as Inbound (outside-in), Inside-out (outbound) and coupled process are described in the table below.

Table 3: Description and mechanism of different Open Innovation types

Open innovation type	Description	Mechanism
Inbound (***Outside-in)*** Pecuniary inbound ***(Acquiring)*** Non-pecuniary in bound (***Sourcing***)	Involves opening up the company's internal innovation processes to external contributions and feedbacks.	• In-licensing intellectual property • Scouting • Crowdsourcing • Intermediaries • Competitors&tournaments
Inside-out (***Outbound***) Pecuniary outbound (***Selling***) Non-pecuniary outbound (***revealing***)	Involves allowing unused and under-utilized ideas and assets to go outside the organization for others to use in their businesses and business model	• Out-licensing intellectual property and technology • Donating intellectual property and technology • Spinoffs • Corporate venture capital • Corporate incubators
Coupled ***Bi-directional Interactive collaboration*** in form of joint production	Combining inflows and outflows of knowledge to jointly develop and/or commercialize an innovation	• Strategic alliances • Joint ventures • Consortia & Networks • Ecosystems & Innovation platforms

Value proposition of OI – added value to customers: OI brings in several advantages which are favoring companies to adapt to OI model (Chesbrough 2006). Some of the key advantages associated with OI model are, ***i)*** fewer costs as well as shared risks, ***ii)*** increased quality of products and services, ***iii)*** reduced time for products to reach the market, and ***iv)*** flexibility. In addition to enabling companies to push their technologies faster in the market with OI model, there are increased chances of commercialization of non-core business expertise as well as more innovations over the course of time. There are several positive factors which are driving a rapid shift towards OI such as ***i)*** changing dynamics of the world, ***ii)*** globalization contributing to fierce competition, ***iii)*** increased customer awareness/activeness, ***iv)*** technological advancement, ***v)*** technology fusion and global connectivity, ***vi)*** increased private venture capital, ***vii)*** increased product and service complexity.

Open innovation strategies: Needs and profile of an organization dictate the types of innovation strategies it employs. Based on this, two different approaches in innovation planning have been used ***i)*** using own resources (resource utilization approach) or ***ii)*** collaborating with other organizations and open itself for new ideas from outside. Resource utilization approach becomes a fundamental aspect of being considered. It is therefore recommended for the organizations to begin their innovation strategy selection process by identifying their approach in resource utilization. This phenomenon has been reinforced by the increasing globalization of research and technologies and innovation fueled by new information and communication technologies as well as by new organizational forms and potential of business models. OI demands a change in the company's innovation strategies. Only companies that wish to commercialize both their own ideas as well as other firms' innovation and seek ways to bring their in-house ideas to market by deploying processes outside their current businesses can start an "era of open innovation" (Chesbrough 2007, 22-28). Examples of products invented for a specific market which then became a great success in other markets are

numerous: for instance, the TCP/IP protocol (later became internet), Teflon - which was invented for space missions later became a market success as kitchenware.

2.1 From Open Innovation (OI) to Open Innovation 2.0 (OI2.0)

OI2 is a new innovation approach formulated by Martin Curley and Bror Salmelin in their paper ‘’Open Innovation 2.0: A New Paradigm’’, published in conjunction with the Irish European Union Presidency conference Open Innovation 2.0 held in Dublin in May 2013 (Curley & Salmelin 2013, 1-8). The paper identifies critical elements in the new approach, clearly differing from the previous approach based on cross-licensing knowledge to create OI. In OI2.0 entrepreneurship and diversification of economic base also received increased emphasis. This was a clever and much-needed update for OI. It also helped the community and practitioners to see that the paradigm change in OI had indeed taken place and had elevated the practice to a whole new level. OI2 has been encouraged by the rise of inter-organizational innovation networks and ecosystems (Gabison et al. 2016, 49-54). The key components of OI2.0 are based on 20 interlinked elements

Figure 12. Twenty snapshopts of open Innovation 2.0 (Curley & Salmelin 2013)

which are highlighted in Figure 12. Three common features acting as enabling factors and four key managerial approaches (referred to as conditions of success) have been identified in the shift from OI to OI2.0. Enabling factors are i) technological pivot, ii) clear appropriation strategy, and iii) ability to orchestrate a rich ecosystem.

Table 4: Evolution of OI2.0 from closed innovation (Bror Salmelin 2020)

Closed Innovation (1970 – 2002)	**Open Innovation (2003-2012)**	**Open Innovation 2.0 (2013-2020)**
Dependency	Interdependency	Interdependency
Subcontracting	Cross-licensing	Cross-fertilization
Solo	Cluster	Ecosystem
Linear	Linear, Leaking	Mash-up
Linear subcontracts	Triple helix	Quadruple helix
Planning	Validations, pilots	Experimentation
Control	Management	Orchestration
Win-lose game	Win-win game	Win-more – Win more
Box thinking	Out of the box	No boxes
Single entity	Single discipline	Interdisciplinarity
Value chain	Value network	Value constellation

The key managerial approaches that were relevant in the transition, acting as conditions of success are i) balance between external and internal resources, ii) leveraging organizational culture, iii) developing a sound business model, and iv) human resources management. It has been noted that four conditions of success are mostly relevant in the implementation of OI2.0. It should be noted that the

mindset needed in the implementation of OI2.0 is different compared to OI as OI2.0 shifts from partnerships to the community of partners and users. Organizations clearly need to be aware of the elements that are critical in securing them a strategic advantage in their OI strategy. Nonetheless, it has been suggested that when companies shift to an OI2.0 they need to re-elaborate their entire approach to innovation and hence reconfiguring their strategy. The paradigm changes from closed innovation to OI and furthermore to OI2.0 are presented in Table 4.

New Open Innovation Models: Both technical and societal aspects are involved in ecosystem-centric, cross-organizational innovation. Actors (research, industry, public sector, citizens/users) involved in OI2.0 ecosystems collaborate and innovate based on common purposes, aligned efforts, shared vision, and shared value co-creation (Curley 2016, 16). OI2.0 is not a linear extrapolation from the past. In New Open Innovation Models (Figure 13), the innovation pyramid is also turned upside down instead of having the traditional top-down view. It can be seen

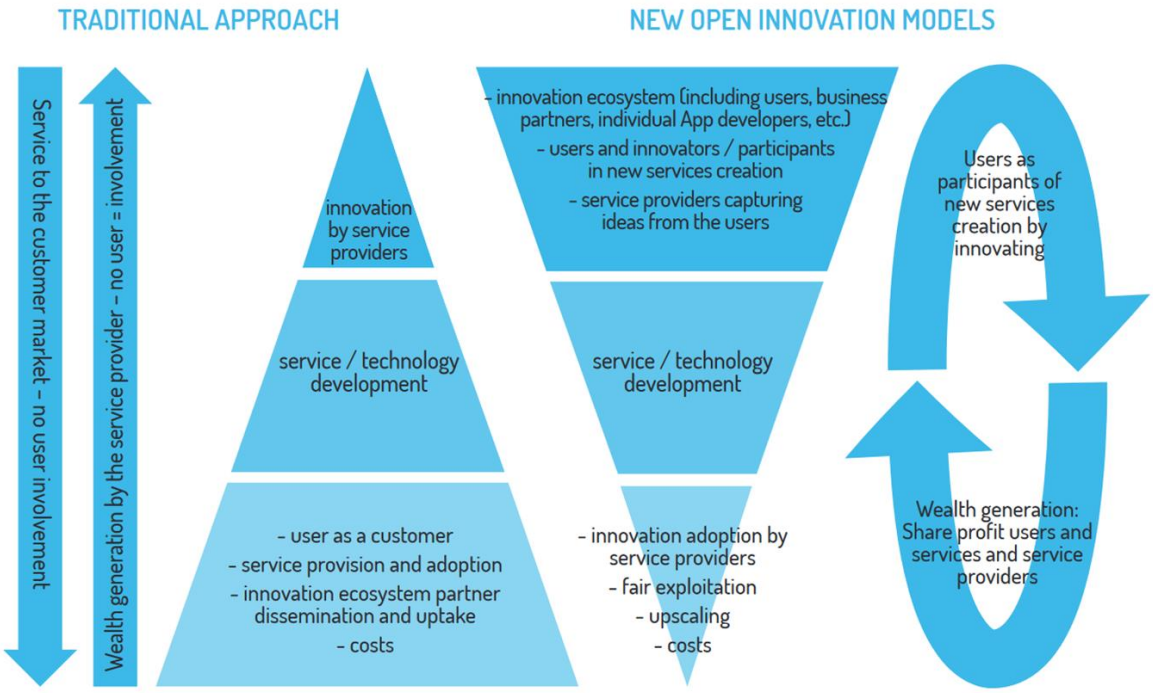

Figure 13. Traditional versus new open Innovation models including reverse innovation pyramid model (Curley & Salmelin 2013)

clearly that the innovation power is with the crowd. Those actors who can best take advantage of this change will be the winners in innovation capability.

Quadruple helix innovation model: In quadruple helix innovation model research, industry, public sector (the main components of the triple helix model) is complemented by the people component (Figure 14). Elias Carayannis and David Campbell conceptualized this model as a spiral with four strands (Carayannis & Campbell 2009, 201-234). The role of society as a major actor in innovation systems has been emphasized in the quadruple helix innovation model. This model also shows the significance of actively integrating/engaging the public into innovation projects. Citizens are considered as active agents in the quadruple helix innovation model contributing seamlessly to the whole innovation process of new

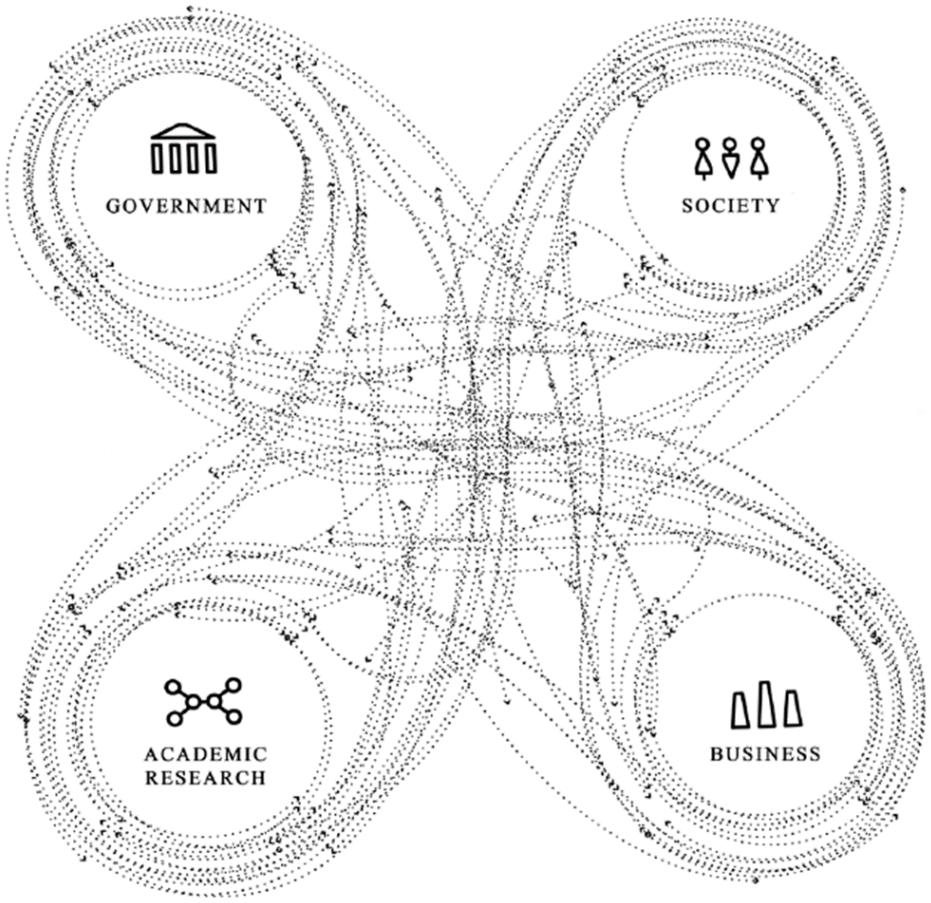

Figure 14. Quadruple Helix model (Schütz et al. 2019).

products or services. This model suggests that the non-linear interdependencies between the different actors (academia, procurer, industry, and user) must be in balance when optimizing the resources and maximizing the impact in professional collaborative networking.

Failing fast - scaling fast: When assessing if we are focusing strongly ‘’enough’’ on modern innovation we need to draw attention to the following key elements of OI2.0

1. Innovation ecosystems instead of clusters
2. Quadruple helix co-creation rather than the triple helix
3. Cross- and interdisciplinary innovation
4. Experimentation and rapid prototyping in real-world settings
5. Fail fast – scale fast
6. Creation of open engagement platforms

It will help us scale up successes quickly. By incorporating end-users as co-creators from the start, we could see easily and at early stages the less successful experiments/prototypes failing fast or successful ones scaling fast. **‘’Failing fast, scaling fast’’ is one of the substantial benefits of OI2.0.**

2.2 Ecosystems and Networks – a shift towards Open Innovation

Ecosystem is defined as an organized group of actors by working together provide additional as well as a new value to the customers. Ecosystems are complex systems that contain a few large players and several small players (Moore 1993, 75). Compared to the natural one, a human-made ecosystem requires leadership and vision for the future (Figure 15). Creating value for customers is at the center of an ecosystem (Van den Borgh et al. 2012, 150-69)**.** There are three kinds of ecosystems, ***i)*** Innovation ecosystem, ***ii)*** Business ecosystem, and ***iii)*** knowledge ecosystem (Valkokari 2015, 17). Three ecosystems are interdependent and aimed to create target customer value (Figure 17). Ecosystems are necessary these days because challenges and solutions are so complex and systemic that no actor has

the capacity nor the capability to create successful business applications alone in the needed time frame (Clarysse et al. 2014, 1164-76).

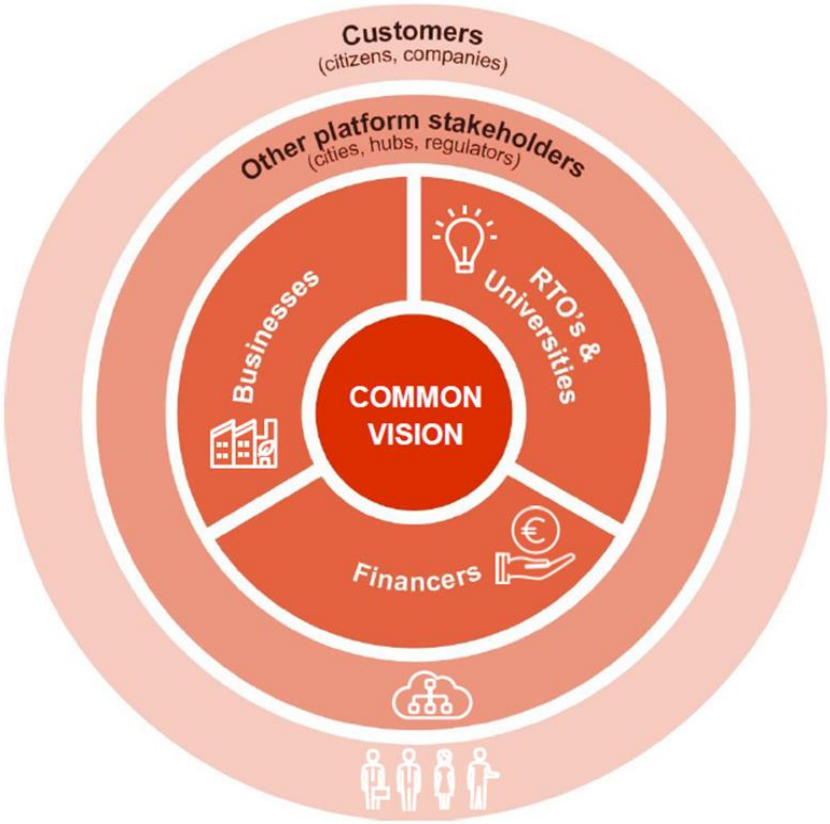

Figure 15. Schematic representation of an ecosystem (adapted from Spinverse Oy).

Innovation ecosystem: Innovation ecosystem includes several and distinct participants and resources which are crucial for innovation. It includes entrepreneurs, investors, universities, venture capitalists, as well as business development. Other technical and professional service providers such as accountants, designers, contract manufacturers are also part of the innovation ecosystem (Oh et al. 2016, 54). A healthy and robust ecosystem provides a structure for building interrelationships and other intangibles between different actors/entities involved (Jackson 2011).

Business ecosystem: A business ecosystem is defined as a constellation of innovation actors working towards one common goal, which is co-creation of value. Concept of a business ecosystem was given by Moore in 1993 which defined it as coevolution of new capabilities leading to new innovations based on competition and cooperation between different players involved in one particular ecosystem (Moore 1993, 75). Typically, a business ecosystem involves several stakeholders, for instance, users, customers, and competitors. A certain level of inter-dependency is a prerequisite for being part of a business ecosystem. Trust and sharing of knowledge are two pillars of the business ecosystem (Isckia et al. 2009, 37-54).

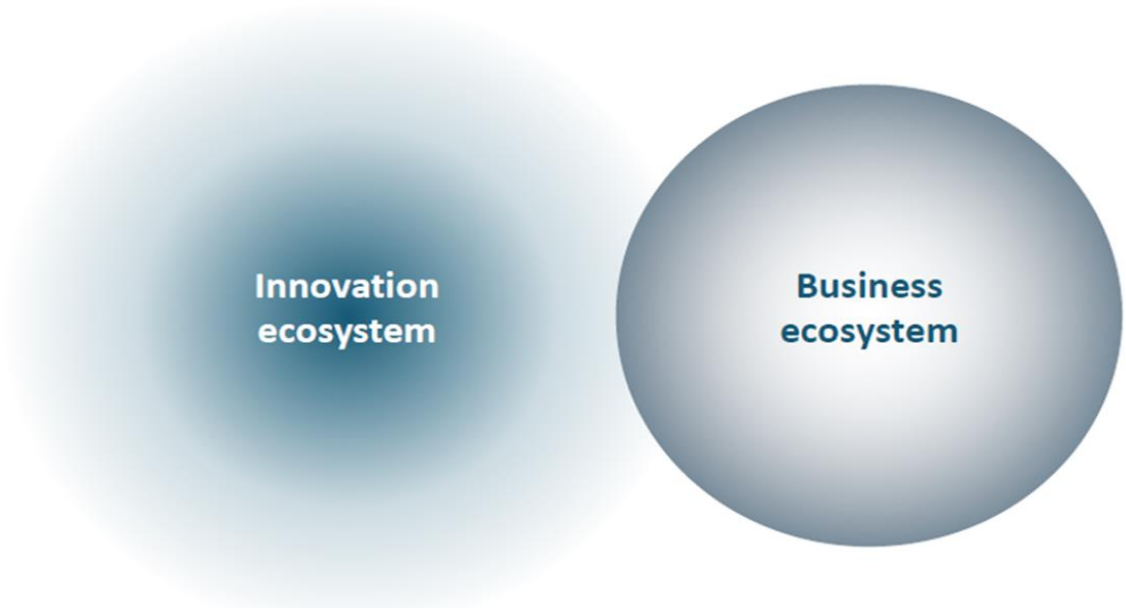

Figure 16. Innovation ecosystem is open network focusing on new solutions for wider use in society and business whereas business ecosystem is more closed network focusing on new business creation or even ecosystem offering (suggested by author).

Knowledge ecosystem: Knowledge ecosystems (new knowledge and technology) have a narrow scope on early knowledge creation and search. In this type of ecosystem, multiple actors join forces to create new knowledge in a pre-competitive setting (Van den Borgh et al. 2012, 150-69; Clarysse B et al. 2014,

1164-76; Valkokari 2015, 17-24). Activities such as exploitation and commercialization are not the focal point of this ecosystem (Figure 16).

Comparison between innovation, knowledge, and business ecosystems: Innovation ecosystem emphasizes mainly to value creation; however, business ecosystem relates mainly to value capture. Knowledge ecosystem focuses solely on knowledge creation and does not focus on exploitation and commercialization activities. Innovation ecosystem comprises of the research and commercial economy. Research and commercial economies are driven by research and marketplace, respectively (Jackson 2011). Along these lines, the innovation ecosystem is believed to be healthy as both the economies (research and commercial) exist in a balanced equilibrium. A healthy and effective innovation ecosystem hence empower different actors involved such as research organizations, academia (universities), entrepreneurs, companies, investors, and government agencies to interact and maximize the economic impact (Thomas

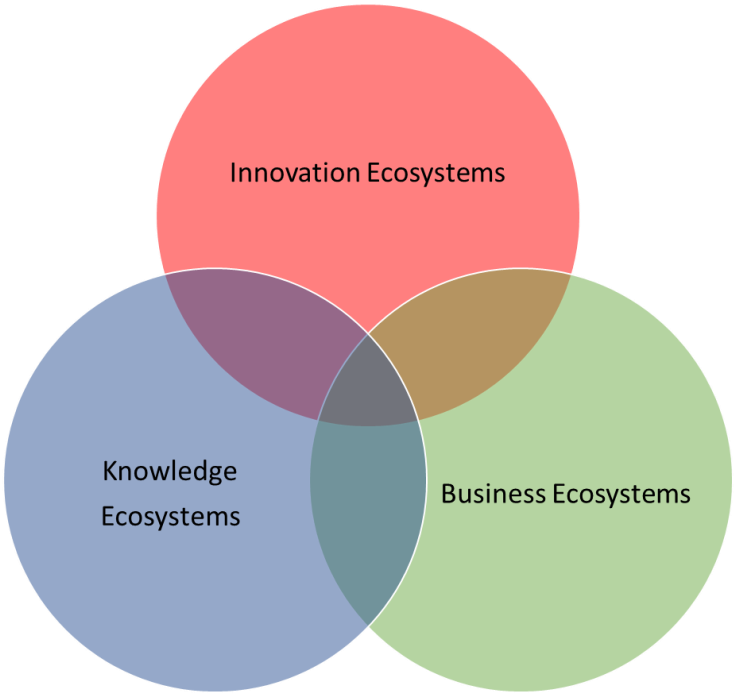

Figure 17. Interdependence of innovation, business, and knowledge ecosystems (Valkokari 2015).

2020). Successful innovation ecosystems incorporate business and knowledge ecosystems (Figure 17), including innovation activities with effective commercialization (Adams & Olesak 2010).

Open Innovation Ecosystems: Open stands for openness both in terms of sharing technologies and challenges. Openness also includes curiosity and interlinking of different stakeholders. **Innovation** is creating a new customer need-based solution by making things happen beyond ideation. It also includes scalability and creating entirely new approaches. **Ecosystems** mean involving all stakeholders in a quadruple helix manner to build interdependencies and to drive a common agenda. Interestingly, taking both the quadruple helix approach and interdisciplinarity into account, we enter the innovation ecosystem model. What is important is that culture is built to enable seamless interaction between the projects and actors in the ecosystem (West & Wood 2008). Process design for open interaction becomes critical. It is important to create a new co-creative culture within the system. This co-creative culture helps in experimenting and bringing the results in to the real world (Xie & Wang 2020, 29-41).

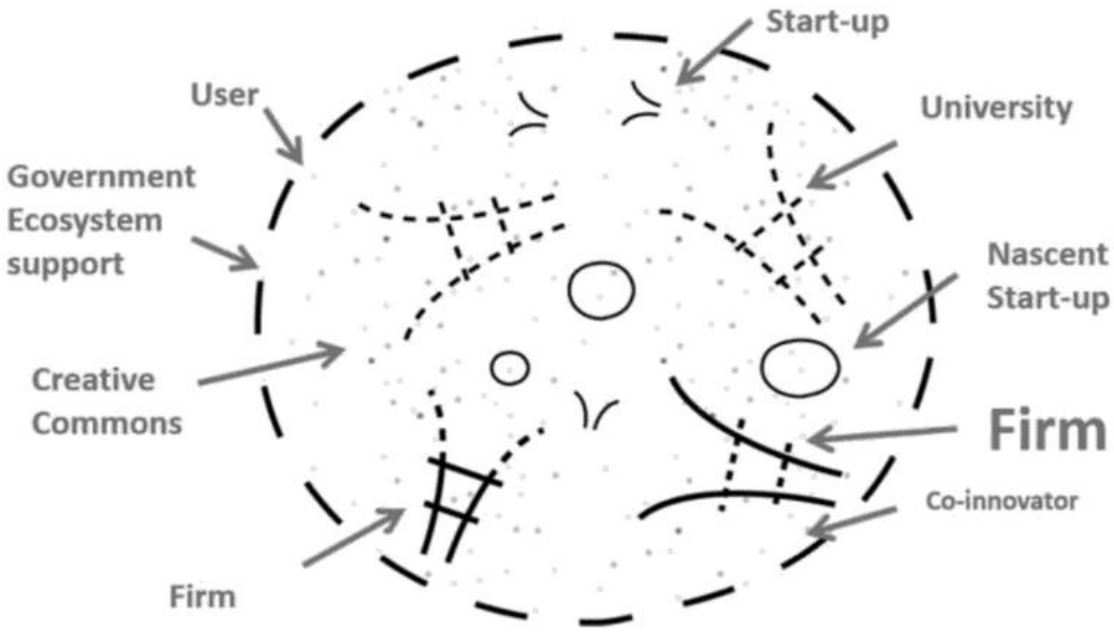

Figure 18. Open Innovation Ecosystem (Bror Salmelin 2020)

Trust and shared values are the core of the ecosystem, and it has processes for interaction. This is essential as open Innovation ecosystems (Figure 18) are much more than a collection of individuals, organizations operating under strict rules (Fasnacht 2018, 131). Basic principles like trust (and guidelines as well) need to be in place. It also means that the challenge within ecosystems is to provide safety nets allowing serendipity to happen simultaneously.

Digital health Innovation ecosystem: Digital health and digital ecosystems are a quite a talked about topic these days (Mellodge & Vandetti 2011, 33-38) and are often discussed in the literature (Chang E & West M. 2006, 3-23; Pranata et al. 2011, 33-39). However, the term digital health innovation ecosystem is rarely discussed (Iyawaa et al. 2016, 244-252). Furthermore, there is limited theoretical research that focuses on the components that constitute digital health innovation ecosystems (Figure 19).

Figure 19. Overview of different actors and their relationship in a digital health innovation ecosystem (Wynn et. al. 2015).

Digital Health Innovation Ecosystem - Clever health network by HUS: The medical technology sector is one of the fastest-growing fields globally. Use of technology in healthcare is revolutionizing the traditional operating models of the health care sector. The need for digital health solutions is growing worldwide. Incorporating innovation ecosystems into providing digital health services is an innovative approach to revolutionize existing health care models. Finland is one of the first countries in the world that has digitized national health registries originating since the 1960s. Finland has also digitized its biobank data from the 1920s. All Finns have 100% access to their electronic health records (EHR). Clinical and social data are layered on top of each other in Finnish EHR. Real-time patient-reported outcomes add a third layer of data to the EHR. The fourth layer of the EHRs is e-prescription history. In the near future there will be added the fifth layer of patient-drug interaction.

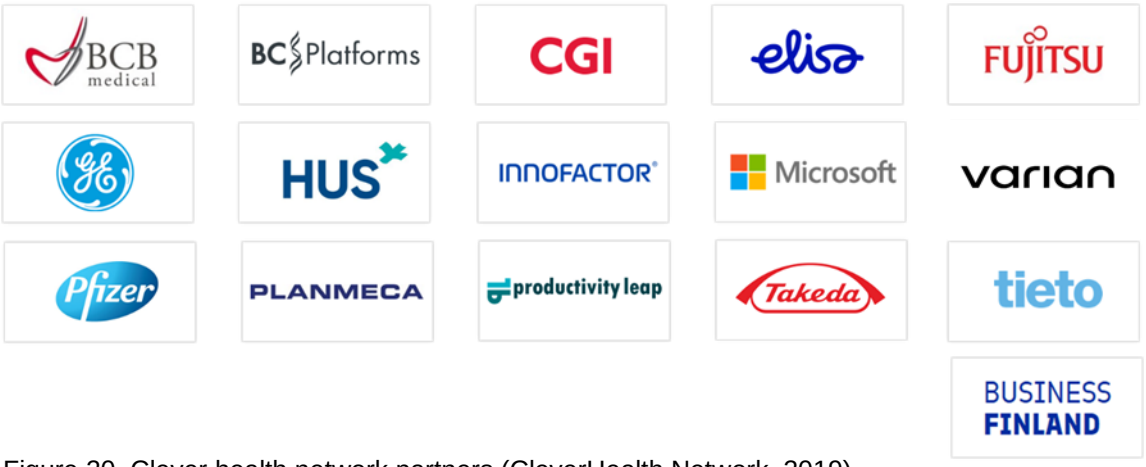

Figure 20. Clever health network partners (CleverHealth Network, 2019)

Helsinki University Hospital (HUS) has fully integrated digital data, and brainpower into a unique, forward-thinking innovation ecosystem called Clever Health network (CHN) (Clever Health Network 2020). Fourteen global companies and healthcare professionals are working together to develop efficient patient care solutions. CHN's (Figure 20) aim is to grow technology exports as well as increase foreign

investments to Finland. Product and service innovations are selected to be based on an actual clinical need as well as specialty areas of HUS and leading expertise of its clinicians. HUS data lake is the core of the CHN. CHN aims to turn innovations into business in global markets and catalyze export for Finnish companies worth billions.

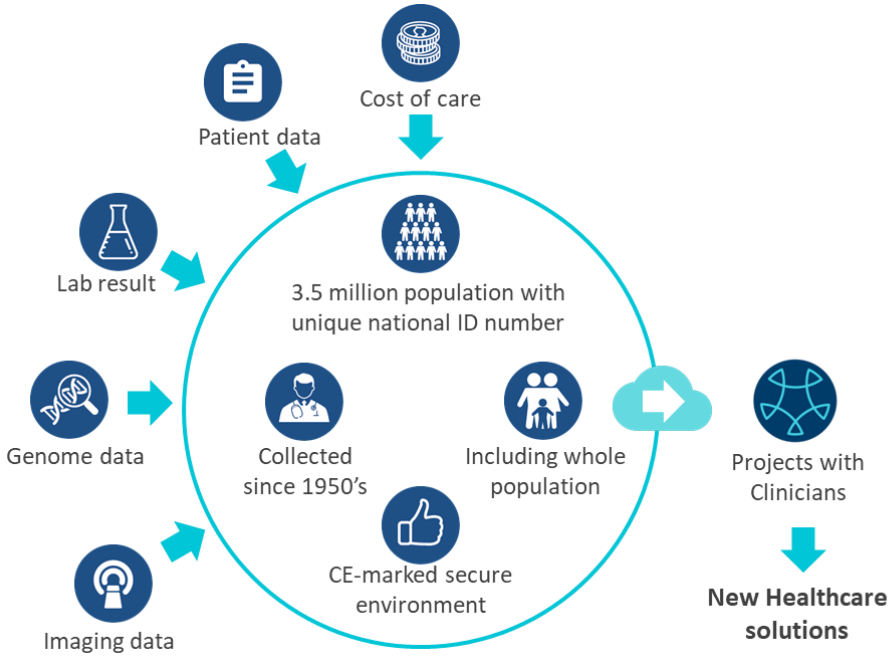

Figure 21. Co-creating new solutions with a globally unique data-set (CleverHealthNetwork, 2019)

HUS strives to provide high-quality treatment to every patient: HUS's vision is to be a high-quality hospital that creates new knowledge and provides effective and timely treatment for patients that is also safe and customer-oriented. HUS generally has developed healthcare solutions with individual partners. However, in CHN digital applications are being developed together by private companies and healthcare experts. Ultimate goal of all the partners involved in the ecosystem is to generate real health benefits for the people of Finland. At HUS, patient data is approximately 100 percent digital – which is unique, even on a global scale. HUS wants to use this wealth of data to develop cutting-edge medical research which

would translate into even higher quality healthcare for Finnish population. In CHN, compared to current standards, it is possible to process data quickly and efficiently because the participating companies seek and carryout projects which suit their specific expertise. Due to this speed and agility in the ecosystem, innovative solutions can be put to use within just six months, even though medical research projects normally take several years (Figure 21). CHN is a win-win case for everybody involved. The companies/businesses get real and meaningful ideas for their product and service development. All partners involved can also learn a lot from each other. From this ecosystem HUS develops new solutions that will create true wellbeing for people living in Finland.

3 DATA COLLECTION AND DATA ANALYSIS

3.1 Data collection

Primary and secondary data forms the basis of data collection of this research work and it is described below.

Primary data collection: The basis of the primary data collection in this research is semi structured interviews (SSIs). In SSIs (Appendix 1), the interviewer starts the discussion by asking general questions within the research topic that are then developed into more defined follow-up questions in order to guide the interviewee in a certain direction. The flexibility of the interview process facilitates SSIs to reveal comprehensive explanations of certain issues while keeping the interview process relatively comparable for all the participating interviewees (Bryman & Bell 2015).

Therefore, semi-structured interviewing is the most suitable approach for answering the proposed research question. The author has used the following six themes in the interviews.

Theme 1. Innovation ecosystem and willingness to join innovation ecosystems.

Theme 2. Shared vision and expectations

Theme 3. Ecosystem strategy

Theme 4. Role of trust and collaboration in creating value within an ecosystem,

Theme 5. Commercialization of the innovation ecosystem

Theme 6. Innovation management

The data primarily collected through eight interviews included key personnel from four large enterprises, three SMEs and one startup. In fact, eight interviews were found to be enough for reaching a saturation state in terms of empirical findings. Generic purposive sampling has been used to select the most suitable companies and persons for the interviews (Bryman & Bell 2015). Firstly, the chosen organizations have been identified to have previous experience from similar kinds of innovation ecosystem projects. Secondly, the intention was to include organizations which have global presence. Table 6 describes the type of organization, the country of origin, field of business and the position of interviewee. The invitations were sent through email and all interviews were audio-recorded and conducted through Microsoft Teams. All interviewees were requested to see the interview questions in advance to be better prepared for the interview. In the beginning of the interviews, a general presentation of the research objectives was given to the interviewee.

In addition, the interviewees were asked to reflect on the questions both based on the current case and previous experience. Similarities and differences between each respondent's answers was investigated since every interviewee had to answer the same questions. All open-ended semi structured interviews followed the respective innovation development processes in their company from start to finish. After the interviews, the recorded data was transcribed for the purpose of content analysis.

Table 5: List of conducted interviews

Type of organization	**Position**	**Country**	**Field**	**Experience in ecosystem/large collaborative projects**
Start up	CEO	Austria	Medical diagnostics	Yes
Large Enterprise	Vice president	Finland	Welfare sector	Yes
SME	Ecosystem Leader	Finland	Innovation management	Yes
Large Enterprise	Director	Finland	Health analytics and data platform	Yes
Large Enterprise	Director	Finland	Business and sales development	Yes
SME	Senior Consultant	Finland	Health and Biotech ecosystem development	Yes
Large Enterprise	Director	Finland	Research and development	Yes
SME	Director	Finland	Business and sales development	Yes

Participant observation: Primary data was further collected from participant observation. Data collection with this method was done in two ways. Participants were observed alone as well as by both participating in the targeted study group's day to day activities. In addition, data was collected by identifying and developing relationships with key informants, stakeholders, and gatekeepers. Data collected through participant observation helped uncover factors important for a thorough understanding of the research problem. Participant observation data was invaluable in determining whom to recruit for the study and how best to recruit them. Data obtained through participant observation served as a check against participants' subjective reporting of what they believe and do. Participant observation was also useful for gaining an understanding of the relationships among people.

Secondary data collection: Secondary data sources refer to existing data sets that are collected by others and it is widely used in case study research because its strengths in terms of objectiveness and unobtrusiveness (Yin 1994). Secondary data in the form of available documentation was used to complement and to verify the findings from the interviews. Academic literature was searched from several databases using terms such as: open innovation, innovation ecosystems, collaborative innovation, digital health, shared value, commercialization, and key success factors. Other information was searched from the websites of several ecosystem projects which are in progress. Furthermore, documentation was reviewed several times during the research process.

3.2 Data analysis

Qualitative data is made up of words, observations, images, and even symbols. First step in qualitative data analysis includes data preparation and basic data analysis. This first step is divided further into four substeps such as ***i)*** getting familiar with the data, ***ii)*** revisiting research objectives based on data collected, ***iii)*** developing a framework (known as coding or annexing), and ***iv)*** identifying patterns

and connections. After performing the first step in the second stage of the data analysis the following methods have been used to analyze the collected data.

Content analysis: Content analysis defines a strict and systematic set of procedures for the rigorous analysis, examination and verification of the contents of the collected data. Content analysis also accounts for a crucial part in qualitative research as it assists in systematizing acquired data into reoccurring central themes (e.g. repetitions, similarities, differences) that are identified throughout the research process. The content analysis can be either conventional, directed, or summative depending on how the data is coded (Hsieh & Shannon 2005, 1277-1288). A directed content analysis approach has been chosen in this thesis to analyze responses from interviewees. Process of analyzing the data followed Yin's (2011) five analytical phases i) compiling of database, ii) disassembling of data, iii) reassembling and arraying, iv) interpreting, and v) concluding. It comprised of two complete iteration cycles. Color-coding and/or numbering system was used to classify data about the separate themes, stacking together ideas and gathering evidence about observations on each theme. In addition, this method was used to analyze documented information in the form of texts, media, or even physical items. Along these lines, existing theories have been iteratively extended and adjusted in consonance with the gathered empirical results/data.

Grounded analysis: Based on Grounded theory grounded data analysis helps in collecting, organizing, analyzing, visualizing, and publishing the gathered data. Using comparative analysis Grounded theory sets out to identify or formulate theory from systematically obtained and analyzed data. While grounded theory is inherently flexible, it is a complex methodology (Tie et. al. 2019, 1-8). Along the same lines, methodology of grounded data analysis is based on 4C's principle such as i) coding the data, ii) customizing the code system, iii) category building, and iv) constructing theories. Based on grounded theory-based analysis, the data in this thesis was analyzed as per following steps. Step 1: Based on the collected data repetitive themes were thoroughly reviewed and identified. Step 2: Identified

themes were coded with keywords and phrases. Step 3: Coded themes were grouped into concepts in a hierarchical order. Step 4: Relationship identification between different concepts was done by categorizing the concepts. Step 5: Categories created through this process and links found between them have been used as the basis for the development of a new hypothesis/theory.

Computer aided data analysis: Qualitative data analysis was further substantiated by the use of data analysis software's such as NVivo and Atlas.ti

Research design and timeline: Research work was designed based on the conceptual framework as described in Chapter 1. Thesis research process and timeline of the work is presented below (Figure 22).

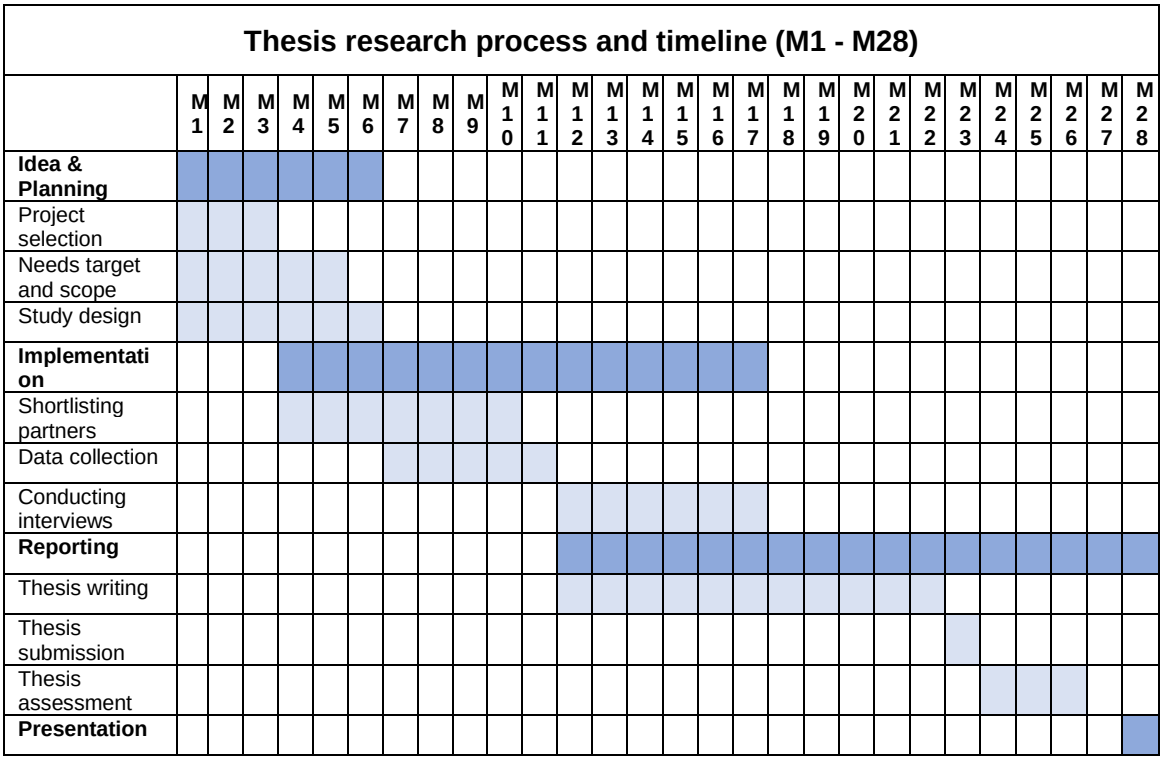

Figure 22. Timeline and research process for the master thesis

4 RESULTS OF THE RESEARCH

Six themes used in the data collection process were as follows.

Theme 1. Innovation ecosystem and willingness to join innovation ecosystems.

Theme 2. Shared vision and expectations

Theme 3. Ecosystem strategy

Theme 4. Role of trust and collaboration in creating value within an ecosystem,

Theme 5. Commercialization of the innovation ecosystem

Theme 6. Innovation management

Results presented in this thesis shows how the interviewed organizations (participants) have answered within each theme. Obtained results emphasize on Willingness *to join innovation ecosystems, Willingness to work with competitors, role of an anchor partner, optimizing value chains, Expectation Management, Shared IP, common vision, role of company strategy, hidden agenda's, flexibility, and ecosystem Strategy* are explained in detail in the following subsections (Figure 23).

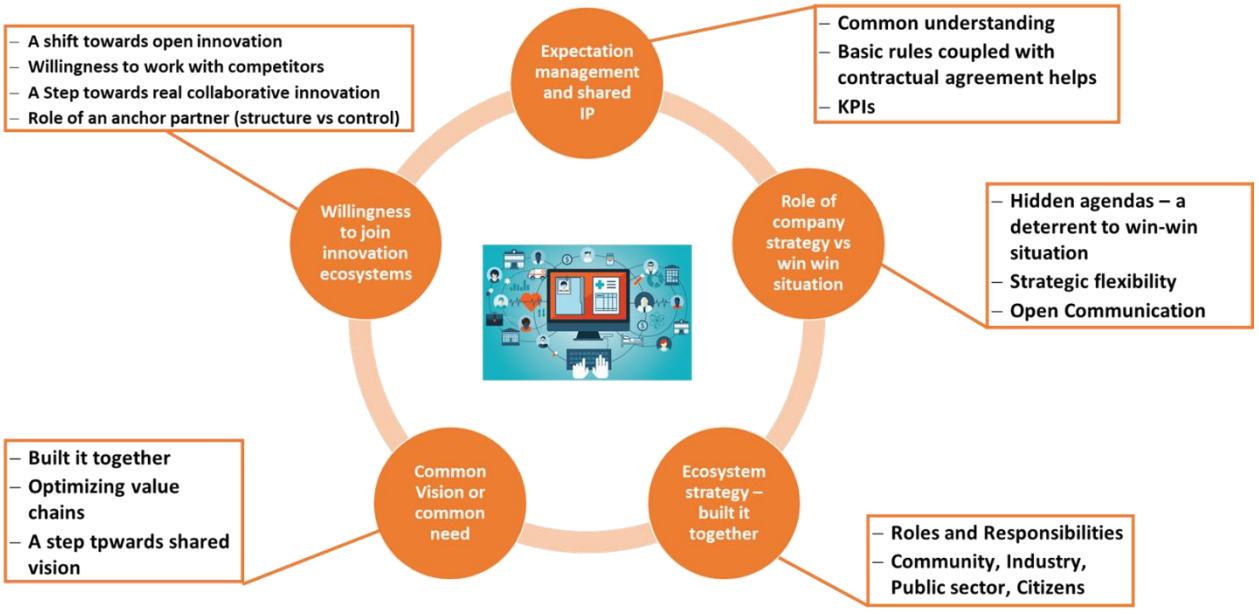

Figure 23 Results of the research work (by author)

4.1 Willingness to join innovation ecosystems – a shift towards open innovation

It was clear from the collected data that there is a clear consensus or willingness to participate in the innovation ecosystems (regardless of the domain). Now a days problems are so huge, for instance, fighting cancers, solving climate change or solving the food problem in the world that one needs huge network to solve such problems. For example, human genome project is a big ecosystem, no one could have solved that alone. No single institute was big enough or capable enough to solve it. There was a clear need to have a global network to solve a problem of such a scale. To produce innovations or innovative products or services requires trans disciplinary approach meaning organizations needs to have deep understanding of different domains such as IT skills, digitalization skills, biology, medical, optics, MEMS etc. No company can now a days find all these capabilities in house so there is a clear need to collaborate with different stake holders like universities, R & D institutions, SMEs, and even with competitors in a way to be a part of needed network or ecosystem. By participating in a network/ecosystem, different stakeholders have the possibility to access the future ideas (or innovative solutions) which might lie somewhere else that they cannot even think about it by themselves (one of the principles of open innovation). By looking at what is happening in USA and Europe, there is clear push for personalized medicine consortium, cancer consortiums, digital health ecosystems, smart city initiatives, and carbon neutrality by 2050 etc. Reasons/Willingness to join an innovation ecosystem are company or organization specific. Primarily the reasons for organizations to participate in an ecosystem are as follows.

1. Aiming to generate new business revenue
2. To avail benefits of partnering, networking and (much needed) funding
3. To build new emerging business areas
4. To expand solution that can add value on top of the enabling technology

5. To provide some kind of common elements (generic solution) that can be shared between multiple solutions
6. Branding or positioning themselves as a modern company willing to open up and collaborate
7. To evolve as an organization to be more successful

Willingness to work with competitors - A step towards real collaborative innovation: A consensus was found that in innovation ecosystems companies are willing to work together and are ready to sort out their differences/concerns in the beginning of the projects. Every participating company in an ecosystem could be a competitor, on other hand all companies can be partners. Hence it is not black and white anymore. In HUS ecosystem two big Finnish IT companies are working together. Within this collaboration both companies are negotiating and discussing rules for shared IP. Safe to say that time is changing. This kind of cooperation could not have been possible 5 years ago. It was quoted that ‘*’Yes competing companies do work with each other. Now a days, they have to otherwise they will not survive, there is no other way. Key question is how open are competitors? I think everyone could be more open, it take some time. It is still people business; one has to gain trust and be more open*’’

Role of an anchor partner – structure versus control: Ultimate target of an ecosystem is commercial success. In an ecosystem there needs to be a party with responsibility of eventually for go-to-market. It was quoted that *’’ there needs to be a party, preferably one instead of multiple with responsibility of eventually for go-to-market. I would call that as an anchor partner in the ecosystem’’*. This anchor partner somehow needs to control the rest of the value chain. if there is an open competition within the value chain without control then it is difficult for competitors to work together. Otherwise, it should be possible to work together even with competing interests, however, it requires control and structure. In other words, a structure (like ecosystem) always requires a control. *’’An argument was put forward*

that conflicting interests between competition requires structure that is non-trivial to achieve''.

4.2 Expectation management and shared IP

In an ecosystem all partners have to win, and it has to be a win-win situation for all. One must understand the different expectations of different kind of partners. There is a need for clear visibility and transparency throughout the project. It was quoted that, *''academics want to publish scientific papers (their motivation), some industrial partners would like to have IPR licensing or to be sold afterwards, some organizations would want new product in the market (commercialization)''*. There is a clear need to understand the motivation/expectation of each partner. It might not always be money (money could be the tool or an added advantage). It was pointed out that *''trust and control with clear rules as well as clear key performance metrics (KPIs) keeps everyone in an ecosystem motivated throughout the project''*. One must have a set of ground rules for organizations to play with. Key questions are

1. *Have rules been defined and if yes then how it has been defined?*
2. *Do all partners have common understanding about what all are aiming for?*
3. *Is there still room for improvement?*

It has been found that in some case there has been secondary interests by organizations. These interests should be communicated in the beginning so as to have more trust between each other. It was quoted that, *''One needs to understand when working with different industries that there should be clear priority to understand their rules and what they think. And what creates problems. How do u manage IPR''?*

Shared IP: Most of the ecosystem projects, especially in the beginning, have encountered conflicts regarding how intellectual property coming out from the project will be shared among the partners. These conflicts have slowed down the

start of the projects. However, there is clear consensus or cooperation between partners to solve this conflict in the initial beginning phase. In ecosystem projects funded by public funding agencies such as European commission or national funding agencies such as Business Finland in Finland, all partners must adhere to the model contracts prepared by these funding agencies. These funding agreements outline the initial ideas about how to divide the IPR generated from the project. However, in industry funded ecosystems rules are different. It has been experienced (specially in medical technology or drug discovery sector) that a big industry player (primarily the main driver of establishing the ecosystem) tries to dictate the terms which are favorable to them (monopolizing). Rules are also dictated to certain extent by investors or venture capitalists (VC's) in industry funded projects. Companies/organizations which have no prior experience of working in an ecosystem environment always hesitate about IPR and what kind of contracts should be made. To handle such situation an experienced program leader of several ecosystem projects quoted that *"to handle such situation the basic rule has been that key bullet points should be described in the beginning and said to everybody. Who invents will be granted the title of inventor? It should be recognized that if it is a joint work then all people involved should be recognized and involved in patent".* Contractual issues should not hinder the progress of the preparation and functioning of an ecosystem. As more and more organizations are working in an ecosystem environment it's been taking less and less time to reach to contractual agreements. Basic rules which have helped to accelerate the process of contractual agreements are as follows;

1. Who invents will be granted the title of inventor.
2. In case of a joint work all partners involved will be awarded the title of inventor
3. Other partners in the project will have the right to use the patents coming out of the joint project.

Hence basic rules coupled with contractual agreements helps.

Common vision – built it together: In the preparatory phase of the ecosystem, first step is always to build a common vision of what an ecosystem would like to achieve. Then obviously a big question is how each partner can contribute into this big vision. What each partner will bring in for others and what do they expect from others. It has been seen from current practices that shared vision is primarily initiated by the core players who have identified the need and defined the target to be achieved within a given frame of time (typically within 2-4 years). This need based shared vision is then elaborated to other partners in the preparatory phase. It was quoted that, *"If an ecosystem have a good strategy with all partners aligned towards it then former will have a good shared vision, its goes hand in hand that everyone Is committed then you have the shared vision"*.

Optimizing value chains – a step towards shared vision: Innovative companies are dedicated to solve a customer problem. These companies are the ones most interested in business opportunity by providing profitable products and/or services in the market. Their vision is to enter new business areas or make the current area more competitive, more lucrative. To realize their vision, they join innovation or business ecosystems so as to connect with right partners (establishing partnerships) which will help them to achieve their vision. For instance, by collaborating with an R & D institution in an ecosystem technological innovation can be achieved which can then be in licensed from the ecosystem (*outside in open innovation principle*). It was quoted that *"I do see conflicts and I think there is difficult/may be impossible balance with the openness and control. Publicly funded ecosystems are built on the open principles, that easily resounds that the value chains are not ideal from some view points".* For instance, if there are parties with similar value-added role (*or overlapping interests*) then duplication is highly likely and path to commercial success will be more difficult. So, the challenge in such an environment is to how to create an optimized value chain.

4.3 Role of company strategy vs win-win situation

Whether competing companies can work together in one project also depends on the company strategy. It was quoted that *''if companies see a win-win situation in certain market or if they divide the market somehow or if they make a deal, we develop this together then u sell it in US and we sell it in Europe, I think now a day's competitors are working together''.* One real case example came from Life Science sector (specifically molecular biology) where a rising SME and multinational Hoffman Roche worked together and in process helped each other and result was a new product. Roche licensed their PCR technology to SME and in return SME shared their results with them which led to new product which in the end was marketed by Roche.

Hidden agenda's – a deterrent to win-win situation: In traditional way of working, one could hardly tell an organization's primary agenda. It has been found that in previous projects that every company has official agenda as well as hidden agenda/needs (not necessarily in a negative way). Such hidden agendas has been deterrent to win win situation. However, it was quoted that, *''organizations can't achieve its hidden agenda/needs if you don't tell your partners in the ecosystem''*. In this kind of ecosystems, one has to be more open and able to tell their motivation and agenda to other partners. It was quoted that, *''Its important to understand that in some cases there could be overlapping agenda's and have to negotiate with other''*. Openly communicate between each other as well as organization working in the projects. Communication should not be in the hands of few people; it should be effective and broaden. It was quoted that, *''Basically companies/organizations don't do the collaboration. Collaboration is always between people, and of course role of organizations comes after that, you need people who gets interested in the topic and willing to work with others, willing to share. Then they need to commit even the organizations to the working mode. If it is not possible to identify the people who can't collaborate/commit then open innovation is not possible''.*

Flexibility: An enabling environment for innovation and entrepreneurship is facilitated with the strategic flexibility in the ecosystem. Such strategic flexibility and enabling environment may lead to formation of disruptive brad new start-ups covering a broad combination of products and services. Enterprise level flexibility alone would not be sufficient and effective until the rest of the ecosystem is also flexible. The maximum maturity level of flexibility would lie in the strategic flexibility for the ecosystem as a whole. Alon these lines, the ecosystem consisting of technology, partners, suppliers, market, regulators, application providers, financiers, and many other relevant actors and processes would create strategic flexibility for innovation, new product development, new market creation, and meeting unforeseen changes in the environment.

4.4 Ecosystem strategy – Built it together

Being complex and non-linear in nature ecosystems require different strategic thinking in comparison to existing corporate strategy. The predominant view of strategy has been based on Michael Porter's ideas about competitive advantage. Key to success, as argued by Porter, was to dominate the value chain by maximizing bargaining power among suppliers, customers, and new market entrants. Porter's ideas dominated thinking in corporate strategy for decades, yet they had a fatal flaw that was not always obvious. Thinking in terms of value chains is viable when technology is relatively static, however, when the marketplace is rapidly evolving it can get you locked out of important ecosystems and greatly diminish the ability of a company to compete. It was argued that power derives from the center instead of at the top of a value chain. You move to the center by connecting out. The truth is that markets today are much faster, more interconnected, and more complex than they were when Porter formulated his ideas about competitive advantage. If companies are always looking to strengthen their bargaining power then former are likely to cut themselves off from critical information as well as capabilities needed to effectively compete. Today, rather

than looking to dominate value chains, the company seeks to widen and deepens connections with research partners, customers, and startups.

4.5 Discussion

This section interprets and discusses the empirical results in relation to existing theories and research within the topic of interest.

Societal benefits of digital health: The way healthcare is provided is changing considerably. Medical care and disease interventions in the future will no longer be restricted to hospitals, clinics, or medical offices. However, healthcare services will be available and provided anywhere in people's normal life, especially in their homes. "*Five to seven years from now, we'll look back on this time period as when the inflection happened, when remote care flipped from eclectic proof of concepts and pilots to become the new standard of care*," said David P. Ryan, General Manager, Health & Life Sciences Sector, at Intel. Instead of the "first touch" being an urgent care clinic or, more likely, an emergency room, Ryan envisions a time when it will be an app, an email, or a video call. This trend of a digital and decentralized healthcare will not only have an impact on how medicine reaches the patient but will require a redefinition of the role and positioning of healthcare providers. Digital health industry has the potential to provide suitable system solutions, both to support the rising importance of personalized delivery of healthcare and to smarten existing healthcare providers and to help the population in changing behaviors to improve their health. It is extensively recognized that healthcare systems must focus on prevention and embrace a person-centered rather than a disease-centered approach. The goal must be to overcome service fragmentation and to move towards integration and coordination of interventions along the continuum of care. Personalized early risk prediction models can empower the participation of citizens and facilitate the transformation of health and care services to more digitized, person-centered, and community-based care models. Such a change will ensure that communities have better access to the

healthcare. Digitalization and increased use of digital health will substantially increase the sustainability of healthcare systems. However, the current challenge is to develop and validate these comprehensive models based on artificial intelligence (AI) or other state of the art technologies for prediction, prevention and intervention using multiple available data resources and to integrate them in personalized health and care pathways.

It will empower individuals to actively contribute to risk mitigation, prevention, and targeted intervention. Secure and interoperable data as an enabler together with state-of-the-art technologies such as AI and Big Data analytics are essential building blocks for the digital transformation of health and care.

Innovation and translation gaps in healthcare sector – Why it takes long time from ideas to products in the healthcare sector? Translational research is intended to bridge the gaps between basic scientific and clinical research and its implementation in clinical practice. Translation research is a dynamic, multidirectional process which demands effective transdisciplinary collaboration to produce research that is relevant to end-users. There is a strong evidence which suggests that the translation of scientific results into clinical practice fails if the underlying science is not solid and proven (Shaywitz 2012). An effective innovation ecosystem handles systemic failures and facilitates efficient utilization of resources (EC, Open Innovation 2.0 yearbook 2017-2018). It is increasingly recognized that there are different ways to model, classify, address, and help understand various barriers to economic impact and clinical practice from research excellence to market.

Two-valley innovation chain model: This model recommends the need to address, in a nonlinear manner, all maturity levels for exploitation of the results of the research. Valley 1 (innovation gap) indicate to the reduced capacity to decipher

the results of innovations/discoveries enabled by basic research into real life practice and to successfully commercialize the discoveries (Figure 24).

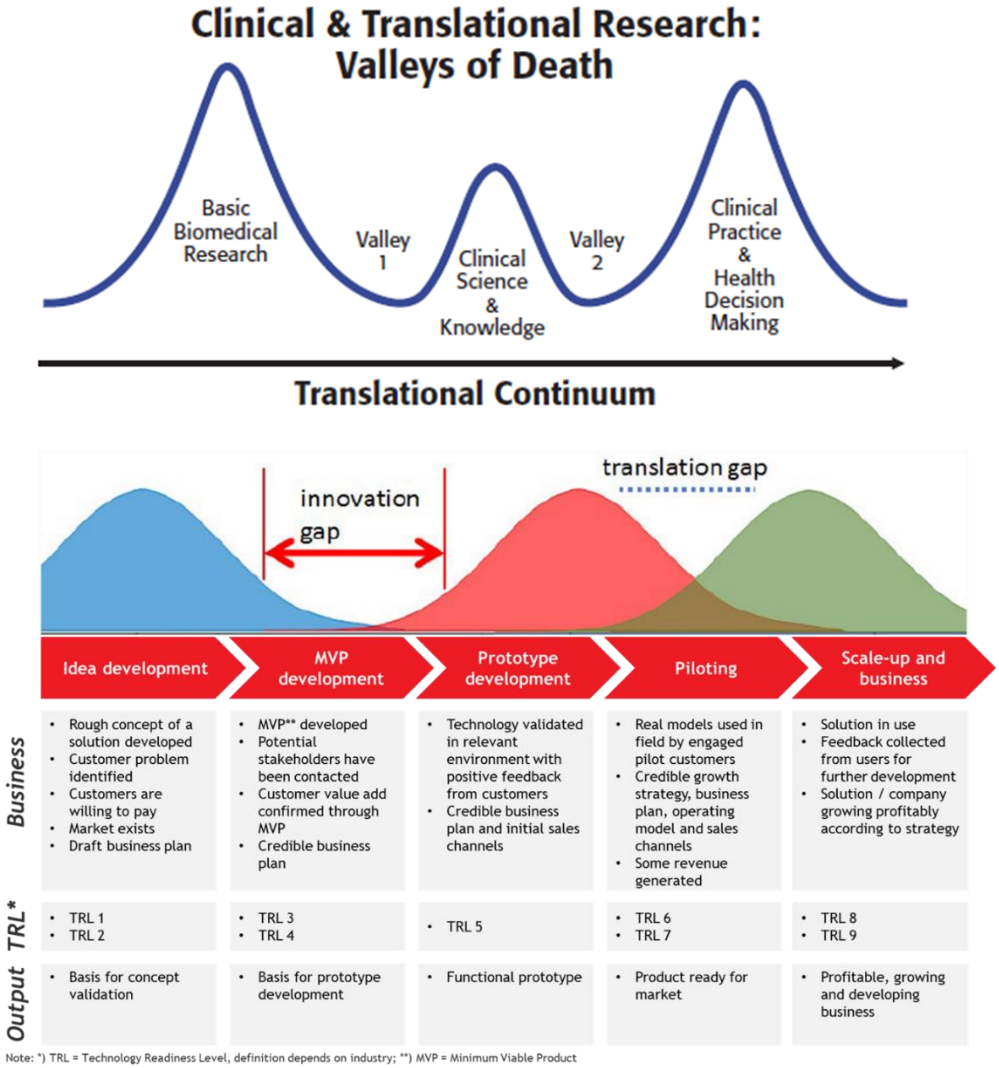

Figure 24. Two valley model: The two valleys of the medical research to practice continuum (Shaywitz 2012).

This gap has a substantial negative impact on the research and knowledge base. Valley 2 (translation gap) indicated the limited capacity to synthesize, disseminate and integrate (translate) research results more broadly into practice and economic value. There has been a great push to reduce the distance between innovation and

translation gap. All measures that squeeze the distance between the innovation and translation gaps are useful to speed up the adoption and scale up. Non-linear multi-collaborative growth model has been proposed to squeeze the gaps. Factors which have been identified to reduce the gaps are ***i)*** collaborative policymaking and design, ***ii)*** multi-policy/strategy approaches, ***iii)*** knowledge sharing, ***iv)*** joint decision, and ***vi)*** dedicated budget. Disruptive technologies and related ecosystems benefit from collaborative policymaking. In addition, ecosystem centric large partnership initiatives (e.g. public‑private partnerships) have significant potential to squeeze the gaps.

New health care model enabled with digital health ecosystems: A revolution in healthcare is being led by digital technology and digital health ecosystems. Digital tools are giving healthcare providers a better view of patient health through access to data. In 2025, digitalization will be common in our society and will bring healthcare from clinical centres into the everyday life of the citizen.

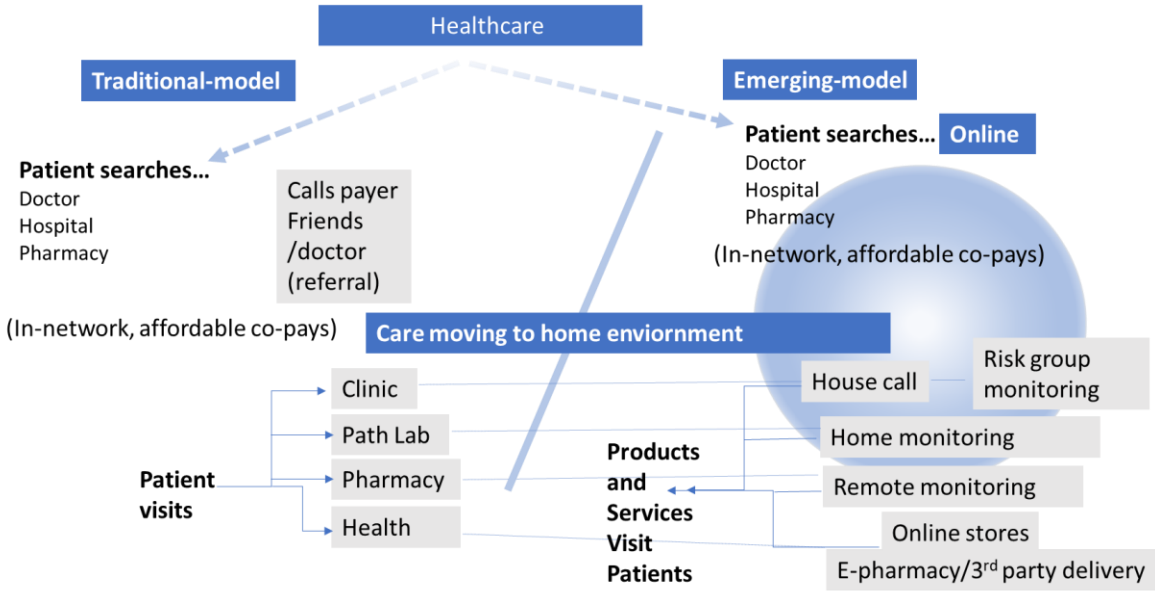

Figure 25. Emerging new healthcare model - decentralization of health Care services enabled by digital technologies (Siddharth 2019)

The development of digital health ecosystems (comprising digital health platforms, health monitoring wearables and devices, mobile applications, and online services) empower individuals to monitor against a norm, manage, track, and improve their own health. It has opened new markets of solutions and services directly targeted at both healthy and patient individuals and positively impacting the effect of preventive healthcare practices. A variety of socio-cultural, technological, and governmental factors are driving digital health adoption in this space. The EU is developing strong approaches in high performance computing, data analytics and AI, which can help design and test new healthcare products, provide faster diagnosis and better treatments. However, the success in these endeavours depends on the availability of vast amounts of high-quality data and appropriate regulatory frameworks that will safeguard the rights of the individual and society as well as stimulating innovation. Digital solutions are enabling a shift from hospital-centred systems to more community-based and integrated care structures (Figure 25).

Digital technologies are already enabling the shift: Decentralization and connectivity together have substantial potential to tackle several of the current challenges of healthcare systems. Importantly it will result in better health outcomes for citizens while reducing the financial burden on the public purse. Successful deployment of this will require the combined and collective efforts of decision makers, healthcare professionals, healthcare institutions (hospitals), community-based facilities and patients. The digital healthcare tools and technologies such as AI, cloud, bigdata/advanced analytics, telehealth, mHealth (applications & wearables, sensor-based devices), and patient health records are already enabling shift from the clinic to home (Figure 26). Wearables and associated mobile apps are directing towards building a support infrastructure of inform, instruct, store, guide, and alert. Natural language processing (NLP), machine learning, and advanced AI algorithms are helping in patient condition management. Frost and Sullivan report published in 2019 has shown that adoption

of AI technologies has reduced healthcare costs by 50%, while improving patient outcome by over 50%. Advanced analytic frameworks evaluate unstructured data such as EHRs wearables and mobile applications. Cloud services allow patients and care providers to access, download and transfer medical information, test results, prescription, medical dosage, and doctor's appointment. Telehealth/Tele medicine is enabling care at home and intervention when needed and it is coupled with remote patient monitoring.

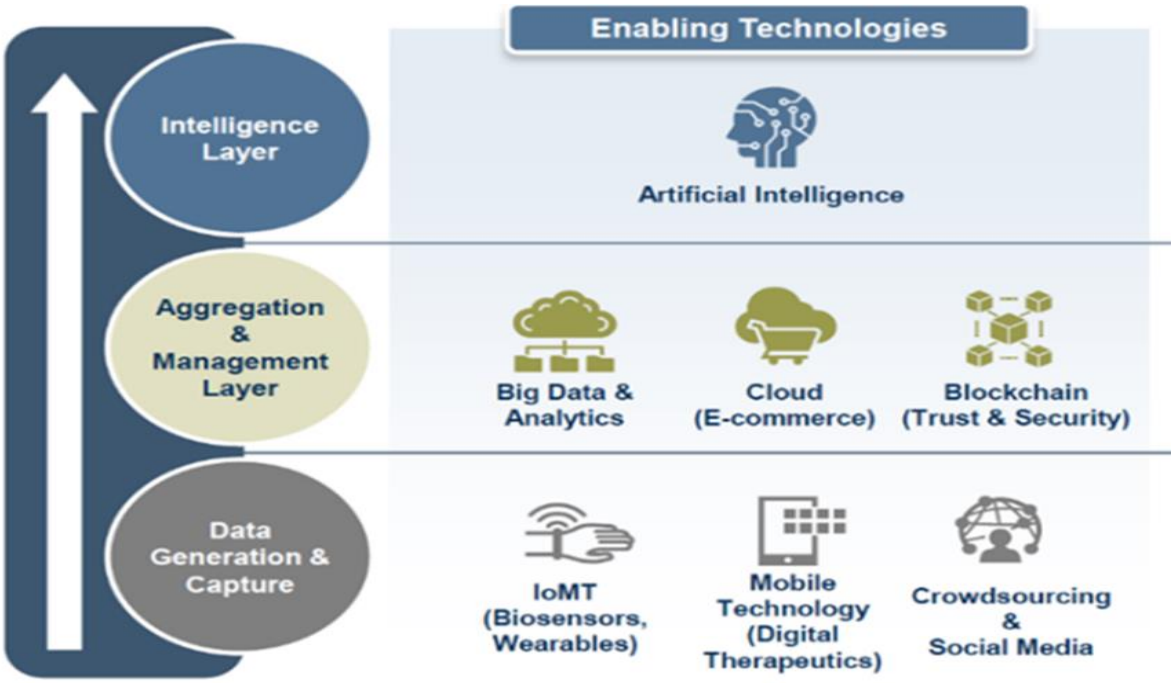

Figure 26. Digital technologies enabling the shift (Mathur 2019)

5 CONCLUSIONS

The aim of this study was to study key factors which might help organizations to innovate faster while working in a collaborative innovative ecosystem. The objective of this study was to implement these driving factors in real world so that organizations work together, innovate faster, and create business opportunities by providing profitable products and/or services in the market. The research question of this study was to how these factors can impact the success of collaboration while working in an ecosystem environment (where several players/partners are involved). This work crystallizes into five key success factors addressing the research question. Proposed key success factors are

i) new rules demand new skills,
ii) trust and mobility,
iii) winning by sharing not closing,
iv) user and industry collaboration, and
v) collaborative and co-creative culture.

This section also highlights the key managerial implications of the study.

5.1 Proposed by author - key driving factors for the success of any ecosystem

In conclusion this research work outlines the following five key driving factors which could play a significant role in the success of any innovation ecosystem (Figure 27). These are explained below.

New rules demand new skills: Foundation of open innovation ecosystems is common values and common purpose-driven actions instead of organization or instrument-driven ones. Common values and/or common goal can be achieved effectively if people's skills match with the requirements. With right skills people can contribute better towards the common goal. It is also essential to look at the new professions and the new rules people need to adhere to be able to form

effective innovation paths. We need orchestrators for setting common objectives, creating an interaction, and initiating a common vision for all quadruple helix players. Orchestrators lead the value shaping process like the conductor of an orchestra who determines how the masterpieces are to be performed. Curators ensures that the quality and transparency is used to full extent in ecosystems. Curators are responsible for consistency and quality of knowledge. We need bridgers who are central to creating and initiating actions in the innovation ecosystem. Bridgers bring the curated contents together under the commonly played masterpiece. Bridgers need to be T-shaped persons with broad knowledge and curiosity about everything and courage to link together very wide competences. And finally, we need to have systems designers who enable this interaction to take place in the ecosystems in a highly spontaneous manner.

Trust and mobility: As discussed, research community, industry, public sector, and citizens play an important role in innovation creation. To enable structural intellectual capital to grow which is an essential for success and competitivity, the trust and mobility between the four player groupings needs to be in place. Without common values and commonly agreed (behavioral and compensational) rules a sharing economy is not possible nor are genuine open innovation ecosystems where additional value is built on shared commons.

Winning by sharing not closing: OIEs acts as a tool to attract talent, financial resources, and ideas to be experimented with. When these ideas translate into prototypes then latter can be tested in the real world. OIE create strong interdependency and a drive to make things happen. OIE leads to the need to engineer, design and deliver the portfolio of activities to create a win-win situation for all involved by sharing not closing. OIE have the possibility to drive the change by merging the technology enablers like ICT, digital health etc. with societal change.

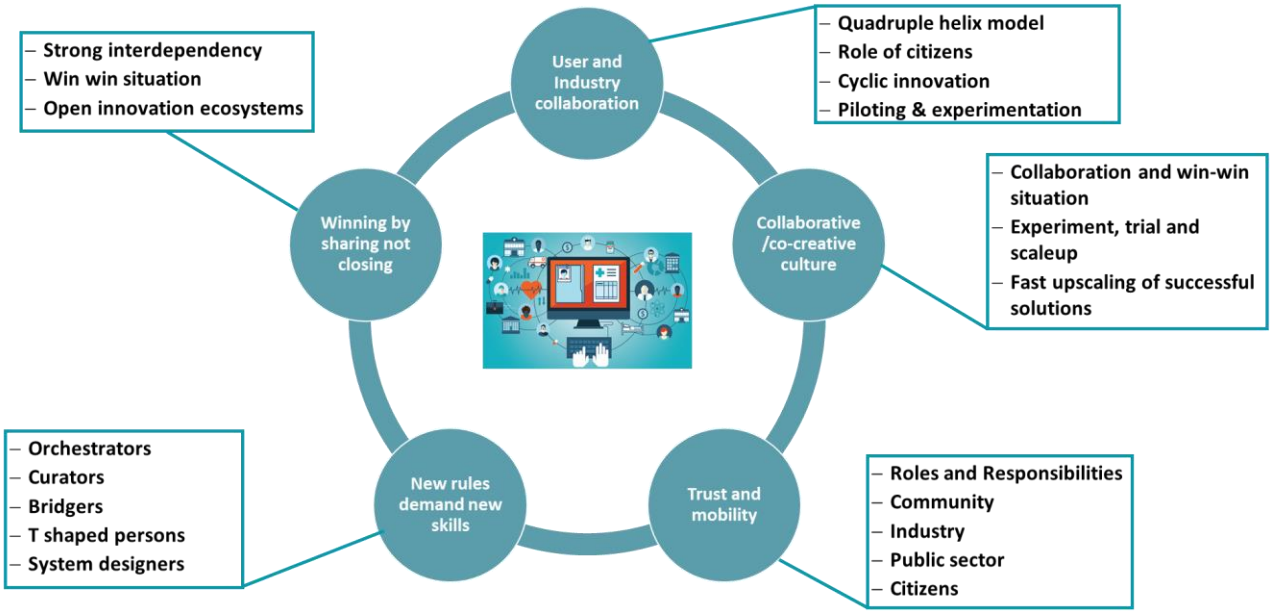

Figure 27. Key driving factors for the success of any ecosystem (proposed by the author)

Users and industry collaboration: Quadruple helix components needs to be actively present and contributing to commonly agreed values in modern innovation ecosystems. As described earlier citizens (civic Society) plays an important role in this model. From an innovation perspective, generally citizens are considered as passive users. The research institutions, industry as well as community is bringing new seed into the innovation system. The former interacts with the real world users via research, technology, developement and innovation. The users based on this interaction act as a piloting and experimentation environment which in return leads to creating new markets for products and services. Cyclic innovation can also be initiated by the cool creativity of the users. What is important is that we have the fast cycle of new market creation where users and industry are the key. In longer/slower cycles infrastructures (conditions for innovations) are being created. Public sector has an important role to foster conditions of innovations for instance by investing in infrastructure development as well as to create favorable conditions for frictionless processes in the faster innovation cycle.

Collaborative and co-creative culture: Open innovation environment demands for a R&D&I methodology based on the courage to experiment, trial, scaleup and daring to fail small but not big. OI2 demands for different types of mind setting where the participation of all stakeholders in a collaborative, co-creative culture is key. Collaborative and co-creative culture highlights the importance of the quadruple helix model. All actors involved in this model play crucial role. Involvement and collaboration of the key actors of quadruple helix model creates a win-win situation for all. Such a collaboration is aimed to create new markets as well as the fast upscaling of the successful solutions. Public support for the ecosystems is not only important in funding but also as a vital participant in creating the basic principles and/or rules of the ecosystem. It helps in increasing trust as well as increasing the open mindsets of all participants in their various simultaneous roles.

5.2 Managerial implications

Ecosystems are inherently international so the outcome of this research work can easily be implemented to study any ecosystem in the world (Figure 28).

Defining common need: Each company has their own thinking and strategies. But important thing is when building something together as per common vision all partners must steer and bring everything in the same table in keeping their own company strategies aside and built a common strategy for the ecosystem (supporting their own company strategies). Its natural that different players will have their own different strategic thinking and bring their own special knowledge. By defining common need in the very beginning of the project helps all partners who can solve the need by building solution together. It was quoted that, *''To have value chain players which complement each other and create higher value while working together one should have fast implementation thoughts already from the beginning of the project so partners understand that each partner can take something out of the big project at each step''*.

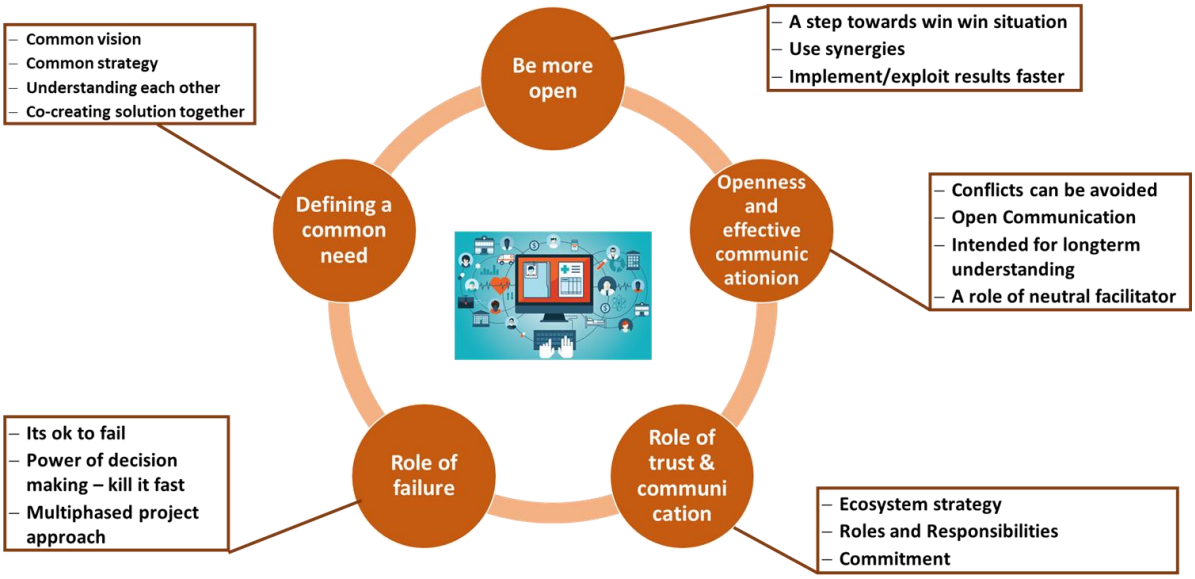

Figure 28 Managerial implications of the work (by author)

Be more open – a step towards win-win situation: It was quoted that, *"In an ecosystem all organizations are 65-70% open. How it can be improved? Because 30% is huge number"*. Within an ecosystem, we typically built several projects. Project contains the action; certain targets and it promises the results. For each ecosystem one needs to select best competence for each project/subproject. An ecosystem is a very dynamic entity where there are many targeted oriented projects, and such an ecosystem has the potential to create lot of value. While building a project, one should be fair with their promises to others. When partners participate in a project, they have some need in their mind. Partners bring new knowledge to the project and are willing to combine the results of this project/ecosystem to the other work they are doing and vice versa. Such synergies help to implement/exploit project results faster. This is very crucial aspect that one can take certain part of the result during the project and implement it in own/own/another project. It ensures faster cycle of value creation and exploitation.

Conflicts can be avoided with openness and good communication: There can be several competitors in one ecosystem but its not recommended to include competitors in one project which is very critical for business of the player involved. In contrast if the goal of a project is to develop something more for future and of general interest then participation of the competitors in the same project is feasible. It was quoted that *"In the past it has been observed that some big companies never participated in a project with competitors unless it was standardization or regulation related project"*. However, companies always worked with companies in projects, not directed towards short term businesses, intended for long-term understanding such as sustainable life cycle management project. Recently, there has been change to this approach. By not bringing competitors in one project an atmosphere of trust can be built faster and a neutral facilitator can play a key role in such a situation. A neutral facilitator in an ecosystem has the ability to discuss key issues with partners separately before bringing them together. In a way it helps in creating a right mindset within an ecosystem. Hence conflicts can be avoided via good communication and facilitation.

Role of trust and communication in establishing ecosystem strategy: Ecosystem strategy should be communicated to everyone regularly. One needs to understand that individual partner strategies are different for a company, universities, and R & D institution. Best way to get the commitment is to involve each partner in building that strategy so all are involved in the strategic process. It was quoted that, *"when you make the strategy then best commitment is with those people who are in the process of creating/defining the strategy".* Everyone should be benefitted while being in the ecosystem. There is a clear need to have a sub strategy in an ecosystem emphasizing on the commercialization/exploitation of the ecosystem results. Strategic process must outline steps to ensure that ecosystem work translates into results which are technological as well as economically feasible. Innovation potential of the ecosystem/project results should be continuously assessed throughout the project according to the innovation

management plan. The ideas to be protected and exploited should be discussed with all partners. So trust within ecosystem is highly important. Communication plays an important role in establishing ecosystem strategy. Communication clarifies the steps taken to involve all partners in the project to create a shared vision. Communication also helps in committing the partners in the project and in keeping them motivated. It lays the foundation of building trust and to make all partners work together. Its good to get different opinions and challenge each other and in a process help each other. Little by little built the commitment and trust.

Role of failure – A step towards thinking that ''Its ok to fail'': Projects in an innovation ecosystem often falls in a category of high risk high reward projects. While working with high-risk R & D projects there is high probability to fail. If no one fails in these main projects, then it could mean that the selected projects were not high enough risk projects. However, if several sub projects have failed, it gives an indication that this is not the way to proceed. It was quoted that*, ''in high risk high potential projects its ok to fail and then understand why we failed''.* A detailed analysis of failure is needed. Project failure could be highly important aspect for the joint projects which should be considered all the time. It could inject a sense of flexibility in the whole ecosystem. This flexibility/agility could be the ability of an ecosystem to change the plan when needed based on the real needs. It was quoted that,*''ecosystem partners should be open for questioning the original plan and change the plan when needed, prioritize things, and do push for active program management/ecosystem management and follow flexibility''*.

Project failure 1– power of decision making to *Kill it fast:* One has to measure the value creation during the project continuously. Key performance indicators have to be defined and followed throughout to keep the projects in a right direction. If a project shows early warning signs that it's not feasible anymore then ecosystem should have the flexibility to follow the principles of *kill fast*. Project in charge should have the power of decision making and support of ecosystem leaders to replan and realign the goals. It was quoted that, *''project needs good KPIs, people with power*

of decision making, power of saying that lets take another direction''. Flexibility also highlights the role and degree of trust within an ecosystem. Ecosystem must give the power of decision making to project leaders and have trust in their decision-making capabilities.

Project failure 2 – A step towards multi-phased project approach: Value chains were short and simple 15 years ago, however, these days value chains are long and complex. It was quoted that, *''In short value chain it used to be easy to kill a project, however, in a long value chain where there are multiple parties investing a lot and if certain elements doesn't work then it is a crisis.''* Based on real life (practical) experiences lot of importance to ''phased approach'' has been given in certain projects, meaning carrying out activities in several phases. For instance, Phase 1 is a feasibility study, Phase 2 is innovation project, Phase 3 is commercialization. A walkaway option is available in each phase. It was quoted that, *''how I see all projects needs to be phased and there needs to be a stage gate where project should be assessed''.*

How commission company can benefit from the research?

All partners involved in ecosystem have diverse and different internal drivers and objectives. It makes OIE projects complex, demanding and involve high technological and commercial risks increasing the level of complexity. Spinverse has developed its own maturity model to assess a company's capability to run open innovation R&D&I projects (Figure 29). Spinverse's assessment model is based on 1) top management engagement, 2) current portfolio, 3) initiation, 4) partner search, 5) collaborative attitude and 6) commercialization. The research work presented in this work will help Spinverse in strengthening their assessment model especially regarding collaborative attitude and commercialization. Spinverse has already used this work to convey the benefits of innovation ecosystems to its customers. Second, this work will help Spinverse in running their current ecosystem projects in a better way. The key success factors mentioned in this work will be implemented in present and future projects. Please see assessment and

feedback on my pilot work from Spinverse (Appendix 2). I have been and will continue to play a key role in implementing these success factors in running open innovation ecosystem projects in Spinverse.

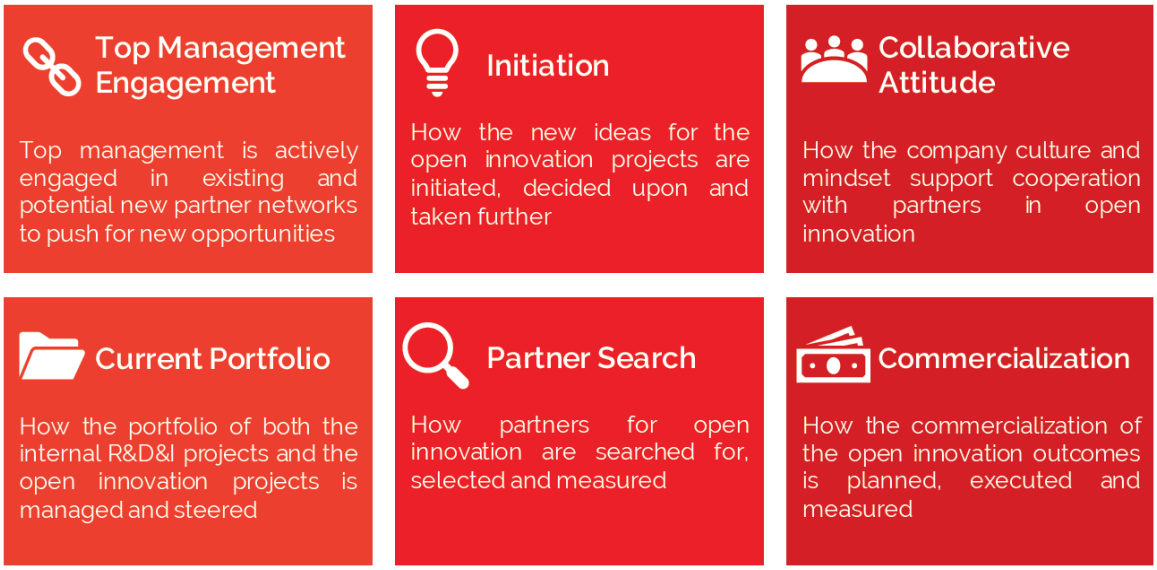

Figure 29. Spinverse maturity model (Ropponen 2018)

Analysis, reliability, and validation of the collected data

The analysis, evaluation, reliability, and validation of the collected data was based on the criteria proposed by Yin (1994). It emphasizes the use of *construct validity*, *external validity*, and *reliability* as three main evaluative criteria for assessing the quality of research (Yin 1994). High *construct validity* of empirical findings of this work was achieved by using both triangulation of data sources and methodological triangulation. Triangulation of data sources was achieved by selecting a startup with 20 employees, SMEs with 50-500 employees, and large enterprises with 1000+ employees. Methodological triangulation was achieved by the use of primary data (interviews), secondary data (documentation) and participant observation for data collection. The combination of alternative research methods increases the credibility and the validity of the study (Bryman & Bell 2015).

High *External validity was achieved* by choosing respondents (interviewee for data collection) who have been involved in several public and/or privately funded ecosystem or large scale multiparty collaborative projects. Involvement of such an experienced people for data collection makes the findings more generalizable and hence increased external validity. High *Reliability* has been achieved in this thesis work by providing a thorough description of the processes of data collection (primary, secondary and observation methods) and data analysis (content analysis, grounded analysis, and computer software aided analysis). The objectivity of the study has been ensured by iterating the findings several times. In other words, this means that the findings reflect the respondents' actual thoughts rather than the researcher's interpretations.

Research limitations and future study suggestions

Single case studies generally involve the limitations of naturalistic research, meaning that the analytical generalizability the findings is limited to the specific contextual setting (Yin 1994). Nonetheless, the findings of this thesis can easily be extended and generalized to private or publicly funded ecosystems in other industries due to the involvement of respondents with varied background and extensive former experience from consortium projects. This thesis provides detailed insights into digital health, trends affecting healthcare models, new health care models enabled with digital health ecosystems and implementing key driving factors for the success of any ecosystem. Hence, four main suggestions for future research are as follows:

First, finding of this thesis should be applied to innovation ecosystems in other industries.

Second, once studies have been carried out in different industrial sectors then one should study best practices for the innovation ecosystem.

Third aspect is to study in detail how to measure value creation at each step of a project in an ecosystem.

Fourth, it will be interesting to study the role of a neutral facilitator in innovation ecosystem projects.

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7 APPENDIXES

7.1 Interview questions

1. Practicalities
   a. All answers will be treated anonymously.
   b. Can I record this interview?
2. Personal role
   a. Please state your current position?
   b. Please explain your role in the innovation project?
   c. Any prior experience in other open innovation ecosystem projects?
3. Why companies join innovation ecosystems (business focused answer).
4. Shared vision and expectations of the innovation ecosystem initiative
   a. Can you please describe why your company/organization participated in this ecosystem?
   b. What are/were your company/organization's expectations towards the project outcomes, innovation/creating value point of view?
   c. How will/did your company/organization ensure that your expectations are taken into account in the innovation ecosystem? How they see or measure that its been fulfilled?
   d. Were there any conflicts (while building the ecosystem or during the project)? If yes could you please elaborate, how did the ecosystem/consortium managed conflicting expectations across different companies/organizations? (Rules/IPR defined at this stage?)
   e. Can companies work with competitors?
5. Can you please elaborate on how the project was started? (starting process)
   i. What role did your company/organization play during the starting phase? Were you the key drivers for this ecosystem? Were you Ecosystem leader/coordinator/contributor?
   ii. Can you think of any hindrances (such as agreements, IPR, share of the innovation etc) that held back/delayed/? the starting phase of the project?
   iii. What, in your opinion, were the (key success factors or) main objectives-key performance indicators set in the beginning of the project (keeping in mind the innovation/value creation) during the starting phase?
6. How would you describe the shared vision/strategy of the innovation project? (how did you formulate shared vision strategy)
   i. Do you have a shared vision/strategy? Can you describe how a shared vision was created/found within your ecosystem (network)?
   ii. Who defines the strategy in such ecosystem projects?
   iii. What do you think about the role of fecilitator in business projects?

iv. What challenges did you encounter in establishing a shared vision in collaboration with key players in the ecosystem?
v. How did you overcome these challenges?

7. What are the success factors for establishing a good vision and a strategy for a common goal?

8. Roles in innovation network (trust) Collaboration to creating value (commercialization)
   a. How do you measure trust and motivation of different partners throughout the project?
   b. If people are not motivated then how to overcome those challenges?
   c. In your experience how often it happens that partners get demotivated?

9. Can you please elaborate on how the specific roles in the innovation project were established?
   i. What is required in terms of roles for establishing a complete consortium?
   ii. What were the challenges in agreeing on the specific roles in collaboration with other key partners? iib: what was the motivation of different partners to participate in the ecosystem collaboration.
   iii. How did you overcome these challenges? For example, how did you collaborate and solve problems during consortium meetings (both in the proposal preparation phase and at the kick-off meeting)?

10. In your opinion, what capabilities do a company/organization need to possess in order to successfully collaborate within an innovation network?
   i. How do these capabilities differ between SMEs and large companies according to you?

11. Questions specifically targeting creating value (commercialization angle) of the innovation ecosystem:
   a. How do you foresee in the beginning of the project that value can be generated for the end users (how fast can the innovation be brought to the market)?
   b. Do other partners in the ecosystem has the same thinking/strategy/opinion?
   c. In your opinion, what are the key factors that should be taken into consideration from the very beginning of the project, so as to achieve creation of value faster (commercialization faster/better).

12. Current portfolio of projects with a focus on innovation
   a. Is your organization/company currently involved in other ecosystem/collaborative projects as well? Could you briefly describe them? What is the current way of R and D innovation generation in your company.

b. Could your organization/company use any synergy effects between the other existing and this particular project?
c. What are the key learnings that your organization/company could derive from these projects, particularly in terms of collaboration and commercialization with diverse partners.

13. Innovation management-

a. Setting the rules for conducting the collaboration and exploiting the results.

14. Other questions

a. Is there anything else you would like to add?
b. Do you have any available documentation regarding the commercialization process (e.g. Powerpoint-presentations or public available annual reports) that you can share with me?
c. Can you recommend somebody else that I should speak to in regard to the establishment of open innovation ecosystem networks with focus on commercialization?

7.2 Assessment of Master thesis by commission company

SPINVERSE

9.11.2020

Review of Master Thesis Work

Dear Sir/Madam,

I had the opportunity to supervise MBA thesis of Rohit Sood. To my knowledge limited research has been done addressing the key success factors which can speed up the process of the value creation in multiparty collaborative open innovation projects.

In this research work, current concepts within OI, open innovation ecosystem and collaborative capabilities of the ecosystems are presented. A comprehensive review of the existing literature has been presented. The thesis is very well written and well structured. In my opinion Rohit has done exceptionally comprehensive work in the field of Open innovation (OI) and digital health.

This work and the insights in it will certainly help Spinverse. First, we are planning to use this work to convey the benefits of innovation ecosystems to our customers. Second, this work will help us in running our current ecosystem projects in a better way. The key success factors mentioned in this work will be implemented in present and future projects.

Sincerely,

Timo Ropponen, Dr. Tech.

Director
Manufacturing & Energy
Sustainable Industries Business Unit
Spinverse Oy