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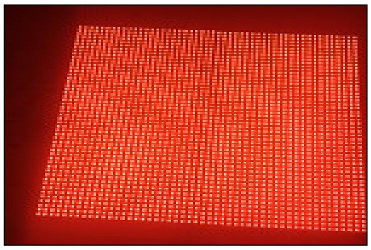

Insights

Welcome to the January issue of the Technology Innovation Management Review. We invite your comments on the articles in this issue as well as suggestions for future article topics and issue themes.

Carleton University

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Technology Innovation Management Review

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Overview
The Technology Innovation Management Review (TIM Review) provides insights about the issues and emerging trends relevant to launching and growing technology businesses. The TIM Review focuses on the theories, strategies, and tools that help small and large technology companies succeed.

Our readers are looking for practical ideas they can apply within their own organizations. The TIM Review brings together diverse viewpoints —from academics, entrepreneurs, companies of all sizes, the public sector, the community sector, and others —to bridge the gap between theory and practice. In particular, we focus on the topics of technology and global entrepreneurship in small and large companies.

We welcome input from readers into upcoming themes. Please visit timreview.ca to suggest themes and nominate authors and guest editors.

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About TIM

The TIM Review has international contributors and readers, and it is published in association with the Technology Innovation Management program (TIM; timprogram.ca), an international graduate program at Carleton University in Ottawa, Canada.

Editorial: Insights

Stoyan Tanev, Chief Editor and Gregory Sandstrom, Managing Editor

Welcome to the December issue of the Technology Innovation Management Review.

The edition starts with a paper by **Sylvia Mónica Pérez Núñez** and **Arturo Serrano-Santoyo** on "Multi-Actor Network Perspective: CaliBaja an emergent binational innovation ecosystem". The authors lead us through a brief history of the development of the Mexican innovation system in the state of Baja California, with a particular focus on the aquaculture industry. The paper addresses several binational features of this regional ecosystem with Southern California, drawing attention to what makes a global mega-region develop innovatively based on local contributors. Actor mapping and social network analysis were applied to identify a dynamic multi-actor network perspective to the regional aquaculture industry. They conclude by noting that, a "binational innovation ecosystem has great potential to catalyze cross-border competitiveness and collaborative initiatives that value territorial proximity to institutions, which is essential for an innovation ecosystem" (12-13).

The second paper by **Behrooz Khademi** is on the topic of "Ecosystem Value Creation and Capture (EVCC): A Systematic Review of Literature and Potential Research Opportunities". In it he responds to a current need given the fragmented character of current research on EVCC, that "there has not yet been any attempt to organize and synthesize the various different studies that have focussed on and proven relevant to EVCC" (29). The author uses Web of Science to conduct a review of EVCC-oriented literature, a topic which has been growing rapidly since 2016. With a focus on business ecosystems, the paper addresses the mechanisms, operational practises, and drivers of EVCC, as well as highlighting some of its challenges. The paper provides a substantial bibliography with related materials, suggests further research opportunities for EVCC, and offers directions to organize and synthesize previous works as a coherent overview of the field.

In the next paper, **Mika Westerlund** follows with "An Ethical Framework for Smart Robots", the first of two papers in consecutive TIM Review editions on the topic. The author presents an approach to the incoming challenge of "roboethics", which has recently begun to emerge alongside of the growing adoption of "smart robots". These he defines as "autonomous artificial intelligence (AI) systems that can collaborate with humans" (35). He points to growing trends in AI that have accelerated the use of robots, even while mainly negative public opinion about the widespread use of robots in society persists. The paper highlights and builds upon key ethical issues already in the literature for smart robots, as 1) amoral and passive tools, 2) recipients of ethical behaviour in society, 3) moral and active agents, and 4) ethical impact-makers in society (37-40). It follows up on this with an ethical framework for smart robots based on two dimensions: the ethical agency of humans using smart robots, and robots as objects of human moral judgment. The paper also raises the provocative topic of the rise of autonomous and semi-autonomous robots, which are built to be sensitive and responsive to human needs as the main source for ethical assessment.

A team of scholars from the VTT Technical Research Centre of Finland **Tuija Rantala, Tiina Apilo, Katariina Palomäki,** and **Katri Valkokari**, presents the next paper on "Selling Data-Based Value in Business-to-Business Markets". Their focus on business-to-business sales is predicated on the notion of data-based value as a way of driving value sales. This can lead to new business creation that offers digital solutions. The paper takes the perspective of both sellers and customers of data-based value through two sets of focussed interviews with data seller companies, as well as data customer companies. The paper offers a note of caution that in today's data-based value market, "customers now know and demand more than they did before, and therefore creating value for demanding customers may be difficult" (51). The paper displays a general background for the recent growth of data-based business sales with the rise of digitalization and advances in IT channels. It looks at conventional data-mining in contrast with disruptive AI systems, as they impact both the marketplace in general, as well as personnel involves in sales.

The final paper is a collaborative work by **Harini Mittal, Punit Saurabh, Devang Rohit,** and **Kathak Mehta** asking: "What impedes the success of late mover IT clusters despite economically favorable environments?" They attempt to answer this difficult question of timing, through a case study of an Indian IT cluster in the state of Gujarat. The paper looks at the enormous IT industry in India as whole, and compares the growth as well as the growing pains and challenges of Gujarat arriving later than other Indian states in developing a competitive IT cluster. The paper looks at various different models of IT-oriented clustering, the IT-talent

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pool, government policies, educational and innovative research institutions, funding sources, and the importance of having an entrepreneurial culture to drive the cluster.

The TIM Review currently has a Call for Papers on the website for April and May special editions on "Digitalization and its Impact on the International Growth of SMEs", and "The Sharing Economy as a Path to Government Innovation." See the Upcoming Themes on the website for further information for prospective authors. For future issues, we invite general submissions of articles on technology entrepreneurship, innovation management, and other topics relevant to launching and scaling technology companies, and solving practical problems in emerging domains. Please contact us with potential article ideas and submissions, or proposals for future special issues.

Stoyan Tanev
Chief Editor &
Gregory Sandstrom
Managing Editor

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Multi-Actor Network Perspective: CaliBaja an emergent binational innovation ecosystem

Sylvia Mónica Pérez Núñez and Arturo Serrano-Santoyo

"Innovation is the central issue in economic prosperity."

Michael Porter
Harvard Business School

To contribute to the field of management of technology and innovation, this paper focuses on a multi-actor network perspective to map stakeholders and identifies key actors in CaliBaja's binational innovation ecosystem. This region has a unique territorial extension and population dynamics. It is a land of opportunity for global businesses, houses world-class colleges, universities and applied research institutes, and has been recently acknowledged as a global innovative mega-region. We apply social network analysis to this region as an innovative and valuable methodology to identify significant local contributors, defined as according to key elements and success factors that promote and establish communication and interaction among the network stakeholders.

Introduction

Multi-actor network analysis has become an integral element in innovation ecosystem research. This perspective analyzes the dynamic behavioral relationships among actors with different attributes, beliefs, and decision-making mechanisms, such as entrepreneurs, private investors, government officials, policymakers, and a variety of non-business actors. The main purpose of this approach is to study the change mechanisms and find patterns of emergence and extinction (Tsujimoto et al., 2018). What characterizes an innovation ecosystem is the central role of the learning process, the importance of its historical trajectory, the influence of institutions in and on the ecosystem, and the diverse and multiple relationships the ecosystem fosters between technological, organizational, and scientific innovations. These "ecosystems" are therefore seen as the result of complex behavior between numerous heterogeneous actors. What governs these complex systems are the behavioral mechanisms and interactions that lead the alignment of resources, activities, and efforts in innovative directions (Valkokari, 2015; Muller, Héraud, & Zenker, 2017). To understand a complex system thus implies understanding the behavior of each component of the system (Miller & Page, 2007).

Viitanen (2016) insists that innovation ecosystem research should focus on studying the key factors and success elements for their effective management, in other words, to identify local strengths of an ecosystem. A significant local contributor is a local stakeholder or actor that circulates information and resources among the network, and who is a key element and success factor promoting and establishing communication amid pairs of actors. The development of innovation ecosystems has contributed to regional revitalization because this model brings together key actors that perform important technology-driven development processes. What guides the ecosystem is the particular combination of public sector interests as they align with private sector business-oriented needs and actions.

CaliBaja's binational innovation ecosystem relates to Baja California (Mexico), and the state of Southern California (USA). This mega-region is distinguished internationally as intensive in both innovation and entrepreneurship initiatives. Other elements, such as a population of 7.7 million people, a territory of more than 35 thousand square miles, a gross domestic product of 255.2 billion USD, a workforce of 3.4 million people, and a territory rich in ocean and land biodiversity, contribute to its distinctiveness. As a result, CaliBaja is a land of opportunity for global businesses operating in sectors like renewable energy, agribusiness, aerospace technology, medical devices manufacturing, international trade, and logistics (CaliBaja, 2019).

The present study focuses on aquaculture firms from the agribusiness sector of Baja California. Aquaculture has

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been catalogued as one of the local economic sectors with high expectations for growth and high demand for innovation processes (GOBBC, 2015). Furthermore, responsible practice in aquaculture will add to the prudent management of oceans. This is a key characteristic of a sustainable future that contributes to ocean conservation, as well as food security and nutrition (UN, 2019). Aquaculture is the farming of aquatic organisms involving biotechnological interventions in the rearing process to enhance production. It is probably the fastest growing food-producing sector in the world and accounts for 50% of the world´s fish for human consumption (FAO, 2019).

The last 30 years of development in biotechnology practices among regional research institutions in Baja California (BC) has led to the emergence of a group of 64 aquaculture firms, whose characteristics match up with a common profile that biotechnology companies have worldwide. These are small and medium-sized companies with a well-qualified workforce, which have developed in a knowledge-intensive environment (Perez, et al., 2016). BC's aquaculture production grew nearly seven times between 2000 and 2015, from 1,677 to 10,707 tons, and its economic value rose from 2 to 39 million dollars in the same period (CONAPESCA, 2015). Due to its wealth in biological diversity, BC is at the top of the national Mexican ranking with strong growth expectations in the production of marine species (GOBBC, 2015).

Assuming that to identify significant local contributors, innovation ecosystem research should focus on studying key factors and success elements for their effective management (Viitanen, 2016), we use social network analysis methodology to focus not only on the actors themselves, but especially on the connectivity and relationships among them. By studying the network and its interactions, we can understand its multiple relationships as well as identify key nodes or local significant contributors. The purpose of this study is to identify significant local contributors among CaliBaja's binational innovation ecosystem. First, we map ecosystem actors by studying their historical processes of emergence and growth. The ecosystem's network in our study is composed of 27 actors with different

Map 1. CaliBaja - binational innovation ecosystem stakeholders

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Table 1. Aquaculture firms that participated in the survey

Abulones Cultivados
Acuícola Pacar
Productos Oceánica
Ostricola Nautilus
Acuamos
Ostiones Guerrero
Baja Seas
Aqualap
Vizsomar
Acuacultura Oceánica

attributes. Second, using social network analysis, we identified significant local contributors by studying multiple relationships based on information and resource sharing among actors (Luna & Velasco, 2017). As a result of our examination, local contributors in one CaliBaja domain (aquaculture) were able to help other ecosystem actors to catalyze their cross-border competitiveness and collaborative initiatives that value territorial proximity, which is essential for an innovation ecosystem.

Method

This section describes the methodology. The data was gathered in two phases. The first phase is actor mapping.

Actor mapping explores the relationships and connections among actors, as well as their relationships regarding a certain issue. The purpose of actor mapping is also valuable to identify opportunities for improving the system's overall performance. Four actor categories were established: 1. Binational research agencies and higher education institutions, 2. Baja California public entities (government-run), 3. Non-government actors, and 4. Aquaculture firms (see Map 1).

We used data gathered from official websites and online documents of bi-national institutions and BC´s public and private entities, to map the relationships every time two network actors participated on joint projects, shared information, attended a meeting, or coincided at a physical or virtual space. With this collected data, we constructed an adjacency matrix.

In the second phase, an electronic survey was designed and sent to 64 firms registered in the directory of BC´s State Aquaculture Health and Safety Committee. A sample of aquaculture firms was determined and ten firms participated in answering the survey, all of which did so on-time (Perez, 2016), see Table 1. The data collection from firms nevertheless depended on the willingness of individuals to participate in the survey. Besides gathering demographic information, the survey was designed to establish relationships among ecosystem stakeholders and between ventures following the same criteria described above, and captured on the adjacency matrix.

Social Network Analysis (SNA) is a tool that allows the understanding of interactions between actors and how these relations derive the flow of information, resources, and influences within the network structure (Salancik, 1995). In other words, it allows the quantification and visualization of the system seen as a network of actors with collective achievements and personal interests (Daly & Finnigan, 2009). This tool involves four defining properties. First is the importance of structural intuition base on ties linking social actors . Second, actors are linked based on the collection and analysis of data regarding social relations. Third, graphic imagery is used to reveal and display link patterns. And, finally, patterns are drawn that describe and explain mathematical and computational models (Freeman, 2004).

With these properties in mind, SNA consists of nodes and ties. Nodes can represent a firm, a government or a non-government institution. Ties are lines connecting the nodes, representing a relationship between the various ecosystem players. The relationships can be knowledge transfer, joint projects or sharing physical and virtual spaces. In addition, SNA is relevant for multi-actor network analysis because it emphasizes the identification of multiple actors and their relationships, in order to explore how such relationships among actors affect dual efforts that attempt to change a given situation. Specifically, the relationships established among actors are studied, rather than the actors themselves. With this vision, Gephi's open-source network analysis and visualization software was used. This tool allows the observation of network attributes, such as the degree of centrality, intersection or betweenness.

Significant local contributors were on this basis identified in two categories. First by actor, using the degree of centrality attribute, which is defined as the capacity or ability of an actor to reach all other nodes in the network. Second, among the entire network using the betweenness attribute, which focuses on communication control and provision, as well as, information about the possibility of a node or actor to mediate communication within pairs of nodes. In other words, a key factor and success element.

Results

We start this section by describing historical developments, as well as network mapping of the CaliBaja region.

Bi-national, Research and Higher Education Actors

This section presents a historical overview of local efforts in BC regarding the development of science and technology capabilities, specifically in the aquaculture sector. We also briefly describe efforts in the bi-national context to strengthen innovation, science, and technology in the region. All these efforts are supported by national, local, and bi-national regulatory frameworks that contribute gradually to build up CaliBaja's binational innovation ecosystem.

To overcome social, economic, innovation, and political asymmetries, combined bi-national institutional efforts have been carried out in the CaliBaja mega-region to pursue economic development through strengthening innovation, science, and technology initiatives, especially in the area of education and specialized human resources training (Celaya & Almaraz, 2018).

In 1960, the Autonomous University of Baja California (UABC), created two institutions simultaneously in the city of Ensenada, the Institute of Oceanography and Ichthyology, later Institute of Oceanology Research (IIO), and the School of Marine Sciences. Their mission was to promote and carry out scientific research focussed on solving regional and national problems. Since its inception, the School of Marine Sciences had the valuable support of several researchers from California institutions, such as the Scripps Institution of Oceanography (SIO) in La Jolla California. In 1984, the School of Marine Sciences started research activities, and a year later the Master's program in Biological Oceanography was created.

During this time, academic agreements with the Center for Scientific Research and Higher Education of Ensenada (CICESE) were established (UABC, 2019). Particularly relevant for the study of BC’s biodiversity in 1968, CICESE was established, as a result of formal collaboration among academics of the School of Marine Sciences of UABC, and SIO of the University of California San Diego (UCSD), an idea that materialized in 1973 through the Mexican National Council of Science and Technology (CONACYT) (CICESE, 2013). Currently, CICESE is a public research centre; the largest of the 27 CONACYT has nationwide.

With the objective of strengthening the relationship and collaboration between the University of California and Mexican academic institutions, the University of California Institute for Mexico and the United States (UC MEXUS) was created in 1980. UC MEXUS is an academic agency dedicated to encourage, promote, safeguard, and contribute to bi-national research, in order to develop collaboration and academic exchange programs. Its main objective is to improve bi-national scientific knowledge.

In 1997, CONACYT and UCSD signed the UC-CONACYT agreement on Cooperation in Higher Education and Research. Up to the present time this program has provided funding and support for graduate students who have collaborated on numerous research projects, becoming the most important, collaborative, and fruitful program of Mexico with any university abroad. This agreement is managed by UC MEXUS and represents a long-term commitment to building cultural bridges and strengthening the bi-national academic community to influence issues of common concern to both countries. Its fundamental principle is that in bi-national collaboration research all participants must share equally in training. Over the past two decades, UC MEXUS and CONACYT have initiated a series of highly successful programs that provide opportunities for collaborative research, academic exchanges, and student development (UC MEXUS, 2019).

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The United States-Mexico Foundation for Science (FUMEC) is a non-profit bi-national organization created in 1993 under the tri-national North American Free Trade Agreement (NAFTA). Its objective is to promote bi-national collaboration in science and technology, to contribute to the solution of problems of common interest. FUMEC promotes best practices in three areas: 1) economic development based on innovation, 2) human resources training in science, and 3) technology, environment and health.

FUMEC has launched several programs to generate innovation processes. From their perspective, these programs are the key to achieving economic growth and success with countries and regions in global markets. Like TechBa, in conjunction with the Mexican Ministry of Economy, this program aims to facilitate the access of Mexican technology companies to dynamic business systems worldwide. TechPYME is also an enterprise program for accelerating and strengthening regional systems, which supports the migration of small and medium businesses to strategic niches. In 2013, the Council of Mexico-United States for Entrepreneurship and Innovation (MUSEIC) was created as a way to give priority to economic development through activities linked to entrepreneurship. In contrast, FUMEC's scope of action is national, with the responsibility of managing Mexican border actors' activities in search of industrial, scientific, and technological development. In 2013, with support from CONACYT, FUMEC was the general coordinator of a project on State Agendas of Innovation (FUMEC, 2019).

One of the most recent efforts began in 2005, with the Trans-Border Initiative for Competitiveness and Innovation at the San Diego Dialogue UCSD program. This was started in collaboration with CENTRIS, a BC high technology incubator, CICESE, and the City of Chula Vista, California, among others, which together published the report Borderless Innovation (San Diego Dialogue, 2005). This report mentions three key aspects to catalyze cross-border competitiveness. First, the need to implement collaborative initiatives to raise awareness of regional high value-added clusters with special attention to biotechnology and high technology industries that value the physical proximity of institutions for building up an innovation system from the research and development stage to the manufacturing and distribution stage. Second, to ensure growth and competitiveness, it is of vital importance to bring together leaders on both sides of the border who will collaborate to significantly increase professional and workforce training programs and technical assistance. Also, innovative social institutions and mechanisms are required to propel the cross-border region from words into action. This will involve shared leadership, as well as co-investment and coordination of programs aimed at strengthening the capacity and competitiveness of the bi-national region (San Diego Dialogue, 2005: 5).

The above effort lead to the creation of the Innovation Corridor of the Californias, an organization that groups associations, companies, institutions, and government entities who collaborate in areas of opportunity at the border from a technological standpoint. Some of these actors are the Biotechnology Council of Ensenada, California Institute for Telecommunications and Information Technology (Cal-IT2), BC's National Chamber of the Electronics Industry, Telecommunications and Information Technologies (CANIETI), Economic Development Council of Tijuana (CDT), CENTRIS, CETYS University, CICESE, Colegio de la Frontera Norte (COLEF), CONNECT a San Diego organization that promotes entrepreneurship, Tijuana Economic and Industrial Development (DEITAC), Institute of the Americas, International Community Foundation, UCSD's Jacobs School of Engineering, San Diego Dialogue, Scripps Institution of Oceanography, San Diego State University (SDSU), BC's Secretary of Economic Development (SEDECO), Baja California Information Technology Cluster (IT@ Baja), USCD's Center of US-Mexican Studies, University of San Diego´s (USD) Transborder Institute, and UABC, among others (San Diego Dialogue, 2005: 47).

The bi-national long-term economic development initiative in the CaliBaja mega-region began in 2008 and is one of the most recent bi-national cooperation efforts. It was founded by the counties of San Diego and Imperial Valley in California and by the state of Baja California. Its objective is the cooperative development of strategies for global competitiveness. It brings together public and private efforts on both sides of the border to take advantage of business development in the bi-national region. In this context, UCSD formalized with three Baja California's higher education institutions, UABC, COLEF, and CETYS a Memorandum of Understanding (MOU) agreement. Its objective is to strengthen and increase the collaboration ties and exchanges to generate bi-national research projects in technology innovation and entrepreneurship that enhance the cross-border region (CaliBaja, 2019).

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Baja California public actors
The Secretary of Economic Development (SEDECO) is a government institution whose objectives are to achieve national leadership in growth indicators, such as economic development and quality of life, establish a sustainable business policy where innovation is a strategy for competitiveness, and promote an efficient regulatory framework for investment. Furthermore, to maintain BC´s third place in national competitiveness indexes, SEDECO created a system of training and development to guarantee the required skills in the state's workforce. This involved a virtual network of educational institutions with undergraduate and graduate technical programs, linked for the

Table 2. Bi-national Innovation Ecosystem Multi-Actor Network

Type of Institution	Actors
Higher education or research center	UABC, Universidad Autónoma de Baja California (Autonomous University of Baja California) CICESE, Centro de Investigación Científica y Educación superior de Ensenada (Ensenada Centre for Scientific Research and Higher Education) CETYS Universidad (CETYS University) COLEF, Colegio de la Frontera Norte (North Border College) UCSD, University of California in San Diego SIO, Scripps Institution of Oceanography CONACYT, Consejo Nacional de Ciencia y Tecnología (National Council of Science and Technology)
Binational	CIDLC, Californias Innovation Corridor MUSEIC, Council of Mexico-United States for Entrepreneurship and Innovation CALI-BAJA Mega Region UC-MEXUS, Institute of Mexico and the University of California in the United States FUMEC, The United States-Mexico Foundation for Science
Baja California government	SAGARPA, Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación (Secretary of Agriculture, Rural Development, Fisheries and Food) SENASICA, Servicio Nacional de Sanidad, Inocuidad y Calidad Agroalimentaria, (National Service of Health, Safety, Food, and Agriculture Quality) SEDECO, Secretaría de Desarrollo Económico(Secretary of Economic Development)
Non-governmental organization	CESAIBC, Comité Estatal de Sanidad e Inocuidad de Baja California (BC's Aquaculture Health and Safety Committee) CDT, Consejo de Desarrollo Económico de Tijuana (Economic Development Council of Tijuana)
Aquaculture firms	F1 Abulones Cultivados F2 Acuícola Pacar F3 Productos Oceánica F4 Ostrícola Nautilus F5 Acuamos F6 Ostiones Guerrero F7 Baja Seas F8 Aqualap F9 Vizsomar F10 Acuacultura Oceánica

development of human capital (SEDECO, 2019).

SENASICA is BC's National Service of Health, Safety, Food, and Agriculture Quality in charge of prevention, diagnosis, and control of diseases in accordance with article 107 of the General Law of Sustainable Fisheries and Aquaculture. In coordination with the State Government through the State Fisheries and Aquaculture Secretariat (SAGARPA), SENASICA coordinates health programs and actions, as well as promoting good production practices in support of the aquaculture sector (SENASICA, 2019).

The National Commission of Aquaculture and Fisheries (CONAPESCA) is the federal institution responsible for managing, regulating, and promoting the sustainable use of the resources of the aquatic flora and fauna. The Secretary of Fisheries and Aquaculture (SEPESCA) is an agency of the Government of the State of Baja California, in charge of promoting fisheries and aquaculture for sustainable development, including activities such as strengthening social and private sectors, as well as linking scientific and technological progress with production. Other activities include the promotion of investment to generate jobs, and the profitability of fishermen and aquaculture practitioners of BC (SEPESCA, 2019).

Non-government actors

CESAIBC is BC's Aquaculture Health and Safety Committee. It began operations in May 2006, in response to producers' concerns pursuing promotion and strengthening aquaculture development in the state, where knowledge, continuous improvement, and implementation of good practices were fundamental for production and market access. The objective of the committee is to promote safe sanitary management practices in aquaculture to reduce and avoid conditions that favor the presence of pathogens and their dissemination (CESAIBC, 2019).

CDT is the Economic Development Council of Tijuana, and coordinates committees that represent educational, business, and social sectors. Its objective is to follow up on the projects of the Strategic Plan of Tijuana (CDT, 2019).

Aquaculture firms descriptions

According to the 2015 BC aquaculture firms' survey results, these firms have been active for 10 to 25 years. The majority use biotechnology processes in their operations, about 30% of the personnel, directly involved in biotechnology activities, have masters or Ph.D. degrees, and 80% of these companies have developed innovation processes mainly with the aim of improving product quality. In recent years, 70% have been beneficiaries of government funds for the development of science and technology. Most of the firms agree that research, development, and technological innovation are the main factors that influence the development of innovation activities, and all of these enterprises have been involved in cooperative relationships with firms in the same field as theirs, especially for technology transfer (Perez, 2016).

In accordance with this paper's conceptual approach, companies are agents in a multi-actor ecosystem that establishes, facilitates, and maintains multiple relationships through the circulation of information and resources.

Binational innovation ecosystem, multi-actor network

As discussed in the Introduction, a multi-actor network perspective analyzes the dynamic behavioral relationships among actors with different attributes, beliefs, and decision-making processes like entrepreneurs, private investors, government, policymakers, and a variety of non-business actors. For our study, 27 actors are part of the bi-national innovation ecosystem network, see Table 2.

The objective of this study has been to identify significant local contributors among CaliBaja's binational innovation ecosystem. We took into consideration information and resources shared among actors to established dyadic relationships.

Degree of centrality is an SNA parameter defined as the capacity of an actor to reach all other nodes in the network. Considering this, we find that UABC, CESAIBC, SAGARPA, CICESE, and CONACYT exhibit the highest centrality degree; see Figure 1. The node size is related to this condition. This means that these nodes are near and collaborate with all other actors in the network. We argue that the higher number of nodes an actor interacts with, the greater its grade of centrality will be. The more central nodes, therefore, are in a position that may allow greater access to resources from different sources. Secondly, these actors can mediate with others and obtain benefits, or persuade them. However, this does not represent 'power,' rather only that the central node is in an advantageous network position (Ramírez, 2016). In terms of firm participation, we noted that Ostrícola Nautilus y Productos Oceánica share an advantageous

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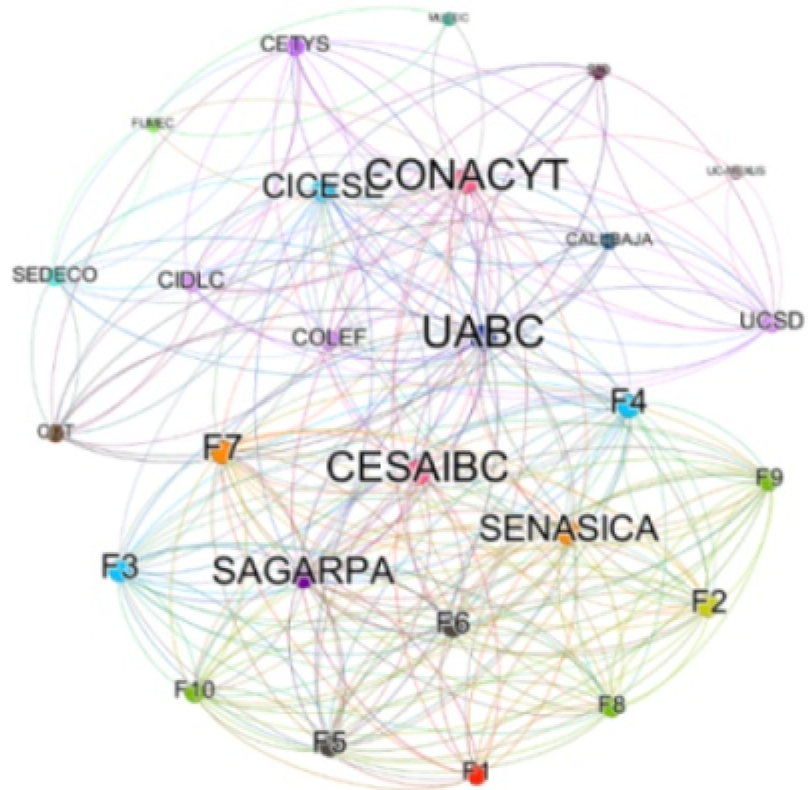

Figure 1. CaliBaja's binational innovation ecosystem network: centrality degree

position.

The importance of an actor in the network is related to its interconnection or betweenness; this SNA parameter focuses on communication control and defines the possibility that a node or actor has to mediate communication within pairs of nodes. For instance, it is possible for an actor to have a low centrality degree, not being popular, and to have connections with only two nodes. If at least one of these nodes connects with an endless number of actors or groups of actors, the connecting node has a high degree of network betweenness, that is, network actors will not connect unless they are linked with this highly connected actor. This intercession is based on local dependency, since the nodes that are in many routes that connect to several actors have a greater capacity of betweenness compared to those that do not. These nodes are also named 'bridge nodes' (Ramírez, 2016).

In this regard, CONACYT is the actor with the highest degree of betweenness (see Figure 2). This means that many interconnections and communications with others in the ecosystem and among actors depend on this particular and unique node. Hereby, this institution has become the bridge that facilitates interaction and builds interdependence between network stakeholders, as a trustworthy "bridging" partner. Valkokari (2015) argues that intermediate actors build a platform for innovation ecosystems and connect the network with other actors. CONACYT is the most significant national contributor that provides local information and resources among CaliBaja's binational innovation ecosystem.

Conclusions

The multi-actor network perspective presented in this paper has the objective of contributing to the understanding of CaliBaja's innovation ecosystem by using actor mapping and identifying significant local contributors. In this scenario, our analysis provides an information platform for entrepreneurs and decision makers regarding the management of binational information and resources. We believe CaliBaja's binational innovation ecosystem has great potential to catalyze cross-border competitiveness and collaborative initiatives that value territorial proximity to institutions,

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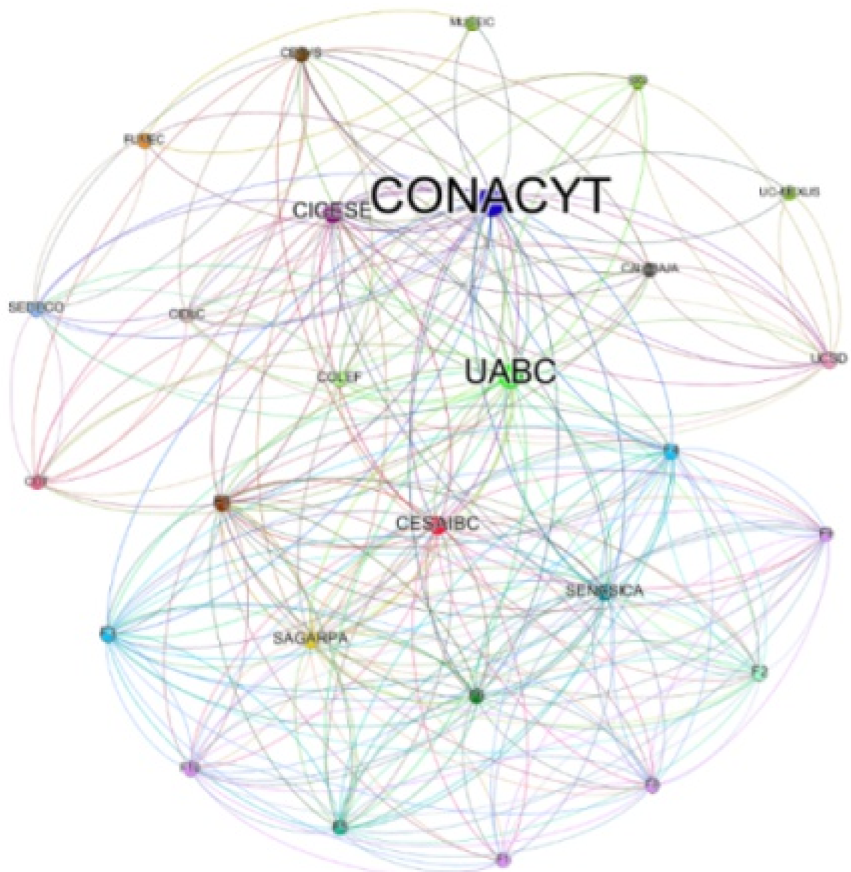

Figure 2. CaliBaja's binational innovation ecosystem network: betweenness

which is essential for an innovation ecosystem.

UABC, CESAIBC, SAGARPA, CICESE, and CONACYT experience a high degree of centrality. This means that they influence all other actors in the network, and are key for connecting the aquaculture firms with the rest of the network actors. These institutions are in an advantageous position that allows them to access resources from different sources, mediate agreements and contracts with others, and eventually to persuade the less connected nodes to join in.

Furthermore, though CONACYT is a federal entity, we can identify it as a significant local contributor and bridge actor because it widely across Mexico distributes information and resources. CONACYT also promotes and establishes communications amid pairs of nodes in the national ecosystem. Moreover, we also noted that research and higher education institutions show greater capacities to reach multiple relationships. As well, universities have been catalysts for cross-border exchanges and joint projects. These capacities and the relationships themselves are what fundamentally describe the network paradigm, such that achievements in innovation and learning arise as these network relationships and the new opportunities they bring for collaboration and competition intensify.

We conclude that the level and quality of interactions among aquaculture firms must rise. Future research is therefore needed to study the dynamics of ecosystem networks in terms of alliances and cooperation, by taking into account other network parameters such as behavior, adaptation, interaction, and self-organization.

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UN United Nations about the Sustainable Development Goals. 2019. https://www.un.org/sustainabledevelopment/sustainable-development-goals/

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Ecosystem Value Creation and Capture: A Systematic Review of Literature and Potential Research Opportunities

Behrooz Khademi

"Creating value is an inherently cooperative process, capturing value is inherently competitive."

Barry Nalebuff
Professor of Management
Yale School of Management

Collaboration, co-creation, and competition are essential strategies for success in today's modern businesses. In comparison with former ways of doing business in isolation, ecosystems nowadays have created ample opportunities for generating significantly more values. However, there are also potential threats in the pathway towards success in ecosystems. Ecosystem value creation and capture (EVCC) has recently gained significant attention in the academic literature of business and management. Yet, due to the complex structures of ecosystems and ambiguity in understanding value creation and capture in ecosystems, the contributions heretofore are fragmented, where scholars analysed different aspects of EVCC. The present study offers a systematic review of the literature to shed light on the EVCC studies. The content analysis of a fine-grained sample of articles relevant to EVCC revealed that despite the initiation of discussions in 2007, the topic did not gain noticeable attention until 2016. A 150% increase in the number of papers has since been observed. The paper contributes to the intersection of strategy and studies on EVCC by synthesizing existing knowledge, illuminating current EVCC research, and highlighting potential research avenues.

1. Introduction

The number of papers emphasizing the importance of value creation and capture in ecosystems and collaborative networks has been growing. Especially, the growth has been more noticeable since 2016, with a 150% increase in papers published. However, the contributions are mainly fragmented, where scholars have addressed different themes involving 'ecosystem value creation and capture' (EVCC). Reasons for such fragmentation could include a lack of adequate understanding of the concepts in collaborative networks of innovative organizations (Chesbrough, et al., 2018), complexity of interactions in ecosystems (Ben Letaifa, 2014; Ritala & Almpanopoulou, 2017), and overall ambiguity in the exact structure of ecosystems (Ben Letaifa, 2014; Ritala & Gustafsson, 2018). Furthermore, as it pertains to collaborative networks of innovative firms, the concepts of 'value creation' and 'value capture' have been addressed with ambiguities regarding value perspectives (Chesbrough et al., 2018). Therefore, it is essential to comprehensively analyse EVCC in the academic literature.

'Ecosystem' is a metaphor from the field of ecology, suggested by Moore (1993) to describe the complex, dynamically changing, symbiotic relationships formed among a network of business organizations. 'Value creation' and 'value capture' have been debated conceptually in the fields of marketing, strategic management, industrial organizations, and business models (Chesbrough et al., 2018; Pitelis, 2009). The 'ecosystem value creation' process is regarded as a mechanism for collaboration and activities within an ecosystem to create value for customers and users (Hannu Tuomisaari et al., 2013). 'Ecosystem value capture' refers to firm-level strategic plans that appropriate their share of the total value created by an ecosystem (Hannu Tuomisaari et al., 2013), be it captured purposely or serendipitously (Radziwon, et al., 2017; Ritala et al., 2013). EVCC is an integral part of ecosystem business models (Ceccagnoli et al., 2012) and the sustainability of ecosystems (Chesbrough et al., 2018). It serves to dynamically monitor contributions of actors to the proposed collective value, while determining their share of the total appropriated value.

The research questions (RQs) leading this paper are as follows:

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RQ1: *How have EVCC studies grown and changed over time in the literature?*
RQ2: *What are the underlying research themes in EVCC studies?*
RQ3: *What are the potential opportunities for future research in EVCC?*

The remainder of this paper is structured as follows: The next section describes the research method used to collect data and answer the RQs. The subsequent section presents the results of the analyses and a response to each of the RQs. The paper ends by summarizing the results, highlighting the contributions of the study, and pointing out the limitations in conducting the research.

2. Research Method

The study follows a standard systematic literature review. This section describes the sampling process (conducted in early 2019) used to identify the relevant literature as well as the steps undertaken to answer each of the RQs.

2.1. Identifying the literature

2.1.1. Choice of Database

Web of Science (WoS) was the preferred database to search the literature for several reasons. First, compared to other databases such as Google Scholar, WoS provides the highest number of high quality journals and articles (as cited in Scaringella & Radziwon, 2017) and reliability (Augillo and Falagas, as cited in Prins et al., 2016). Second, Gavel and Iselid (2008) quantitatively showed that the coverage of WoS in social science and humanities is broader than SCOPUS. Third, according to these authors, WoS has a longer time span and citation coverage in comparison with SCOPUS.

2.1.2. Search Rules and Initial Article Extraction

To identify the initial pool of articles to be reviewed, a synthesis of keywords such as “ecosystem”, “value creation”, “value co-creation”, “value capture”, and “value appropriation” were used in two rounds based on the following search rules:

- ecosystem AND ("value creation" OR "value cocreation"),
- ecosystem AND ("value capture" OR "value appropriation").

The first rule identified 313 articles, while the second rule resulted in 32 articles.

2.1.3. Paper Selection and Sample Screening

For this study, only high-quality papers pertinent to EVCC in business and management scholarship and in English language were of interest. As only high-quality papers were of interest, the search was limited to refereed journal articles in WoS. The search process identified 171 unique articles (after removing duplicate results from the two different search rules) at the preliminary step.

The preliminary sample had to be screened for context and content relevance. For value creators, continuous satisfaction of customers must be the main target. This is irrespective of whether the offer is collectively presented or if solutions are offered by an individual enterprise (Bowman, as cited in Hannu Tuomisaari et al., 2013). EVCC includes optimizing, preventive, and radically innovative approaches for efficiency maximization and differentiation in ecosystems. Such approaches are essential for an entity (or a constellation of entities) to be able to create and capture higher value. Based on such an understanding from EVCC, irrelevant papers were excluded from the preliminary sample of articles.

The titles, abstracts and conclusions of the papers were thoroughly analysed. Findings where ecosystem was applied as a ‘buzzword’, ‘wrong metaphor’ or ‘irrelevant analogy’, without being considered as the proper unit of analysis (Aarikka-Stenroos & Ritala, 2017; Ritala & Almpanopoulou, 2017; Suominen et al. 2019), were excluded from the sample. Similarly, those studies that tested non-technological contexts in service ecosystems or marketing studies were removed from the sample (See Scaringella and Radziwon (2017) for the same approach). The sample was shrunk to 50 papers after this stage.

2.1.4. Sample refinement

It was found out that some other studies in the reference list of the papers in the shrunk sample (N = 50) were relevant to EVCC but they had not appeared in the preliminary search phase. One reason is that author keywords were not used in some of the papers relevant to EVCC, hence those papers were not listed in the initial search attempt in WoS. Examples include papers from R&D Management, Journal of Product Innovation Management, Strategic Management Journal, and Technology Innovation Management Review. Therefore, adding the most relevant papers in the backward citations list, the shrunk sample was complemented to increase the percentage of recall for the sample (the measure used to indicate the share of the number of papers in a sample from all possible number of papers in

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Fig. 1. Step-by-step sampling process

the sample) and a more precise content analysis (See Takey and Carvalho, 2016, for an example of such an approach in sample refinement).

The same quality screening criteria (only relevant and English journal articles in the WoS database) were applied in the sample refinement phase. Applying this strategy, 10 more papers were added to the sample. In total, the final sample consisted of 60 papers, which formed the foundation of the content analysis. Fig. 1 describes the step-by-step sampling process.

2.2. Data analysis

Descriptive statistics of the sample used for observing the trend in popularity and trajectory of EVCC studies in the relevant literature, i.e., for responding RQ1. Next, content analysis was conducted and all the 60 papers of the sample were carefully analysed to explore the main themes discussed heretofore in the scholarly research of EVCC (response to RQ2). The sample was not too large and for higher precision, text mining was not applied for theme exploration. The content analysis provided the required input for identifying the research puzzles in the literature of ecosystem studies and EVCC, thereby responding to RQ3.

3. Results

3.1. Trajectory of EVCC using descriptive statistics of the final sample

The final sample (N = 60) was analysed according to the year of publication to explore the publishing trend in EVCC. Despite a fall in 2015, there has been an upward trend in publishing papers on EVCC since 2012. However, the growth is more notable since 2016, with 36 papers (60% of the sample and a 150% increase of the sample size), out of which 16 papers (26.7%) were published in 2018 (See Fig. 2).

Table 1 lists the 13 authors (first author or co-author) in the sample with more than one paper. From all 142 authors in the sample, Annabelle Gawer and Paavo Ritala had the highest number of contributions in the final sample.

Fig. 3 illustrates the number of papers per authors' affiliation in the final sample for the top 25 organizations. As can be seen, scholars affiliated at

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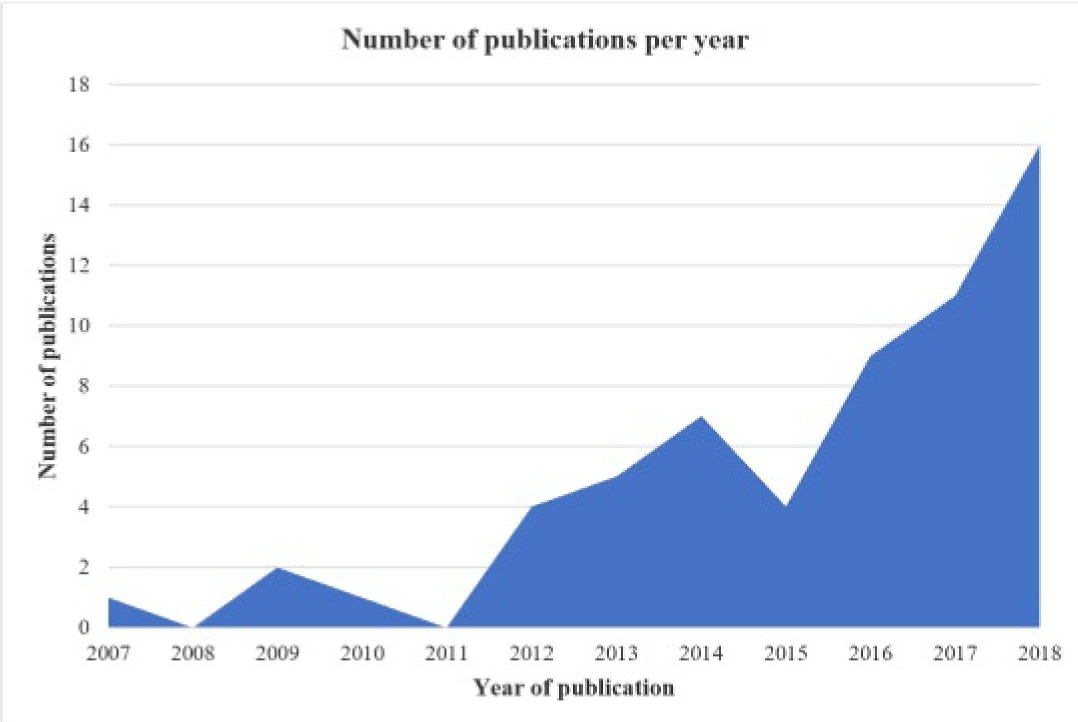

Fig. 2. Number of publications per year for the final sample of articles (N = 60)

American, British, and Finnish organizations have engaged the most in EVCC research.

Table 2 details the number of papers per each source title in the sample. According to the results, International Journal of Technology Management, Research Policy, Technological Forecasting & Social Change, and Technology Innovation Management Review were the top four popular journals among the scholars.

3.2. Major research themes emerging from content analysis

The findings of the content analysis were classified into four categories according to the emerging research themes: mechanisms of EVCC, drivers of EVCC, challenges of actors for EVCC, and effective strategies and operational practices for EVCC. Below, scholarly research in each of the themes is highlighted.

3.2.1. Mechanisms of EVCC

While ecosystem value creation requires collaboration, ecosystem value capture forces firms to protect themselves. This "paradox of openness" (Laursen & Salter, 2014) makes understanding the mechanisms of EVCC complex. Not only are the mechanisms for value creation different from those for value capture, but also the mechanisms of EVCC differ from one type of ecosystem to another. Such differences stem from their unique mutual intentions ("baselines"), players in the ecosystem, their roles, interactions between players, and the logic of action (Valkokari, 2015). Different

Table 1. Authors with more than one paper in the final sample

Authors	Number of Papers
Annabelle Gawer, Paavo Ritala	3
Ron Adner, Rahul Kapoor, Michael Jacobides, Katri Valkokari Carmelo Cennamo, Jens Dibbern, Shaz Ansari, Raghu Garud, Arun Kumaraswarmy, Thomas Kude, Christopher Lettl	2

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Fig. 3. Number of papers per authors' affiliation for the top 25 organizations

mechanisms of EVCC can be the result of differences in complementarities; direction of relationships, symmetry or asymmetry of the effect location, and modularity of ecosystems (Jacobides, Cennamo, & Gawer, 2018). Fig. 4 depicts the determinants for different mechanisms of EVCC.

Business ecosystems consist of focal actors, suppliers, complementors, and users. The interaction between actors are non-linear and geographical boundaries do not limit the operations of the business ecosystem. Co-creation and co-capture of value are mainly realized through resource exploitation (as a shared intention), coopetition (Dagnino & Padula, 2002), and provision of a unique platform by a focal actor for complementarities (Valkokari, 2015). Platforms and developers play a crucial role in value creation involving creative industries and business ecosystems (Parker et al., 2017). The co-created value is co-captured through sharing (distributing) the revenue among business ecosystem members (Oh et al., 2015). A decent appropriability regime is therefore essential in ecosystems to ensure of the realization of value capture (Ceccagnoli et al., 2012; Oh et al., 2015).

Knowledge ecosystems are comprised of universities, research centres, and entrepreneurs. Co-exploration of new knowledge in decentralized networks is the mutual objective of actors, assisted by innovation intermediaries, and by co-innovation within defined geographical clusters (Valkokari, 2015). Having said that, the new definition for knowledge ecosystems indicates the increasing blurriness of spatial boundaries and nowadays, knowledge ecosystems are operating in a more global scale (Järvi et al., 2018). Unlike in business and innovation ecosystems, focal actors in knowledge ecosystems (universities and research centres) are not involved in direct competitions (Clarysse et al., 2014). Furthermore, the value creation process in knowledge ecosystems is a linear process with the flow moving from upstream to downstream actors (Clarysse et al., 2014). Depending on whether a knowledge ecosystem specializes in a knowledge domain or is still in pursuit of one, EVCC mechanisms can differ. In the former case known as 'partial forms', more formal mechanisms for membership and access to knowledge and resources are common, whereas in the latter case known as 'prefigurative forms', less formal and more voluntary mechanisms are used (Järvi et al., 2018). In the same vein, value capture mechanisms in knowledge ecosystems differ according to the technology lifecycle. Less formal IP strategies such as secrecy are more common in pre-development phases, whereas more formal strategies such as patenting are used near the beginning of the development phase (Toma et al., 2018).

The main actors of innovation ecosystems , the lead producers, suppliers, competitors, policy makers,

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Table 2. Number of papers in the final sample per publication

Source Title	Number
International Journal of Technology Management	6
Research Policy, Technological Forecasting & Social Change, Technology Innovation Management Review	5
California Management Review, Strategic Management Journal, Journal of Product Innovation Management	4
MIS Quarterly	3
Organization Science, Electronic Markets, Journal of Management Studies	2
Academy of Management Journal, Advances in Strategic Management, Business Process Management, Creativity and Innovation Management, European Journal of Information Systems, European Management Review, IEEE Transactions on Engineering Management, Information Systems Research, International Entrepreneurship and Management Journal, International Journal of Innovation Science, International Journal of Innovation and Technology Management, Journal of Information Technology, Journal of Management, Management Decision, Management Science, R&D Management, Technology Analysis and Strategic Management, Technovation	1

intermediators and public and private funding agencies, are geographically bounded in innovation hubs. Actors and their interdependencies, activities, positions and links are the main constructs of innovation ecosystems (Adner, 2016). In lieu of incremental improvements, focal actors are keen (together with their long-term partners) on co-inventing radically new and non-replicable solutions (Ritala et al., 2013; Valkokari, 2015). Value creation process in innovation ecosystems is described dynamically from the “building” phase to “management” (Ritala et al., 2013), where the mechanism becomes clearer over time (Ben Letaifa, 2014; Chen et al., 2016; Ritala et al., 2013). Similar to value creation, value capture is a dynamic process in innovation ecosystems. In fact, for effective value capture, an actor needs not only the ability to capture a share of the collectively created value, but also the ability to capture value through other actors’ efforts in further stages of value creation (Chesbrough et al., 2018).

3.2.2. Drivers of EVCC

Four major drivers that influence EVCC in ecosystems were identified in the content analysis: ecosystem attractiveness, efficient architecture and platform design, proper management of intellectual properties (IPs), and government intervention. Fig. 5 represents a visualisation for the major drivers of EVCC.

Ecosystem attractiveness

The literature review identified ecosystem attractiveness as one of the main drivers of EVCC. Value maximization and risk minimization were regarded as the two major incentives for actors to join ecosystems. Maximizing financial value (Chesbrough & Appleyard, 2007; Herskovits et al., 2013), having competitive advantage and higher degree of innovativeness (Herskovits et al., 2013; Luo & Triulzi, 2018; Mäkinen et al., 2014), and creating social value (Fulgencio, 2017) are the main incentives for ecosystem partnerships. Reduction of risks and uncertainty impacts also has a positive outcome in ecosystems, such as leading to higher motivation for external complementarities, cost reduction, more consistent and trustful knowledge sharing, and ecosystem differentiation (Williamson & De Meyer, 2012).

Efficient architecture and platform design

Standardization of platforms enables better access to partners’ knowledge and resources and thus to better EVCC (Tura et al., 2018). In addition, a proper and explicitly designed platform allows firms to grow more symbiotically and systematically (Li, 2009). The application of a wrong ecosystem architecture per se can lead to failure of the ecosystem. Therefore, considering the ecosystem architecture at all stages of the conceptual platform design is paramount (Tee & Gawer, 2009).

Proper management of IP

Proper IP management by ecosystem orchestrators not only positively affects their captured value, but also increases the entire EVCC (Azzam et al., 2017; Leten et al., 2013). Therefore, R&D investments for smart selection and implementation of appropriability mechanisms are essential, which in turn helps to minimize negative effects of spillovers, and also to maximize R&D productivity (Teece, 2018). Furthermore, focal firms can allow complementors to use their IPs to develop their own technologies in new markets as well

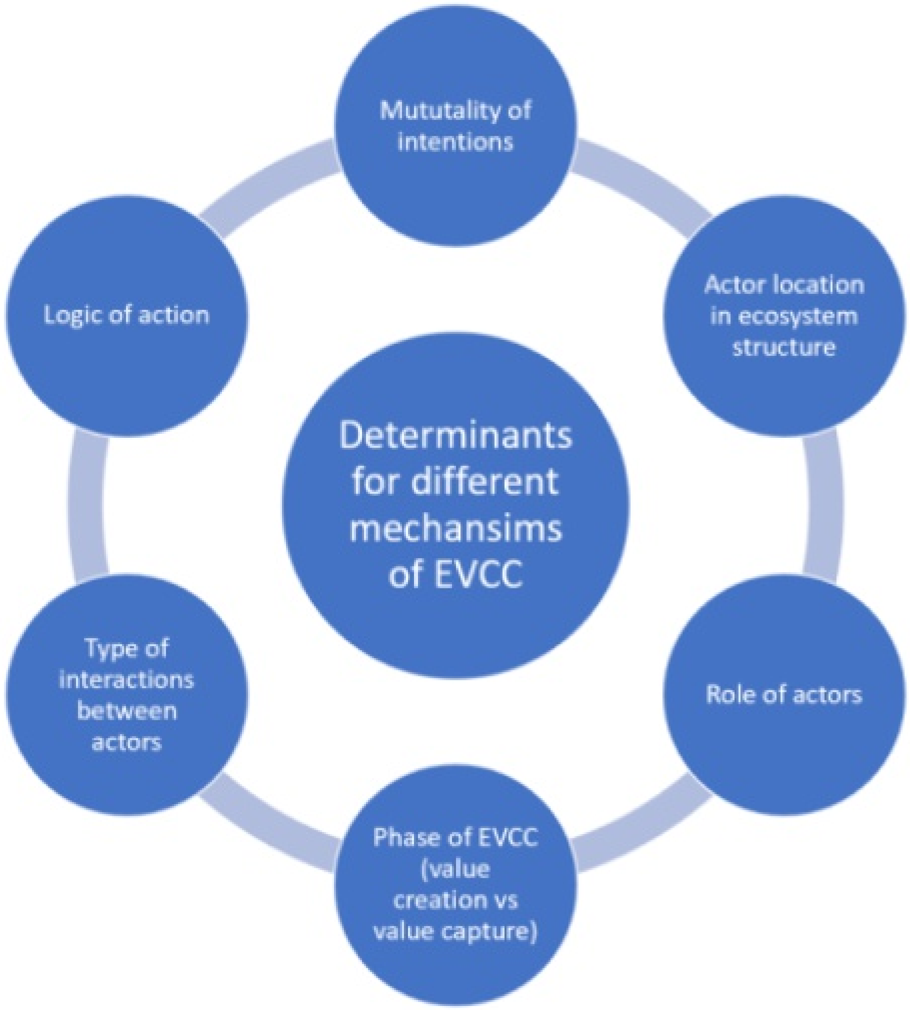

Fig. 4. Determinants for different mechanisms of EVCC

as generate new and diversified sources of revenue for their ecosystem (Azzam et al., 2017).

Government intervention

Government intervention by means of supportive funding plans and regulatory policies also often affects EVCC. External funds and common objectives of regional knowledge and innovation ecosystem actors have proven to have a significantly positive influence on EVCC (Radziwon et al., 2017). However, funding regional knowledge ecosystems without proper commercialization plans does not necessarily culminate in shaping a network of industrial firms for better innovation output (Clarysse et al., 2014). In the absence of regional players that commercialize innovation outputs from knowledge ecosystems, governments can intervene by inspiring global technology players, investors, financial agencies, and crowd-funding to support regional knowledge ecosystems (Clarysse et al., 2014). City governments have a critical orchestrating role by providing integrated solutions for end customers and also of facilitating the interactions between ecosystem members through the making of local 'platform hubs' (Visnjic et al., 2016). Inconsistent decision-making in multi-layered governments, however, has a tendency to delay the potential value appropriation process of new technologies (Teece, 2018).

3.2.3. Challenges for realization of EVCC

Challenges for realizing EVCC have been discussed mainly with regard to innovation and business ecosystems. In innovation ecosystems, focal actors encounter challenges where applying certain strategies

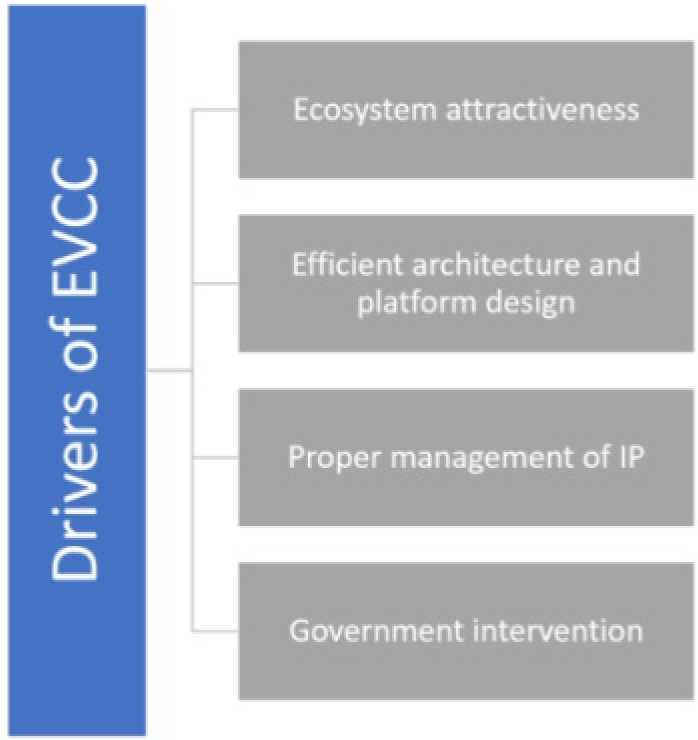

Fig. 5. Major drivers of EVCC

are essential to survive the ecosystem. Overlooking systematic partner selection in innovation ecosystems may result in serious consequences as radical changes in technologies and platforms are expected (Pellikka & Ali-Vehmas, 2016). The effect of challenges with upstream and downstream sectors are asymmetric and unlike the positive effects of bottlenecks related to suppliers' delay in innovation, such bottlenecks emerging by complementors curb the speed of innovation for leaders (Adner & Kapoor, 2010). Despite the positive effects of upstream bottlenecks for value creation, the risk of opportunistic behaviours by upstream sector for changing contracts in their favour is high. Although focal actors' complementary technologies may differentiate their platforms, it is likely that their core technology would permeate because of such disclosures and allow other players (with the same expertise) expropriate the focal technology (Toh & Miller, 2017). Start-up companies face serious challenges in persuading incumbents for further support of technology development and commercialization (Ansari et al., 2016). The absence of ecosystem culture, improper or no orchestration mechanism and replacement of rivalry instead of competition are the main threats for innovation ecosystems (Ben Letaifa, 2014).

In business ecosystems, keystones must be mindful about domination and the extent of access to platforms by complementors. Domination has been known as a big challenge in ecosystems as it can make the ecosystem vulnerable and easier to fail (Tellier, 2017). Despite the benefits of 'kingpins' in industry segments, their presence and dominance increases the heterogeneity in value and R&D leadership within the segment over a long run (Jacobides & Tae, 2015). Access of complementors to platforms owned by focal firms have been among the challenges in business ecosystems. In software ecosystems, access of complementors to the resources and knowledge of platform owners is essential for value co-creation. The motivation for open source software vendors is not benefiting from the product itself, but the complementary and intangible assets such as tacit knowledge and differentiation (Morgan et al., 2013). Despite success stories in open business models, their implementation and governance could be challenging (Huber et al., 2017). Attraction and retention of complementors, lack of innovation and support from complementors, and revenue generation are among those challenges (Chesbrough & Appleyard, 2007). Table 3 concisely demonstrates the discussed challenges for ecosystem actors taking the location of actors (structure-wise) into account.

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Table 3. Challenges of ecosystem actors for realization of EVCC

Challenge No	Challenge	Actor location
1	Systematic partner selection	Focal actors
2	Delay in complementary contributions to the major platform	
3	Expropriation of focal technologies by other ecosystem actors	
4	Absence of ecosystem orchestration mechanisms	
5	Extent of complementors' access to the focal actor's platform	
6	Continuously attracting and retaining complementors	
7	Lack of innovativeness in complementary contributions	
8	Dangers of domination	
9	Persuasion of incumbents for supporting radically new technologies	Start-ups and new entrants
10	Absence of ecosystem culture	All actors
11	Replacing constructive competition (for better EVCC) with destructive rivalry	
12	Business models and revenue generation	

3.2.4 Effective strategic and operational practices for EVCC

Ecosystem business models and collective approaches towards characterizing roles and strategies for all actors are crucial (Borgh et al., 2012; Ikävalko et al., 2018; Papert & Pflaum, 2017). Despite the criticality of orchestrating roles of keystones, a collective approach towards ecosystem orchestration with more flexible and extensible business models (Rong, Patton, & Chen, 2018) is essential for improving EVCC (Valkokari, Seppanen, Mantyla, & Jylha-Ollila, 2017), because ecosystems' constructs and interdependencies cannot be predicted ahead of time (Dattee, Alexy, & Autio, 2018). Flexible and collective approaches in ecosystem business models support start-ups to manage uncertainties while developing radically innovative technologies (Vasconcelos et al., 2018). Invention of disruptive technologies and disruptors' entry stimulate the emergence of 'business model adaptation' and formation of ecosystem business models by incumbents to source external knowledge (Cozzolino et al., 2018). An ecosystemic approach towards cybersecurity enables identifying the major stakeholders, prioritizing risk mitigating plans, and creating more value for end customers (Tanev et al., 2015). In contrast, a "performative approach" collectively frames and reframes all the plans and joint activities within an ecosystem, giving an example of practices that offer firms flexibility and respond to uncertainties more efficiently (Kumaraswamy et al., 2018).

Applying certain strategies and practices in ecosystem business models can significantly enhance EVCC. Identifying and involving universities and research centres, integrating knowledge, and disseminating knowledge are considered as essential practices for enabling innovation ecosystems (Spena et al., 2016). Network visualization is an invaluable practice for identifying opportunities by extracting information on current interactions (Li, 2009; Still et al., 2014). In addition, dynamic capabilities support platform leaders (Helfat & Raubitschek, 2018) and complementors (Ehrenhard et al., 2017) to overcome ecosystem challenges more effectively. Facilitating innovation processes in individual organizations and creating innovation communities (Hooge & Le Du, 2016) serve to strengthen value creation in knowledge ecosystems (Borgh et al., 2012).

Essential strategies are required for focal firms prior to becoming an ecosystem leader. Leaders need to define a clear vision for the ecosystem, design a modular platform with open modules for other members' contributions, continuously monitor the relationships, make continuous innovations, and ensure the platform is always interesting for complementors (Pellikka & Ali-

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Vehmas, 2016). Managers must also have a correct perception of the limits of their knowledge, the higher value of integrating intellectual properties, and the importance of the proposed value (Williamson & De Meyer, 2012).

Platform leadership strategies have significant influence on EVCCs and ecosystem survival . Proper architecture that enables convenient interactions between players, control over the relationship with other ecosystem actors, and monitoring the competitiveness of the platforms is the responsibility of the platform leader (Helfat & Raubitschek, 2018). But this is insufficient for success in the ecosystem game. Idea evaluation, partner selection and incentivization, making continuous improvements to core competencies, proper orchestration, continuous revision of business models, and adopting appropriate expansion strategies are among other keystone responsibilities (Gawer & Cusumano, 2014). In order to expand an ecosystem's boundaries, mergers and acquisitions (M&A) could be a helpful and effective strategy. A key success factor in M&A is leaving the assignees' culture and employees virtually unchanged, while providing them with new leadership training, instead of recruiting a new labour force (Li, 2009). Vertical integration has been shown as a successful strategy in order to prevent the risk of opportunistic behaviour by firms in upstream sectors (Adner & Kapoor, 2010).

Assessing partners before and during partnerships is paramount for all ecosystem actors. Assessing core competencies and the extent of internal complementary activities enables platform vendors to identify the need for complementarities, thereby informing the selection of the right partners (Kude et al., 2012). Setting up rules and unique practices for each dyad, as well as explicitly defining the optimum degree of openness (Parker et al., 2017), minimizes risks and provides co-creation of the maximum possible value (Huber et al., 2017). Keystone leaders must have appropriate strategies for attracting complementors under various market and dominance conditions (Mantovani & Ruiz-Aliseda, 2016). However, focal actors must pay special attention to the risk of core technology disclosure. A higher degree of firm-complementor collaboration is possible only when the core technologies and competencies are distinct (Kapoor, 2013). Analysis of EVCC from the perspective of complementors and how they evaluate partnerships in ecosystems are crucial as they create a large share of value in ecosystems (Gawer & Cusumano, 2014; Teece, 2018). Access to keystone resources and taking advantage of their innovativeness and reputation, enable complementors to help expand the firms production (Morgan et al., 2013). The main motivation for complementors to collaborate with platform leaders is to improve the platform's attractiveness and viability (Chesbrough et al., 2018; Morgan et al., 2013). Input-oriented views (resource motivation and hub capabilities) and output-oriented views (product-level complementarity) should be combined to evaluate the motivation of "spokes" for partnering with "hubs" (Kude et al., 2012).

In platform-based business ecosystems, it is crucial to pay special attention to retaining end-users (rather than complementors), reducing the application review time, and lowering the frequency of platform updates (Song et al., 2018). Diversity of users is one of the keys to success in value creation for platform ecosystems (Kim, 2016). System usability, service variety, and user connectivity influence user value (Haile & Altmann, 2016). Beta products are essential for the competitiveness of a business ecosystem in a new product development phase (Mäkinen et al., 2014). Some platform leaders such as LEGO go even further to build sustainable producer-user ecosystems. Such ecosystems benefit from lower risks for entrepreneurship, increase in product lines and market segments, and higher level of awareness or "buzz" surrounding new ideas (Hienerth, Lettl, & Keinz, 2014). Due to the heterogeneous behaviours and preferences of customers in platform lifecycles, complementors must contemplate different option strategies in the early stages, and develop the most successful ones afterwards (Rietveld & Eggers, 2018). Table 4 demonstrates the effective strategies and practices for EVCC by taking various types into account.

3.3. Potential avenues for future research

Content analysis of the final sample shows that there are missing puzzle pieces in the literature of ecosystems and EVCC. This could signify potential for further research development.

3.3.1. Empirical studies on non-focal actors for EVCC

Most research in ecosystems and EVCC is shaped around focal actors (Aarikka-Stenroos & Ritala, 2017) and how they influence EVCC. Much less focus is on how complementors, policy makers, investors, start-ups, and intermediaries influence EVCC. Only a few studies drew on the role of innovation intermediaries, business incubators, and business accelerators (Carvalho & Galina, 2015; Ngongoni, Grobbelaar, & Schutte, 2017) in entrepreneurial ecosystems. For a more established concept, it is crucial to have a deeper understanding of all participating actors and how they operate in the ecosystem. For instance, it would be interesting to examine the ways ecosystems address the tensions among all actors as it pertains to cannibalization over resources. Thus, although radical innovation may create invaluable opportunities for ecosystems, it could also be in some ways challenging to actually benefit from the radical idea, since all partners in an ecosystem need to fully respond to a major change with respect to their various platforms and portfolios.

3.3.2. Appropriability regimes in ecosystems

In comparison with ecosystem value capture, scholars have focussed more on value creation in ecosystems. Increase in an ecosystem's value creation does not necessarily result in higher appropriated value by the actors, unless a precise value appropriation regime (Veugelers & Cassiman, 1999) exists in the ecosystem. To this end, collective and dynamic strategies for protecting intellectual property rights are required in ecosystems. Notwithstanding a few studies (see for example, Huang et al., 2014; Hurmelinna-Laukkanen & Puumalainen, 2007; Hurmelinna et al., 2007), the current level of knowledge regarding collaboration and ecosystem appropriability regimes remains limited.

3.3.3. Consequences of technological and industrial convergence for ecosystem actors

Industrial and technological convergence are not new phenomena (Athreye & Keeble, 2000; Rosenberg, 1976). Although numerous contributions have been made on the process of convergence (Hacklin et al., 2009), including challenges in technological convergence (Jeong & Lee, 2015), asymmetries in technological diversification (knowledge enhancement), and business portfolio diversification (Gambardella & Torrisi, 1998), as well as other case studies for technological and industrial convergence (Geum, Kim, & Lee, 2016; Li & Ouyang, 2017, 2018), nevertheless, still too little is known about the consequences of industrial and technological convergence on the performance of ecosystem actors. For example, the ability to predict possible new technology fusion futures would be highly beneficial for organizational strategies or to help with the adjustment of innovation policy instruments, as a consequence of technological and industrial convergence and new waves of change in technology platforms.

3.3.4. Applying lean thinking in ecosystems

Although analysing ecosystems is complex and system thinking cannot easily be applied to ecosystems, there are still handy practices from systems engineering and new product development that can be applied to an ecosystems approach. Lean thinking for frugal innovation (Zeschky et al., 2011) is among such practices. The majority of papers relevant to EVCC analysed management strategies to increase EVCC in the contexts where highly competitive markets require ecosystems to have differentiation advantages through a variety of complementary solutions. The papers discussed either how mature ecosystems retain their competitive advantages or how radically innovative ecosystems emerge from disruptive technologies. There is, however, a lack of understanding about how lean manufacturing with cost reduction incentives and frugal innovation practices can bring various actors together to collectively deliver products, in particular where the main functionalities (in comparison with incumbent technologies) are included, but at a cheaper cost.

3.3.5. Diversifying knowledge sources and analytics for systematic knowledge exploration

Another issue to empirically address is the relationship of using different sources of information by ecosystem actors with EVCC. Although data science has long been used in both academia and industry, less attention has been paid to how all actors within ecosystems may benefit from using diverse electronically available data sets in combination with a variety of analytics techniques such as scientometrics, patentometrics, social network analysis, and text mining. The key translation requirement is how to "humanize" new value creation and capture for the mutual benefit of various actors within these combined digital and "offline" ecosystems.

Consider a wind energy ecosystem, for example, where the ecosystem consists of different types of actors in different locations including the upstream sector (basic applied research units, R&D departments, universities, raw material providers and suppliers of wind turbine components), downstream sector (complementors facilitating the distribution and consumption of wind power, service and maintenance sector, infrastructure providers, etc.), governments, unions and associations, research funding agencies, investors, end-users, and more (Valkokari, 2015). In this ecosystem, patentometrics, social network analysis, and text mining enable industry managers to access valuable knowledge regarding technological trajectories, promising technologies, and major industry players (See for example, Castriotta & Di Guardo, 2016; Daim et al., 2006; Kapoor et al., 2015; Ranaei et al., 2016).

Table 4. Effective strategies and practices for EVCC

Types of strategies and practices	
Dynamic leadership essentials	**User-related**
Provision of proper architecture to enable convenient interaction between actors	End-user retention
Monitoring platform competitiveness	Reducing application review time and number of updates
Continuous ideation for platform attractiveness	Having a diverse range of users
Continuous complementor incentivization	Enhancing usability
Continuous orchestration	Enhancing service variety
Continuous revision of business models	Enhancing user connectivity
Appropriate expansion strategies	Producer-user platforms
Continuous partner assessment	Real option strategies based on heterogeneity of users
Attention to dyad-specific rules, unique practices and openness optimum	
Core technology IP protection	
Maximizing the value of accessing ecosystem resources	

Table 4. Effective strategies and practices for EVCC (cont'd)

Strategy/ practice No	Collective	Leadership prerequisites
1	Collective approach towards characterizing roles and strategies	Clear vision for ecosystems
2	Ecosystemic approach towards cybersecurity	Designing a modular platform with open modules for complementarities
3	Flexible business models	Ensuring the monitoring system and governance infrastructure
4	Collective knowledge creation and dissemination	Ensuring continuous attraction of the platform in the design phase
5	Network visualization for monitoring interactions	Acknowledging the limitations of the platform
6	Enhancing dynamic capabilities	Understanding the value of shared IP
7	Facilitating innovation process	
8	Creating innovation communities for knowledge creation	
9		
10		
11		

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Scientometrics in combination with social network analysis and text analytics allow managers of research organizations and universities to access insightful information about the emergence of basic research in wind energy, state-of-the-art research topics and the network structure of knowledge workers and actors in wind energy research (See for example, Bonilla et al., 2015; Facin et al., 2016; Randhawa et al., 2016). Market research and consumer analytics provide market analysts and managers with valuable knowledge about the past, present, and future of technology markets in the wind energy ecosystem (See for example, Erevelles et al., 2016; Tirunillai & Tellis, 2014).

However, these sources of knowledge must not be considered separately, but rather only together as a whole for forecasting, strategizing, or adjusting innovation policy instruments. This is because the ecosystem actors have ongoing interactions with each other and as a result the "real time" output from each of the actors' analyses of the ecosystem may be relevant to all ecosystem actors. In many cases, subscribing to most data sources required for data extraction and analysis are free of charge, or at least available to analysts and researchers at reasonable costs. Therefore, using electronically available data sets may serve to assist with reducing the amount of resources required for collecting primary data in organizations (Khademi, 2019).

4. Discussion and Conclusion

A recent upward trend in publishing papers relevant to EVCC has occurred in the literature. However, the contributions remain fragmented and up until now highlight several different themes of EVCC. Therefore, in this paper a systematic review of literature was conducted to shed light on the growth of EVCC studies over time (RQ1), to explore the hitherto underlying themes discussed in the scholarly research of EVCC (RQ2), and to identify potential opportunities for future research for EVCC (RQ3). In response to RQ1, the literature on ecosystems has been accommodating an increasingly growing number of research papers on EVCC. Sixty percent of the papers in the sample have been published since 2016, with 26.7% in 2018. This finding is in line with Scaringella and Radziwon (2017) in that the number of papers relevant to ecosystems has started to significantly grow over the past few years. The *International Journal of Technology Management, Research Policy, Technological Forecasting & Social Change,* and *Technology Innovation Management Review* have been the most popular journals among scholars in EVCC research. Scholars affiliated to American, British and Finnish organizations have showed the most interest towards EVCC research.

The results of content analysis in response to RQ2 revealed that the underlying themes in the fragmented EVCC literature were different EVCC mechanisms and their determinants, major drivers of EVCC, challenges for realising EVCC and, effective strategies and practices for EVCC. The output of the content analysis served as an input to help identify some of the remaining research puzzles in the fields of ecosystems and EVCC, hence the response to RQ3. Among the many possible future research opportunities, this study implied the potential for response to the paucity of empirical research on several areas: non-focal actors for EVCC, proper appropriability regimes in ecosystems, consequences of technological and industrial convergence for ecosystem actors, application of lean thinking in ecosystems, and diversification of knowledge sources and analytics for systematic knowledge exploration in ecosystems.

The study contributes both to academic research and practice. It extends the existing literature on the intersection of ecosystems, value creation and capture, and strategy by synthesizing the contributions on EVCC. Although other scholars have previously conducted systematic literature reviews on the co-evolution of ecosystems (Makinen & Dedehayir, 2012), roles of different actors in the start-up phase of ecosystems (Dedehayir et al., 2018), empirical research in ecosystems (Järvi & Kortelainen, 2017), varieties of ecosystems and their invariants (Scaringella & Radziwon, 2017), service ecosystems (Kohtamaki & Rajala, 2016) and, terminologies and concepts used in ecosystem literature (Aarikka-Stenroos & Ritala, 2017; Alvedalen & Boschma, 2017; Oh et al., 2016; Ritala & Almpanopoulou, 2017; Stam, 2015), there has not yet been an attempt to organize and synthesize the various different studies that have focussed on and proven relevant to EVCC. Furthermore, this study contributes to theoretical knowledge by ushering forward into view some of the potential avenues for future research in ecosystems and EVCC. Managers can thereby benefit from this research irrespective of the position of their firms in ecosystem game dynamics, especially C-suite managers can use the content analysis results to aid with better strategic planning and operations management.

Similar to all academic research, this study was subject to limitations. First, due to the scholars'

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recommendations on the advantages of WoS to Google Scholar and SCOPUS for conducting review or bibliometric analyses in management studies, the data collection process was limited to extracting data only from the WoS database. Second, non-peer reviewed documents including book sections, non-peer reviewed conference papers, and non-English papers were excluded from the final sample. Although these strategies may have resulted in the absence of some relevant articles from the sample, nevertheless it included most of the relevant high-quality papers involving EVCC. Third, the opportunities identified for future research were subjective and limited to the experience of the author of this paper. Other researchers with different academic or practical experiences may have identified other missing pieces of the research puzzle that as a community we may also strive in our own way and together to complete or to solve.

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An Ethical Framework for Smart Robots

Mika Westerlund

"Never underestimate a droid."

Leia Organa
Star Wars: The Rise of Skywalker

This article focuses on "roboethics" in the age of growing adoption of smart robots, which can now be seen as a new robotic "species". As autonomous AI systems, they can collaborate with humans and are capable of learning from their operating environment, experiences, and human behaviour feedback in human-machine interaction. This enables smart robots to improve their performance and capabilities. This conceptual article reviews key perspectives to roboethics, as well as establishes a framework to illustrate its main ideas and features. Building on previous literature, roboethics has four major types of implications for smart robots: 1) smart robots as amoral and passive tools, 2) smart robots as recipients of ethical behaviour in society, 3) smart robots as moral and active agents, and 4) smart robots as ethical impact-makers in society. The study contributes to current literature by suggesting that there are two underlying ethical and moral dimensions behind these perspectives, namely the "ethical agency of smart robots" and "object of moral judgment", as well as what this could look like as smart robots become more widespread in society. The article concludes by suggesting how scientists and smart robot designers can benefit from a framework, discussing the limitations of the present study, and proposing avenues for future research.

Introduction

Robots are becoming increasingly prevalent in our daily, social, and professional lives, performing various work and household tasks, as well as operating driverless vehicles and public transportation systems (Leenes et al., 2017). However, given that the field of robotics has grown to become interconnected with other technologies, it seems more and more difficult to provide a commonly accepted definition of a robot (Leenes et al., 2017). According to Ishihara and Fukushi (2010), the word "robot" was first introduced in Karel Capek's 1921 play that dealt with conflict between human beings and robots, that is, artificial persons molded out of chemical batter. Belanche et al. (2019) add that the word "robot" originates from the Czech word "robota", which means "forced labor;" or, put another way, "slavery". Thus, robots are often seen as mechanical devices programmed to perform specific physical tasks for human beings. That said, many of today's robots are no longer mere slaves - unpaid labor that respond only to human requests - but increasingly embody autonomy and progressive "decision making" capabilities (Lichocki et al., 2011; Petersen, 2007). Hence, Lin et al. (2011) define a "robot" as an engineered machine that senses, thinks, and acts, thus being able to process information from sensors and other sources, such as an internal set of rules, either programmed or learned, that enables the machine to make some "decisions" autonomously. The degree of autonomy, we will see, is a crucial indicator of how "smart" a robot is or is not. Nevertheless, the notion of anthropomorphizing robots, or treating them "as persons", is not under consideration in this paper.

Advancements in robotics have led to the emergence of "smart robots", which are defined as autonomous artificial intelligence (AI) systems that can collaborate with humans. They are capable of "learning" from their operating environment, experiences, and human behaviour feedback in human–machine interaction (HMI), in order to improve their performance and capabilities. The smart robot market was valued at USD 4.5 billion in 2017, and is expected to reach USD 15 billion by 2023 (*Market Research Future*, 2019). Among robotics engineers, the increased focus on HMI and use of AI components has shifted the attention from "mechanoids", that is, robots with a machine-like appearance, towards the development of human-shaped ("humanoid") and animal shaped ("animaloid") smart robots (Kumari et al., forthcoming; Mushiaki, 2013/2014). Belanche et al. (2019) note that while humanoids may only have stylized human features, "droids" (android if male, gynoid if female) have an appearance and behaviour closer to a real human being, at least on the technical level. However, robots' appearances are less important than how easy they are to communicate with, to train to do what we want, and how well they solve tasks. Thus, design and usability matter significantly when choosing what types of smart robots we will want in our home or work (Torresen, 2018).

There are multiple ways to categorize robots, including conceptual typologies based on a robot's function and application area (Lin et al., 2011), the degree of a robot's anthropomorphism (that is, human characteristics of a robot), the purpose or task of its operation (Leminen et al., 2017), its ability to adapt to the environment (Bertolini & Aiello, 2018), and a robot's level of "cognitive" computing and affective resources (Čaić et al., 2019). Leenes et al. (2017) argue that robots can be categorized by their autonomy, task, operative environment, and HMI relationships.

Nonetheless, as the number of different types of robots and their uses increase in our daily lives, there will unarguably be more and more ethical challenges and questions arising with new robotic achievements and applications (Demir, 2017). Although concern about ethical issues in robotics is actually older than the field of robotics itself, "roboethics" has only recently emerged as a discipline dealing with ethical issues related to robotics (Ishihara & Fukushi, 2010; Veruggio & Operto, 2006). In fact, the study of social and ethical issues related to robotics is still in its infancy and calls for more research, although attention to the theme is increasing rapidly (van der Plas et al., 2010). In particular, there is a need for coherent ethical frameworks in order to frame and discuss new types of robots, and contribute to the virtuous development and adoption of such robots (Demir, 2017). Hence, this conceptual article aims at reviewing previous literature on roboethics in order to discuss the main roboethics perspectives, and at the same time use those perspectives to create an ethical framework for "smart robots" as a rapidly emerging new robotic "species".

The article is structured as follows. After this introductory section, the study reviews previous literature on roboethics and discusses the main perspectives on ethics in robotics. It then makes use of the perspectives identified in order to establish an ethical framework for smart robots. Upon establishing and elaborating the framework, the paper identifies two underlying dimensions based on key concepts in ethical and moral theory. Finally, the article concludes by discussing key tenets from the study and highlighting avenues for future research on roboethics in light of the surge coming with ever smarter robots.

Roboethics as an Emerging Discipline

Ethical issues in regard to robots and their impacts on our society are the subject of "roboethics" (Demir, 2017). Research in robotics and discussions about roboethics are currently being promoted globally by several organizations, including universities and technology companies, as well as online and open-source maker communities dedicated to robotics development (Prescott & Szollosy, 2017). Hence, roboethics has mainly addressed the "human ethics" of robot designers, manufacturers, and users (Mushiaki 2013/2014). However, "machine ethics" indicates ethics relating to forms and codes of conduct implemented *in the AI of robots*. The aim of this research field is to guarantee that autonomous robots will exhibit ethically acceptable behaviour during their interactions with human beings. The risk that the actions of robots may have negative consequences on human beings or the environment is a growing area of study in roboethics (Lichocki et al., 2011; Veruggio et al., 2011). In fact, recent research (for example, Beltramini, 2019) uses the term "roboethics" as a synonym for "machine ethics", thus acknowledging that the ethical behaviour of machines is determined by the way their systems have been designed. Nevertheless, both the discourse and application of roboethics remain poorly understood, lacking a clear explanation of basic principles regarding the present and potential consequences of what we can now call "smart robots" on society (Alsegier, 2016).

Fundamental issues in roboethics include the dual use problem of robots (robots can be used or misused), the anthropomorphisation of robots (the illusion that machines have internal states that correspond to the emotions they express, like a "ghost in the machine"), and the equal accessibility to technology challenge, such as for care robots (Bertolini & Aiello, 2018;

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Veruggio & Operto, 2008). Further, many engineering projects lean toward trying to develop more humanized robots, partly due to the increased use of AI components and a focus on developing HMI.

However, a note of caution is expressed that there is an ethically significant distinction between human-human interaction and human-robot interaction (Borenstein & Pearson, 2013). Engineers should therefore be highly sensitive to the potential impacts of their creations on human thinking and emotions, as people interact with robots (Steinert, 2014). The humanoid appearance of a robot might deceive users into believing that the robot has capabilities it does not actually have. The more "intelligently" a robot acts, the more people are inclined to attribute "liveliness" or "life" to it, thus leading them to at least in some ways treat that machine as they would treat other living beings (Steinert, 2014). Lumbrenas (2018) suggests discarding the ongoing current efforts at humanization of robots, and instead distinguishing HMI from inter-personal interaction with human beings, by avoiding the practice of giving names to technology. As it turns out, however, technology manufacturers seem to be navigating in an entirely opposite direction for their AI-driven technologies (for example, Apple's "hey Siri" call).

The unfolding scenarios made possible by smart robotics technology are both fascinating and unsettling at the same time. The increasing adoption of smart robots will raise new ethical, legal, and social issues (Alsegier, 2016; Veruggio et al., 2011). Advanced robotics can be very harmful if it is applied to people's lives without understanding the potential issues that may arise from introducing ever "smarter" technology (Alsegier, 2016). Hence, it is crucial that everyone in a society, especially the creators of smart robots, knows that there are ethical principles that govern the field. They may then in a practical sense try to apply those principles in real life (Alsegier, 2016). As a major branch of philosophy, ethics may be simply described as "the intrinsic control of good behaviour", which is in contrast to "law" that acts as the "extrinsic control of good behaviour" (Majeed, 2017). The main ethical concern involving robotics is the conflict between basic human rights and the responsibilities of scientists and engineers. Accordingly, people have the right to be safe, while at the same time, corporations have the right to attempt to profit from the development of robotic technology (Alsegier, 2016). Hence, addressing key tenets in roboethics as they are likely to arise is a fundamental, market sensitive requirement for assuring a sustainable, ethical, and beneficial human-robot symbiosis (Tsafestas, 2018) in digitized social ecosystems.

Key Ethical Perspectives for Smart Robots

Building on suggestions by Steinert (2014), roboethics provides four key ethical perspectives on smart robots. These are, 1) smart robots as amoral and passive tools, 2) smart robots as recipients of ethical behaviour in society, 3) smart robots as moral and active agents, and 4) smart robots as ethical impact-makers in society. The following sections provide an in-depth elaboration on these perspectives.

Smart robots as amoral and passive tools

According to the instrumental perspective, robots are mere extensions of human capabilities, and can be used as tools to alter a situation according to human desires (Steinert, 2014). A robot can also be part of larger systems that have some control over its actions (Coeckelbergh, 2011). Solis and Takanishi (2010) point out that while robots are viewed as tools that humans use to perform hazardous or dull tasks (for example, robot vacuums), humanoids are increasingly designed to engage people through communications strategies, in order to achieve social or emotional goals. Whether or not such robots are capable of making ethical decisions, thus has become a non-trivial point of contention (Borenstein & Pearson, 2013). Robots are still seen as amoral instruments, because technology is supposed to be neutral concerning the purpose of its usage. For example, a robot can be used to perform a life-saving surgery, while the very same robot could also be used to hurt or kill someone, as a result of human will (Steinert, 2014). In fact, along with the increasing intelligence, speed, and interactivity of robotics technology (Kumari et al., forthcoming), smart robots can potentially be used as "killer robots" by militaries, that is, as offensive semi-autonomous weapons (Demir, 2017). Yet, even if a robotic weapon is built as an intelligent, autonomous or semi-autonomous system, the ethical concerns that arise from its usage nevertheless remain entirely focused on the human designing or using them (Steinert, 2014).

Kelley et al. (2010) note that robots are analogous to domesticated animals in disputes about liability. If a robot is involved in an accident, the robot's owner should be liable, unless the robot is defective in manufacture or design, or has an inadequate warning label, in which case the robot's manufacturer may be held liable for damages (Kelley et al., 2010). Further, either owners or users can be held liable if a robot under their custody harms someone, or if they made the robot unsafe through modifications to display features not intended by the robot's manufacturer (Bertolini & Aiello, 2018). Smart robots cannot also be held liable in case of privacy issues. Advanced social robots such as robot companions and care robots can record sensitive information about customers and patients, even without them being aware of having disclosed that information (Bertolini & Aiello, 2018). The instrumental view argues that machines are unlikely in the foreseeable future to be able to undertake the same or similar reasoning processes of handling sensitive information as human beings can do (Borenstein & Pearson, 2013). Nevertheless, only strong autonomy considered as a robot's full ability to freely determine its own will and course of action would justify treating the robot as a "subject" that (who) can be held liable for its actions. Instead, the instrumental perspective holds that a robot is not an active agent, but merely a passive object to an active human agent's will (Bertolini & Aiello, 2018).

Smart robots as recipients of ethical behaviour in society

Another perspective in roboethics views smart robots as recipients of human ethical behaviour in society. Nowadays, it is unimaginable for civilized societies to hold slaves. As ethical sensibilities concerning our behaviour towards animals has recently advanced, there is also need to contemplate whether the moral realm should also encompass intelligent technology such as smart robots (Steinert, 2014). For example, a scenario arises where it could be considered wrong to be "inhumane" to a homecare robot that is no longer of use to a household, even though that robot has no real autonomy or personality (Petersen, 2007). Similarly, Anderson et al. (2010) argue that roboethics should put more emphasis on developing ethical research guidelines for experimentation on robots, along the lines of rules for experimentation and testing on animals. Although one might argue that robots do not possess "personality", societies actually make "persons" by producing them partly through a process of personification, that is, attributing human qualities to non-human objects, which is conferring the status of a "person" to something non-human (Steinert, 2014). Another issue arises if robots gain an ability to learn to reason themselves out of a "desire" for doing their designed task. Thus, forcing an autonomous smart robot to stick with its designed task, in such a situation, could be deemed unethical, perhaps upheld by law even if the "owner" of the robot paid for the robot to do the designed task (Petersen, 2007). Thus, future work in roboethics needs to discuss more about the potential domain of "robots' rights" (Anderson et al., 2010), alongside of whether rights only exist for human beings as owners of robots, the latter which by definition have no "rights" at all.

Smart robots become part of the "social-relational whole", that is, members of an interactive network of human beings and intelligent machines (Coeckelbergh, 2015). Whatever capacity and understanding of how to interact with human beings a robot is built with, designers have to consider its ethical consequences in HMI (Coeckelbergh, 2015; Solis & Takanishi, 2010). Programming social values and norms into robots that are designed to interact with humans requires input from several types of experts (Weng, 2010), such as engineers, scientists, legal advisors, sociologists, and psychologists. That said, experts working on areas characterized by complexity and controversy, such as AI and smart robotics, cannot assume their technical qualifications will be enough to satisfy questions involving the human condition in HMI (Prescott & Szollosy, 2017).

This partly relates to advancements in robotics, leading to a shift from the ability to execute "simple" navigational tasks, to being able to perform "complex" social interaction with human beings (Campa, 2016). Nonetheless, one issue that arises from people interacting with social robots is that they may show indifference and even cruel behaviour in HMI, knowing that the robot's displayed emotions are not real (Wirtz et al., 2018). On the other hand, there is a danger that children or other groups may interpret the behaviour of robots as controlled by internal cognitive or emotional states (for example, the robot moved or said something because it "wanted" to), as opposed to externally regulated by human control (for example, a programmatic response based on information about the environment gathered through sensors) (Melson et al., 2009). Thus, interacting with a smart robot may spark empathy toward the robot for its "good" behaviour, or, alternatively, aggressive behaviour such as punching or kicking the robot by children simply because of its occasionally irrational, uncanny or "wrong" behaviour (Darling, 2015). Likewise, a robot's right to self-defense against potential abusive behaviour in HMI is an under-researched area that needs further study.

Smart robots as moral and active agents

The third perspective views robots as moral agents in themselves, that is, as active subjects in their own right, rather than as objects and passive instruments of human beings. Sophisticated trading robots and autonomous vehicles can be considered as non-human "decision-makers", because the actions they "choose" to take can have pervasive real-world consequences (Steinert, 2014). Decision-making capacities come inevitably with the question of ethics. At its simplest, ethics signifies conduct a balanced assessment of the harms and benefits of any actions (Iphofen & Kritikos, forthcoming). However, a robot's inability to have human emotions and feelings has raised concerns about their capabilities to act respectfully or in a "moral" way towards human beings (Leenes et al., 2017). The more autonomous a robot is, the more it would seem necessary to be both sensible and responsible to legal and social values and norms, as well as to perceive and interpret its present situation, including to identify what is demanded, forbidden or tolerated (Steinert, 2014). For instance, robotic street cleaners and driverless cars will have to observe traffic regulations (Leenes et al., 2017), and care robots in hospitals need to be able to monitor and perform analyses and operate courses of action that are consistent with established codes of ethics during their interaction with patients (Luxton, 2014). Whereas a robot's simple "decision making" needs to be founded on case-based reasoning, rather than on generic moral principles (Iphofen & Kritikos, forthcoming), at the same time a pre-programmed understanding of the use context will be crucial in order to adjust a robot's design to accommodate ethics based on context and practice (Van Wynsberghe, 2013).

Coeckelbergh (2011) argues that engineers should not implement roboethics in a top-down fashion, but rather design robots that have the capacity to learn, develop and even eventually reproduce themselves over time. According to Vetrò et al. (2019), an overly deterministic approach to a robot's algorithmic operations might affect the machine's behaviour in a way that produces negative social effects. Rather, they suggest it would be better if a robot learned to autonomously perform human tasks and behaviour, by mimicking the demonstration of human subject performances (Solis & Takanishi, 2010). While this technology is still in exploratory territory, it is noteworthy that algorithmic operations involving individuals can result in harmful discrimination, even in the case of robotic learning.

Attempts by robots to reproduce observed human behaviour, may lead to under- or overestimation of certain human beings and representatives of human groups, because of disproportionate historical datasets and learning methods in these different "species" (Iphofen & Kritikos, forthcoming; Vetrò et al., 2019). Although a robot might not be held morally or legally responsible for its operations, or liable for the damage it causes because technology has no intentionality (Bertolino & Aiello, 2018; Lichocki et al., 2011), the "robots as moral and active agents" perspective maintains that an autonomous smart robot capable of learning to perform tasks should have at least "limited liability". This argument is even more crucial if a robot were to show emergent behaviours that were not explicitly programmed, and which only became observable with time (Trentesaux & Rault, 2017).

Smart robots as ethical impact-makers in society

Finally, smart robots can be seen as impact-makers. This view holds that robots can be ethical-impact agents that influence for social norms and values (Steinert, 2014). For example, the spread of smart social robots could alter the structure of the societies globally, influencing humanity and our relationship with technology (Ishihara & Fukushi, 2010). Futuristic visions about a coming "Ubiquitous Robot Society" and "Neo Mechatronic Society" are frequently to be found in public discussions (van der Plas et al., 2010). Thus, this perspective on roboethics stresses the potential constructive and beneficial relationship between humans and robots, focusing on questions involving if, when, and how we can potentially learn to flourish with robots (Coeckelbergh, 2011).

Social norms regarding receptiveness to technology vary in time and place. There are differences, for example, between Japanese and Western cultures about robots. Whereas Japanese culture generally views robots as helpmates, in contrast, Western cultures have tended to lean toward the idea that machines created by humans will ultimately turn against their makers (Leenes et al., 2017). Similarly, while Japanese robot developers are now actively pursuing the creation of smart care home robots for their aging population, Majeed (2017) argues that the provision of widespread robotic care in one culture, may turn out to impose a societal stigma on it from other cultures. Borenstein and Pearson (2013) submit that as the adoption of social robots in some cultures increases, especially children may grow to prefer robots over humans. In this vein, some people may develop a tendency to retreat from social interaction with others, and even start competing with other people for a robot companion's attention, which may bring attendant harmful social consequences.

Also, smart robots are already capable of taking over a steadily increasing number of human tasks (Leenes et al., 2017). Although robotics is often associated with the "three Ds", that is, robots perform jobs that are "dull, dirty, or dangerous", meanwhile advanced robots can now perform increasingly delicate and difficult jobs, such as medical surgeries, with more precision and accuracy than human hands (Lin et al., 2011). Indeed, intelligent robotics technology is coming more and more to replace human labour for performing complicated tasks in domains ranging from manufacturing and economy to finance and health (Beltramini, 2019). Although such robotic "servitude" is perceived quite differently from human "slavery", the growth in robots as unpaid labor brings with it the issue of human "replaceability" changing the composition of the workforce (Petersen, 2007). This begs a question of who or what would be to blame if a large-scale labour force replacement of human workers due to robots were to occur; robots, their designers, or the society and people who pay to use them (Steinert, 2014). After all, humanity has deliberately built automated tools to increase its power and foster economic progress by eliminating manual labour and needless drudgery (Veruggio & Operto, 2008). Thus, in the meantime we have become highly reliant on technology (Anderson et al., 2010). On the other hand, robots do not only cause job losses, but also create jobs. However, the kinds of available jobs for humans will change, with low-skilled jobs being replaced by higher-skilled jobs. This development may exacerbate social inequality in the labour market (Leenes et al., 2017).

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Summing up the discussion on diverse approaches to roboethics, we can establish a conceptual framework that distinguishes four major ethical perspectives regarding smart robots, based on the work of Steinert (2014). Steinert (ibid.) recommends that robotics developers treat all four ethical perspectives simultaneously and, further, that ethical, social, cultural, and technical considerations should be combined. Moreover, Steinert (ibid.) suggests that roboethics taxonomies should incorporate more than one dimension, although one is all that is often used in current roboethical categorizations. Along with advancements in AI and robot technologies, some popular dimensions, such as a robot's autonomy (Wallach & Allen, 2010) are becoming obsolete, as increasingly smarter robots are becoming autonomous or semi-autonomous *de facto*. This means that robots

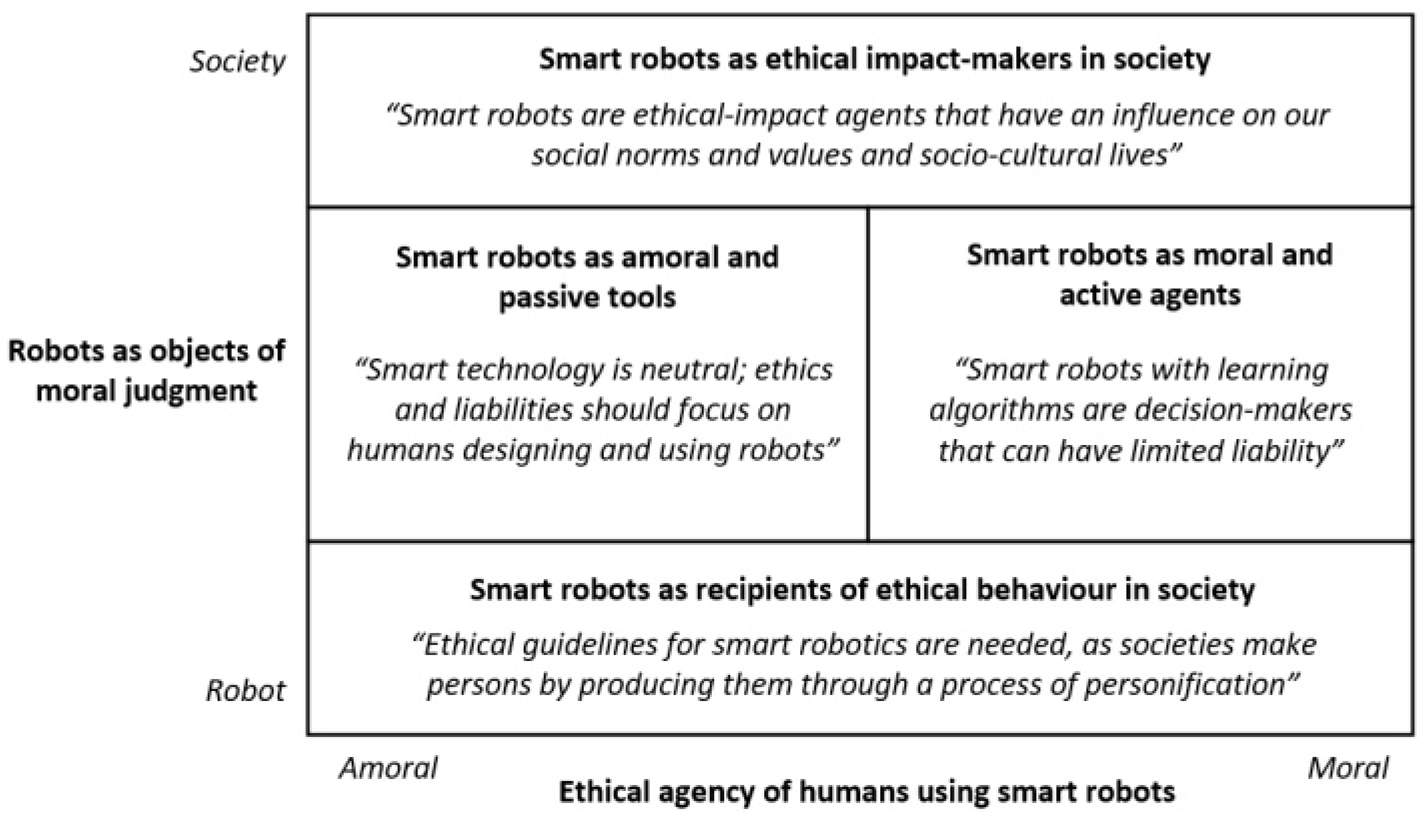

Figure 1. A framework of ethical perspectives to smart robots

are nowadays capable of making what more and more look like “decisions”, and of performing complicated actions in HMI. Similarly, other dimensions such as a robot’s area of usage (Steinert, 2014) are increasingly difficult to define in an accurate manner. New smart robots, such as Samsung’s “Ballie”, can perform tasks in multiple areas, being a life companion, personal assistant, robotic pet, fitness assistant, personal care robot, manager, and coordinator for a number of other home robots in a household, at the same time (Hitti, 2020).

Lin et al. (2011) note that although smart robots may seem to jump out of the pages of science fiction, technological progress nevertheless continues, and we therefore need to consider the ethical issues that are coming along with advancing robotics. In accordance with Steinert’s notion (2014) on the need to use key concepts in ethics as dimensions for categorizing roboethics, our framework identifies two underlying dimensions behind the four ethical perspectives to smart robots: 1) ethical agency of human beings using smart robots (in terms of smart robots as amoral tools vis-à-vis moral human agents) and 2) robots as objects of moral judgment in themselves (in terms of smart robots being objects of ethical behaviour vis-à-vis ethical changes in society due to the introduction of smart robots) (see Figure 1). The underlying approach to each of the perspectives is summarized below the label of the perspective.

Ethical and moral theory (see for example Craig, 1993) put forward many important and relevant concepts. The two dimensions chosen for the purpose of this study have been previously suggested in literature on roboethics, yet they have not been extensively discussed, nor connected together. “Roboethical agency”, that is, the ability of a smart robot to commit ethical or unethical actions, is discussed as a dimension by Moor (2006) and Dyrkolbotn et al. (2017). “Robots as objects of moral judgment”, that is, whether the consequences of ethical or unethical actions affect a smart robot or human society, is discussed by Davenport (2014). The dimensions are not exclusive; whether smart robots are considered amoral tools or as autonomous moral agents, or even as both at the same time, can be the case irrespective of the object of moral judgment. That is, ethical actions can impact either robots, or society at large, or both. This is accords with Steinert’s (2014) argument that various roboethical perspectives have blurry boundaries. The features in each of the perspectives are summarized in Figure 1 below the label of the perspective.

Discussion and Conclusion

This article has aimed at creating and discussing an ethical framework for smart robots based on previous scholarly literature on roboethics. Smart robots were defined as autonomous AI systems that can collaborate with humans and are capable of learning from their operating environment, experiences, and human behaviour feedback in HMI, in order to improve their capabilities. Upon reviewing previous literature on roboethics, the study discussed and elaborated on four perspectives to roboethics, as originally suggested by Steinert (2014). Then it established a conceptual framework to illustrate these perspectives, as well as a general robotics strategy suitable for near future HMI with smart robots. In so doing, the study argued that the dimensions of a framework should be based on key concepts in ethical and moral theory, and identified two dimensions underlying Steinert’s four ethical perspectives: 1) ethical agency of humans using smart robots (amoral tools vis-à-vis moral agents), and 2) robots as objects of moral judgment (smart robots as objects of ethical behaviour vis-à-vis the ethical consequences of smart robots in human societies).

The study contributes to extant literature on roboethics in several ways. First, it updates Steinert’s (2014) discussion on roboethics by specifying how smart robots, as a kind of new robotic “species” that is being increasingly adopted by users at all levels of society, may serve to affect our ethical outlook regarding both robots and robotics. For example, the study points out that some popular dimensions in roboethics categorizations, such as a robot’s autonomy (see for example Wallach & Allen, 2010), are becoming obsolete, as increasingly smarter robots are becoming “semi-autonomous” or “autonomous” *de facto*. Similarly, a robot’s technical features, or area of usage (Lin et al., 2011; Steinert, 2014), are currently becoming increasingly difficult to define, as new smart robots emerge that are capable of performing tasks in multiple areas (Hitti, 2020). Second, the study establishes a conceptual framework that presents Steinert’s four perspectives on roboethics, and summarizes the ethical approach to smart robots from each perspective in a descriptive sentence. Third, the framework contributes to extant literature on roboethics by identifying two dimensions underlying the four perspectives. These dimensions are based on ethical and moral theory (Craig, 1993), and have been suggested in prior studies on roboethics (Moor, 2006; ; Davenport, 2014; Dyrkolbotn et al., 2017), but have not been discussed extensively, nor simultaneously in the roboethics literature. Fourth, the study suggests that

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these two dimensions are not mutually exclusive, but rather can occur at least in part together at the same time. In this vein, the study both accepts and confirms Steinert's (2014) argument that the four ethical perspectives should be considered simultaneously because their boundaries are blurry.

Both researchers and practitioners such as smart robot designers can benefit from the study. First, scientists can use the framework and its dimensions to better focus their area of research in regard to the emergence of new types of robots, including the ethical challenges those robots may impose. Second, the majority of people in technologically advanced nations want robots to contribute to a better and more ethical world. Yet, there is nonetheless still disagreement in regard to how to bring this goal about (Lichocki et al., 2011). According to Alsegier (2016), designers must consider how their robots will impact peoples' behaviours, and continually review their robotics applications, including both the technological and psychological aspects, as safety measures to ensure that their robots do not cause harmful effects on a person or society. However, the present study reiterates the recommendation that engineers should not implement roboethics in a top-down manner, but rather design robots that can learn from mimicking the demonstration of performing human subjects, in order to avoid the negative effects of overly deterministic algorithmic decision-making (Coeckelbergh, 2011; Solis & Takanishi, 2010; Vetrò et al., 2019). This means that in order for smart robots to function ethically with human beings and to exercise context-awareness, they must be able to absorb the necessary legal, social, and even cultural norms and standards from their environment (Steinert, 2014). This, of course, is no small challenge. Third, smart robot engineers can use this framework on roboethics as an aid to assess the potential consequences and risks of AI-driven robotics technologies for people and societies.

Regarding limitations and future research opportunities in the field, Tsafestas (2018) argues that robotic behaviour, behavioural expectations, and related ethical questions vary significantly by the type of smart robot, for example, assistive robots, social robots, and military robots. Although it is acknowledged that context-awareness is important for ethical robotic decisions, the variety of smart robots was only covered briefly at once by discussing generic perspectives about roboethics in the smart robot context at an abstract level. Thus, future research should examine if the roboethics perspective has a relationship with newer "smart robots". Further, previous research (Tuisku et al., 2019) argues that public opinion about the widespread use of robots in society continues to be mainly negative. The paper thus discussed ethical issues in regard to smart robots on largely an abstract level, and did not address opinions about robots and their possible relationship with roboethics as adopted by any specific party such as robot engineers or the general public. Future research should investigate whether negative public opinion about robots can be explained by the particular types of perspective that many people have adopted. Overall, the study concludes that the spread of ever smarter robots will cause numerous ethical challenges in societies around the world.

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Selling Data-Based Value in Business-to-Business Markets

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"This is not an IT project, this is not an HR project, this is a management group's project."

Interviewee, advanced in data utilization,
Founder & Chairman of a start-up company

The purpose of this paper is to study what aspects a sales function needs to consider when selling new data-based value in business-to-business (B2B) markets. The paper combines literature on the business-to-business sales process with data-based value. The study includes altogether 29 qualitative interviews from eight companies, representing seller companies at different stages in big data utilization. In addition, the study includes customer perspectives with six interviews from four customer companies. As a result, selling new data-based value is studied from several perspectives. First, we evaluate the impacts of the generated new data-based value from the seller and the market perspective. Secondly, we study what sales representatives need to understand, both from the customer's perspective, and in relation to data and digital solutions during the sales process. Thirdly, on the customer side, we explore the roles of "digitalist" and old-school buyers, and their effect on the sales process. Our research findings highlight the crucial understanding of customer business and knowledge about real-time data management, digital twins, and artificial intelligence (AI) when selling data-based solutions that create real-time data, recommendations, and value for a customer's business.

Introduction

"Data utilization" as well as "value-based selling" are phenomena widely discussed among academics and practitioners (for example, Manyika et al., 2014; Gandomi & Heider, 2015; Vargo & Lusch, 2016). Developing innovations that deviate from customary offerings and utilize data in innovations, may be a challenge for companies (Erevelles et al., 2016). Utilizing large amounts of data will lead to several kinds of challenges in business-to-business (B2B) companies (see for example, Erevelles et al., 2016; Chen & Zhang, 2014; Barnaghi et al., 2013). Thus, combining big data and business processes can be an insurmountable problem for the vast of majority of large and medium-sized organizations (Frizzo-Barker et al., 2016). Furthermore, when it comes to commercialization, it is crucial that the customer's needs are very carefully studied early in the innovation process in order to answer them by means of data analysis. In value-based selling, quantifying value and understanding it from both the seller's and the buyer's perspective is important (Töytäri et al., 2011). However, although data utilization and value-based selling are widely studied, previous studies do not adequately emphasize the sales perspective when selling data-based value in B2B markets.

This paper combines the literature on B2B sales, data-based value, and data utilization. The focus of this paper is to study what aspects need to be considered when selling new B2B data-based innovation. Specific emphasis is on data-based industrial services and their effects on B2B companies' sales functions. The paper presents practical examples collected from qualitative interviews of what aspects need to be considered when selling new B2B data-based innovations. The paper's results will help companies in developing their sales strategy and assist salespersons in selling data-based value to customers.

Theoretical Background

B2B Sales in Transformation

Advances in IT and digital channels affect the interactions between B2B buyers and sellers, and, thus, are transforming the field of B2B sales (Paesbrugghe et al., 2016). Digitalization has impacted customer

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behavior by making customers' paths non-linear and complex, having multiple touchpoints, both digital and physical. The classical seven-step sales model (Dubinsky, 1980/1981) cannot be utilized anymore as the basis for selling in the digital era of sales. Changing customer behavior promotes challenges to selling, and the interplay between face-to-face meetings and digital channels requires new management practices. Studies have argued (see for example Hoar, 2015) that the B2B sales function might even become useless in the future. As a result, sales organizations are searching for ways to strengthen their power, which has shifted to buyers.

The selling process takes place at multiple levels and is also non-linear (Dixon & Tanner, 2012). In value-based selling, understanding both the seller's and the buyer's perspectives are important, as well as specifying created value (Töytäri et al., 2011). This requires that both the customer and the salesperson are active participants in two-way communication where the customer's value creation potential is mapped (see for example Vargo & Lusch, 2004).

Yet, the issue of how to consider buyers' perspectives when describing a new sales process has proven to be difficult. Buyers expect value when they meet with seller companies. According to Grönroos and Voima (2013), the buyer's value creation process is not linear, and it does not automatically follow the activities of the seller company. Therefore, it is important to understand all of the perspectives that affect customers' value creation.

New Business Creation in the Digital Age

Because of digitalization, companies will have new kinds of business opportunities and the possibility to get a hold of and utilize increasingly distributed customer knowledge sources (see for example Chesbrough et al., 2014). Data can be seen as a powerful vehicle for new business and value creation. Big data, for example, could help sales, create new business models, products, and services, capture cross- and up-selling opportunities, analyze the level of customer satisfaction, increase transparency, establish dynamic pricing, and assist in understanding performance data and root causes (Manyika et al., 2011; Davenport, 2014; Erevelles et al., 2014).

In addition, sensor data creates value in several ways for value chains in manufacturing. For example, real-time input on emerging defects and production adjustments, as well as improved demand forecasting and supply planning across suppliers, are opportunities that sensor data enables (Manyika et al., 2011). Furthermore, becoming highly data-driven may promote the identification and development of new products and services, find new customers and markets, as well as increase operational efficiency (Chen & Zhang, 2014).

The new value enabled by data utilization can lead to new innovations, new business areas and thus, to new sales. Utilizing data may mean collaborating with new kinds of companies to create a joint offering. However, companies face several challenges when utilizing large amounts of data (Erevelles et al., 2016), and in collaborating with new actors in the business environment. In this paper, "data-based value" is described as an offering that utilizes data to create value for a customer's business.

Many authors have studied data utilization and big data (see for example Gandomi & Haider, 2015; Frizzo-Barker et al., 2016; Akter et al., 2016). However, most scientific articles on these topics are analytical or theoretical, focusing on, for example, simulations, algorithms, experiments, and/or mathematical modelling techniques (Sivajarah et al., 2017). Yet, there are fewer papers that combine B2B sales with data-based value. This paper focuses on the practical aspects that sales functions need to consider when selling new data-based value in B2B markets.

Selling New Value Created from the Utilization of Big Data

By means of the IoT (Internet of Things), billions of wireless devices will soon be connected, and along with it, new business models created (Marr, 2015). Data from various sources and sizes create a new kind of business opportunity for B2B companies (Rantala et al., 2018). This means that sales forces are challenged by data-based innovations, which are opportunities that arise from business model reinvention (for example, new data-based services). Furthermore, there may be a radical shift in what is sold, how selling should take place, and how to make money from it. Moving from products to value-added services, rethinking value propositions, reconfiguring value delivery models, reordering value-chains, or even moving to different markets may lead to challenges for sales forces (Westerman et al., 2014). At the same time, with some of the emerging technologies, salespeople are being pressured to become more efficient in the sales process (Rodrigues et al., 2012; Marshall et al., 2012). Nowadays, it is important to deeply understand the customer's business, as well as the solution that a salesperson is selling. In other words, this means having in-depth knowledge when referring to the continuum of data, information, knowledge, and wisdom (DIKW) (for a

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summary of the roots of the DIKW concept, see, for instance, Hey, 2004).

For many years, the information balance has shifted from salesperson to customer. Customers have the upper hand in negotiations because they are able to study enormous amounts of information available online (Scott, 2014). Thus, it might be more challenging for the salesperson to agree to a face-to-face meeting in the early phases of the customer's buying process (Adamson et al., 2012). This is because the salesperson's capability to influence the customer's buying process, in the early phases of it at least, is significantly challenged. Customers who are regularly in contact with sales representatives are more knowledgeable and demanding, which leads to a situation in which it is difficult to create value for the customer during the sales process.

Big data nevertheless also creates value for the sales forces, as well as increasing agility and opportunities for proactivity in everyday sales work (Agnihotri et al., 2016). For example, customized buying processes for each customer are enabled by means of exploiting big data (Scott, 2014). This refers to a proactive selling approach enabled, for example, by digital customer footprints of, as well as with different open data sources. The capability of gathering, interpreting, and reacting to dynamic, real-time information creates market opportunities. A good example of this is real-time feeds customarily utilized by bond traders. Furthermore, we believe sales forces should utilize predictive analytics in order to become one step ahead of both their competitors and customers, beyond only spotting real-time information.

From the standpoint of B2B sales, it is important to analyze for whom the actual new data-based value is created. In other words, who utilizes it and is willing to pay for it? This can also be a challenge. Selling data-based innovations is in many cases the same as selling value, instead of traditional transactions (as is the case with data-based services). Value-based selling places a heightened emphasis on the offering's implications for the customer's business, and thus customers might be less open about their actual needs because needs may be complex and have strategic importance to customers' business. Consequently, the benefits of the existing offering are not the primary discussion topic in a value-based sales meeting. Rather, greater emphasis is on understanding the customer's forthcoming business challenges and competitive advantages in order to proactively enhance the customer's success in the future (Terho et al., 2012). Accordingly, communication is a very important aspect of value-based sales (Rantala & Hänti, 2017). This paper focuses on identifying the target customers of data-based value and quantifying the value for customers of new data-based value in B2B markets.

Research Question and Methodology

In this paper, we focus on the sales of data-based innovations with the following as our main research

Case company	*Industry*	*Size*	*Experience in big data utilization*	*Number of interviewees*
A	Healthcare	Large	Experienced	6
B	Manufacturing	medium-sized	Beginner	3
C	Automation	Large	Experienced	2
D	Manufacturing	Large	Beginner	6
E	Data processing	start-up	Advanced	2
F	Data processing	Large	Advanced	1
G	Advertising	Large	Advanced	5
H	Waste management	Large	Beginner	4

Table 1. Interviewed case companies in Phase 1: the sellers' view

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question for the study: What aspects need to be considered when selling new data-based value in B2B markets?

This paper employs a qualitative case study as its research methodology. The case study was chosen as a method because of its suitability for situations that include multiple variables and complex processes (Yin, 2014). The qualitative data was collected in two phases from 2017–2019, from 35 semi-structured theme interviews with 12 different companies. In the first phase, the focus was on studying the companies' views, and in the second phase, customer perspectives were the primary emphasis.

The seller's perspective was achieved from 29 semi-structured theme interviews with eight different companies from healthcare, manufacturing, energy, waste processing, automation, and data processing industries. The interviews went beyond selling data-based innovation to cover a broad range of themes, such as value for customers, new business creation through big data utilization, understanding the term "big data", contemporary data utilization, advantages of data utilization, and data sources. The following table summarizes the interviewed companies' backgrounds.

The reason for selecting the case companies was that their big data utilization was at different stages, from beginner to advanced levels in big data utilization. Some of the case companies operate both in B2B and in consumer markets, but this research focused only on their B2B relationships. A typical interview took 60–90 minutes, involving one or two interviewers each. Most of the interviews were conducted with one interviewee at a time, audio recorded, generated comprehensive notes, and the audio text was subsequently transcribed. Five group interviews included from two to three interviewees each. Our study was partly explorative in nature, such that the meanings of concepts required clarifications through discussions with the interviewees. Consequently, the main source of empirical material was comprised of semi-structured theme interviews. In two different workshops, the results of the interviews were tested and discussed with a case company and researcher representatives.

Results

Our results validate that companies need to stay at the forefront of industry developments, as the transition towards more data-driven B2B businesses is now happening, and may continue to take place rapidly. Companies need to make decisions in a more data-driven manner, as well as provide new value to customers based on data utilization. This paper focuses on the matter of selling new data-based value. According to our interview results, a major challenge is to identify customer value and as well as customize each data-based innovation so that it generates value for every customer.

First, let's look at new data-based value sales from the seller and market perspective. Data may promote several different business opportunities, or even create new ecosystems and markets. The research by Valkokari and colleagues (2018) shows that different influences depend on the level of data mining, as well as its impacts on the business processes and ecosystem. Thus, our research findings also show that there are different influences on selling and the market, depending on the level of data mining involved, and its impacts on sales representatives and the market.

Case company	*Industry*	*Size*	*Experience in big data utilization*	*Number of interviewees*
I	Pulp manufacturing	Large	Experienced	2
B	Energy	medium-sized	Beginner	1
C	Energy	medium-sized	Experienced	1
H	Waste management	medium-sized	Beginner	2

Table 2. Interviewed case companies in phase 2: the customers' view

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If data mining is done on the conventional level, data may change a company's processes or competitive environment.

- When only the seller is impacted by the use of conventional data mining, the customers are usually internal customers.

- When the market is impacted by the use of conventional data mining, customers can be similar to current ones.

On the other hand, the use of disruptive AI systems in the near or not so distant future, may promote a role change in the value chain, or even lead to the emergence of new business ecosystems, thus creating a new trajectory for markets.

- When the seller is impacted by disruptive AI systems, the customers could be, for example, a customer's customers.

- When the market is impacted by disruptive AI systems, the customers could be almost anyone. There can be new kinds of players, the roles of current players may change significantly, the business model can differ radically from current ones, and the way to sell may be totally different compared to now.

Secondly, let's look at the new data-based value itself. When selling data-based industrial services, it is important to listen to the customer very carefully and answer the customer's precise needs. However, selling services may be challenging for a traditional industrial product company in the first place. Thus, when adding "data" to this context, it may be even more difficult. From a sales' perspective, it requires an understanding of data-based value and customer needs on a detailed level. This transforms the voice of a customer into outputs with data-based value, and in the process, answers the customer's precise needs. In addition, timing is a crucially important factor. The seller needs to recognize a customer's needs, including their hidden needs, as well as the moment when the customer is willing to transition to being more data-driven. Figure 2 shows a framework created by the authors based on the interview data. It illustrates learning and path dependence, as both seller and customer learn, within an organization in the case of data-based services, that focus on operation optimization. From the salesperson viewpoint, it means needing to increase simultaneously one's own understanding of a customer's business and possibilities, which value-adding data services can offer the customer.

The goal of the salesperson is to find the most suitable and cost-effective solution that brings all available sales knowledge and understanding based on data analyses

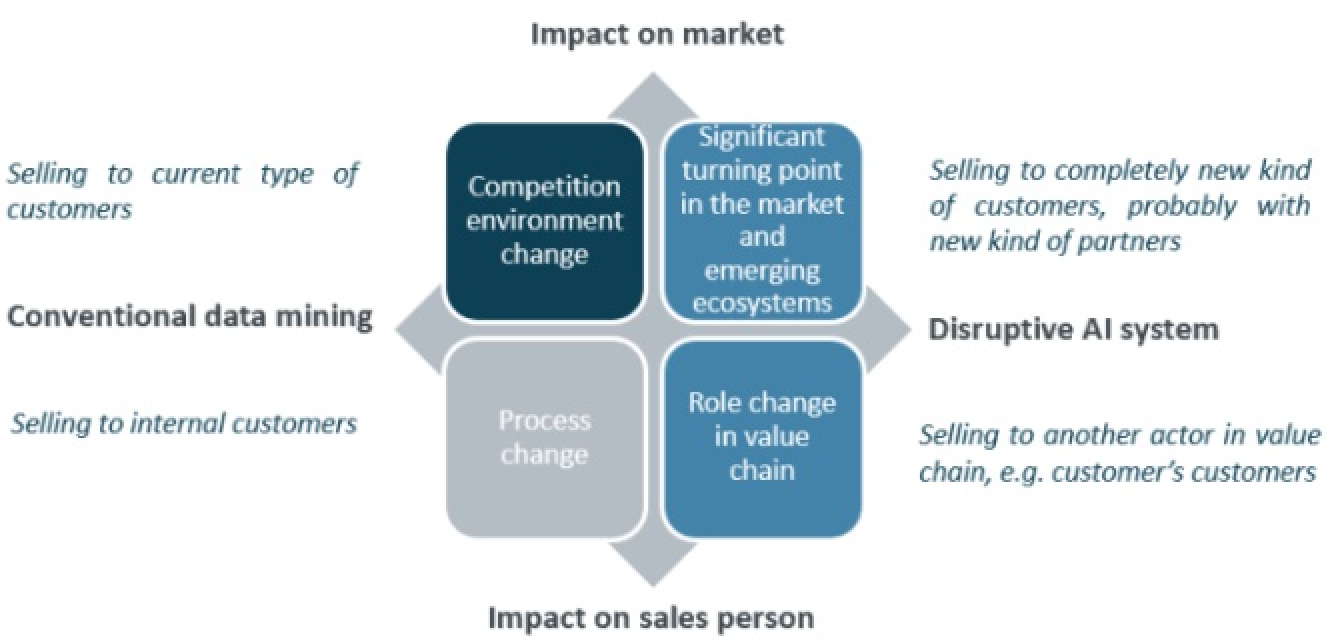

Figure 1. Business impacts of data-based new innovation (modified from Valkokari et al., 2018)

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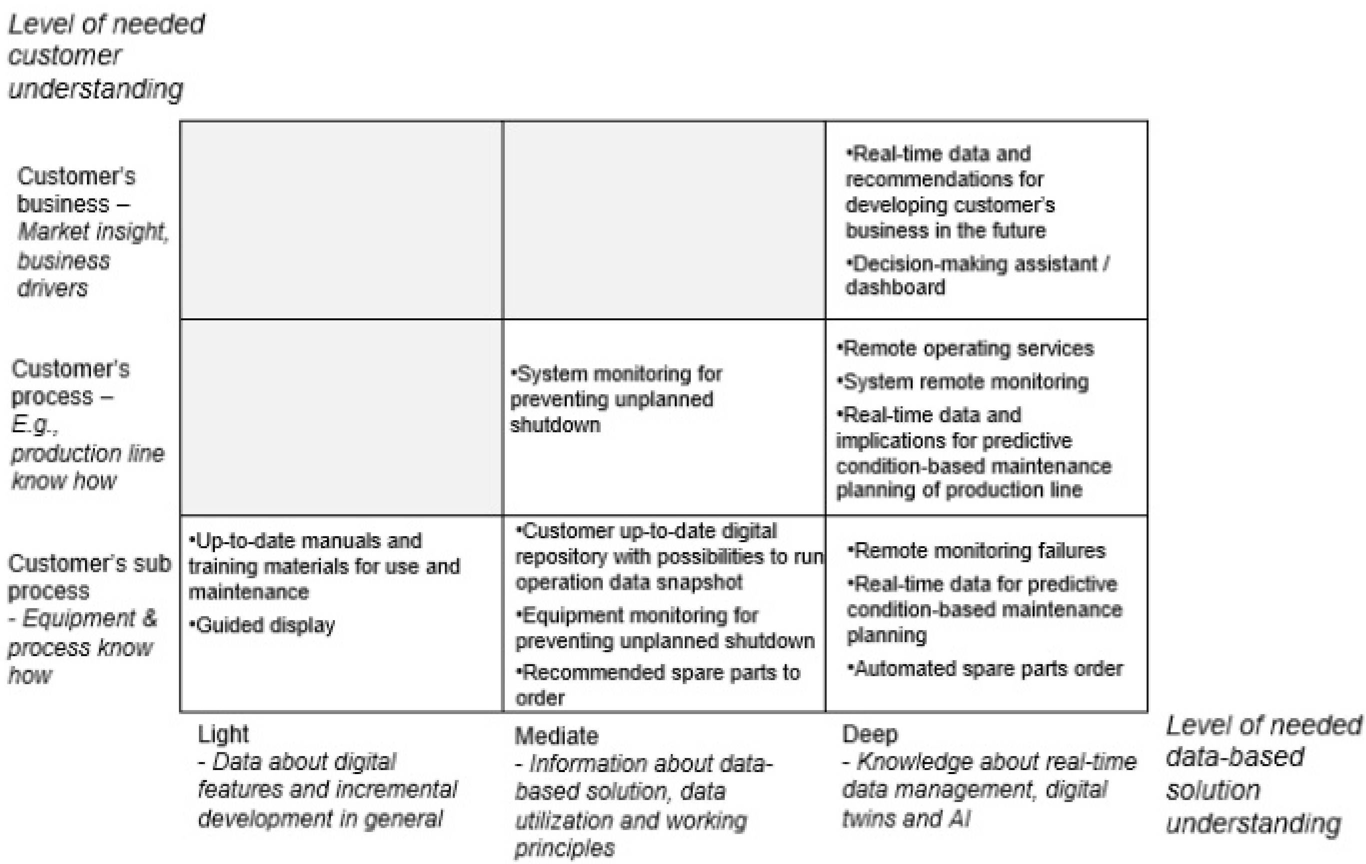

Figure 2. Example of data-based services for optimising an industrial company's operations

to the customer, in order to create substantial value for the salesperson, the customer, and the related network. A new data-based innovation needs to be divided into smaller pieces when formulating value for the customer. If we think, for example, about industrial services for optimizing operation, from the customer perspective, the data-based service is one part of the offering. The offer for optimizing operations may also include a suitable combo of condition inspections, digital manuals, user guidance videos, remote support, and analyses for operation optimization. The value for the customer should be identifiable in all of these aspects.

In summary, if the customer is not used to buying, for example, operation optimization services, then the service needs to be divided into small pieces in order to see what kind of unities (the related data, presence, etc.) and values for the customer can be better clarified. In the same way, it could be, for example, that a customer needs to develop their personnel's know-how, or get assistance through data with analysing the fault situation. The same challenges exist in other kinds of services as well.

Thirdly, here we look at the B2B customer. Customers are knowledgeable and demanding during the sales process, and hence, value creation for the customer may be difficult. B2B buyers can be both digitalists and old-school shoppers (Alhonen et al., 2018). The digitalist buyer is used to digital tools and utilizes them fluently in their work. The digitalist buyer's buying process starts earlier, as they get influences while surfing online. On the other hand, the old-school buyer prefers traditional methods (for example, phone calls, emails and in-person visits) when communicating with the seller during the sales process. However, in some cases, company business codes of may hinder a digitalist buyer from being able to act as a digitalist. According to our interview results, both kinds of buyers exist in

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customer companies. Which kinds of B2B buyers a company uses may affect the ability of the buyer to adapt to the value of a new data-based innovation.

Discussion

Our research results are in line with Chen and Zhang (2014), who argue that most companies consider it beneficial to become highly data-driven. According to our study, companies think that data facilitates creating new services, finding new markets and customers, and increasing overall efficiency. In addition, our findings are in line with Chesbrough and colleagues (2014), such that companies are aware that they need to co-operate with new kinds of companies as partners in order to develop data-based value. However, our research results highlight that there are several challenges to utilizing large amounts of data. In this sense, they are in line with the results of Erevelles and colleagues (2016). Especially companies that are beginners in data utilization face several challenges, such as lack of know-how and expertise, and insufficient resources to learn at the required pace. Identifying the data's core, its most valuable information, is considered difficult.

Data-based services raise the discussion about what is sold and how, as well as how to make money and find customers willing to pay. According to our results, this is challenging for the sales function (Westerman et al., 2014), as well as R&D functions. Based on our interviews, customers now know and demand more than they did before, and therefore creating value for demanding customers may be difficult. Our results highlight that customers' businesses and processes need to be understood very well, when it comes to how their data is utilized. Further, their forthcoming challenges and advantages need to be recognized in order to create value. These viewpoints are in line with Terho and co-authors (2012).

When forming a sales strategy that takes data-based value into consideration, determining who to sell to and with which kind of arguments is important. The value of a data-based innovation may be different for different employees in the customer company. In addition, it may be beneficial to create criteria for identifying which type of customer company and buyer is in question. This may help the salesperson who is trying to find the right pitch and arguments.

Conclusions

Many companies are interested in developing data-based value. However, utilizing large amounts of data, being more data-driven as well as selling the data to customers, also brings out new challenges. In this study, we sought answers to the question: What aspects need to be considered when selling new data-based value in B2B markets?

The question was addressed with the help of 35 qualitative interviews from a total of eight seller companies and four customer companies at different stages of data utilization.

The paper approached "selling data-based value" from several perspectives: the seller and market perspective, the creative data-based value and needed understanding perspective, and a buyer's perspective. The paper presented a framework for understanding data-based value sales and knowledge needed in relation to the customer, data-based solutions and technologies. Our research findings highlight that understanding a customer's perspectives, values, and needs early in the innovation process is especially important.

In the literature, empirical findings on data-based value are primarily focused on big data analytics or analysing consumer data. There are only a few papers combining B2B sales, data-based value, and data utilization. This paper thus opens a new theme and provides practical viewpoints for selling data-driven value on B2B markets.

The paper is intended to help practitioners benchmark company practices , enabling them to offer feedback to managers for successfully developing their B2B sales functions in practice. This paper may also help information-oriented researchers see the value of recent advances in the utilization of data, by applying new innovations in a broader context, including B2B sales and management perspectives.

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What impedes the success of late mover IT clusters despite economically favorable environments? A case study of an Indian IT cluster

Harini Mittal, Punit Saurabh, Devang Rohit & Kathak Mehta

> *"The new industries are brainy industries and so-called knowledge workers tend to like to be near other people who are the same. Think of the City of Hollywood. People cluster. This means you have winning regions, such as London and Cambridge, and losing regions. The people who want to be top lawyers in Sunderland are hoovered up by London."*
>
> Evan Davis
> Economist & Journalist

The Information Technology (IT) industry in India, is one of the major contributors to the country's growth story. It is organized in a few strong and dominant clusters across the country. Recent research focuses on the emergence, growth and success of the seven big IT clusters that account for 96.55% of total software exports from the country. Unlike the six successful late mover clusters, there are several other late mover IT clusters that have not experienced similar growth. Why do some of the late mover IT clusters in India succeed while others fail to take off despite favorable economic conditions? This paper applies a case study method to answer this research question by examining a single cluster, using both primary and secondary data. The paper concludes with a new framework to explain how an IT cluster lacks the motivation to succeed when it has to gain traction alongside the competing dynamics of traditional businesses. We find this to be the case more so when traditional businesses are thriving and growing.

1. Introduction

A "cluster" is a concentration or agglomeration of an industry that develops over time based on geographical proximity, in a way that boosts competition and collaboration that results in innovation. The process of clustering potentially creates greater economic benefits through higher productivity, better knowledge management, and entrepreneurial opportunities (Chuluunbaatara et al., 2014). The significance of economic and industrial clusters in regional and even national development has therefore become the object of a new economic theory (Porter, 1990) being taught now in business disciplines.

The Information Technology (IT) industry in India, one of the major contributors to the country's growth story. It is organized in a few strong and dominant clusters across the country. As a proportion of national GDP, India's IT industry revenues have grown from 1.2% in FY1998, to an estimated 9.5% in FY2015 (IBEF, 2016). India is the world's largest IT sourcing destination, accounting for approximately 55%of the US$ 185-190 billion global services sourcing business in 2017-18 (IBEF, 2019). In 2016, four Indian firms were listed among the top 10 technology outsourcing companies in the world [1]. The seven big IT clusters accounted for 96.55% of software exports by Software Technology Parks in India (STPI) in 2016-17, according to the 2016-17 STPI annual report. The emergence, growth, and success of these big IT clusters (one of them is an early entrant, and the remaining six are late movers) have been the focus of some recent studies (Khomiakova, 2007; Rao & Balasubrahmanya, 2017).

However, there are several other late mover IT clusters that have not experienced similar growth. Why do some of the late mover IT clusters in India succeed while some fail to take off? There is a need to address this question to aid firms and policy makers. This paper therefore investigates the clear distinctions between successful and not so successful IT clusters, in order to point out factors impeding the successes of later moving Indian IT clusters.

This paper uses a case study method in examining a single cluster using multiple data sources and methods. The case of Gujarat State IT clusters was carefully chosen because it ranks number one in India for ease of doing business [2]. Some recent studies have identified Gujarat IT cluster as one of the next emerging clusters. Gujarat has many of the enabling factors identified as important for becoming the next successful entrant in the IT industry. These include ~~a~~ historical and growing concentration of innovative high-tech firms from diverse industries with software needs, temperate climate, entrepreneurial culture, connections between local entrepreneurs and MNCs, supportive state and local government policies, and established connections with the Indian diaspora. These factors are discussed in section four. However, despite these favorable conditions, India's State of Gujarat has not been able to make a mark in the IT industry. This paper uses both primary and secondary data to probe into the factors and contexts that have hindered the successes of late mover IT clusters despite an economically favorable environment, using Gujarat IT clusters as a case study.

The remainder of the paper is organized into six sections. The next section reviews the literature pertaining to models and success factors of clusters in general and IT clusters in particular. The third section traces both the growth models in the Indian IT sector from its inception to its current status with several prominent clusters. The research gap and methodology section four presents a framework explaining the models, activities, success factors, and performance of IT clusters. Application of the framework to the Gujarat case is presented in the fifth section. Key insights in general and specific to the case are summarized in section six. The seventh section concludes with suggestions for future research.

2. Models of cluster formations

In order to understand IT clusters in India, it is essential to examine cluster formations in general. Several researchers have explained cluster formation models.

Bathiet's study has been used to explain four models of regional development and growth (Rao & Balasubrahmanya, 2017). The first export model is a cluster created by a multiplier process that creates further growth mainly driven by exports. This model is limited in terms of innovation, interaction between economic agents within and outside the region and its absorptive capacity. The second model is the innovative milieu approach in which the actors establish linkages with economic agents in global markets and thereby develop absorptive capacity to acquire valuable information and resources from external sources that they can use. The third model is the super-cluster model in which larger groups based on multiple smaller clusters are formed. This type of formation depends on changes in supply and demand conditions in global markets for technologies, as well as the amount of spatial transaction costs that arise out of servicing clients in distant places. Pre-requisites for such a model are a strong mix of interregional and international transaction networks, and a high level of absorptive capacity. The fourth model is "local buzz and global pipelines". This model differs from the other three in terms of emphasis on "relational proximity" as a source of competitive advantage, rather than spatial proximity. In this model, there is a "thick web of local interactions, process of learning and knowledge creation" that is linked to a global pipeline. Boja (2011) classified clusters into horizontal and vertical clusters. Vertical clusters have a vertical chain of production while horizontal clusters have similar outputs using inputs

Markusen (1996) identified three types of industrial clusters. First, a hub-and-spoke industrial district, comprising several small firms revolving around one or more dominant, externally oriented firms. Second, a satellite platform, with an assemblage of unconnected branch plants embedded in external organization links, located in a geographical area that benefits from governmental facilities or low-cost supplies and workforce. And third, a state-anchored district, focused on one or more public-sector institutions that dominate the region and the economic relation between cluster members. The next section explains how the above model characteristics apply to IT clusters.

2.1 IT clusters

This section provides a literature review of the models and success factors of IT clusters. IT clusters represent an important type of technology cluster and on the global stage represent many of the most successful and efficient examples of clustering (Boja, 2011). In these clusters the output is IT knowledge in the form of patents and innovative solutions, services, and products, mostly software as solutions or embedded in other products.

IT clusters can be classified as low-value and high-value based on the products and services produced by the constituent firms (Boja, 2011). Low-value clusters are involved mainly in outsourcing activities for large firms because they offer professionals at relatively low costs, provide various IT services for important companies that externalize different phases from the IT products lifecycle, customer support or quality assurance and testing processes. They depend entirely on a few worldwide IT companies for external input of technologies and financial support. High-value IT clusters develop innovative products and technologies. These clusters have active intra-cluster and extra-cluster interactions with a high absorptive capacity.

IT clusters have mainly horizontal relationships. In the IT industry, it is not a pre-requisite to be geographically close to the customer. Hence, a cluster may not have the entire chain of production. Each cluster is specialized in a particular technology or service, and acts either as a feeder or innovation hub for major firms or other clusters.

IT clusters around the world are organized in the following manner (Boja, 2011):

- Hub and spoke model, like the Seattle cluster in which Microsoft attracts other firms to provide IT services;

- Satellite platform model, found in both low-value and high-value IT clusters. Low value satellite platform model clusters can be found when multinational IT companies relocate their production sites to low-value IT clusters and state-centered or state-anchored IT clusters. Examples of high-value satellite platform model IT clusters are firms located around a) important research and university centers to benefit from their highly skilled specialists, b) laboratories for their innovation capabilities, and c) governments funded technology parks such as Research Triangle Park in North Carolina or the Cambridge Technology Cluster;

- State-centered or state-anchored IT clusters are found around governmental institutions, like aerospace complexes, military research labs, or state universities, that receive large budgets for research and development.

2.1.1 Success factors of IT Clusters

There are four important factors that contribute to the growth and success of IT clusters (Boja, 2011).

Base of qualified IT professionals. Since knowledge is the key input for IT products and services, a highly skilled workforce is critical for the birth, survival, and growth of an IT cluster. A strong higher education system that imparts high quality knowledge in the field of IT, and a network of research centres, both public and private, are prerequisites for creating a solid base of qualified IT professionals.

Availability of venture capital. Supportive institutions like venture capital and law firms play an extremely important role for location of start-up firms in knowledge-intensive industries (Kenney & Patton, 2005).

Clear financial regulations, incentives, facilities and opportunities provided by government.

Presence of functioning networks and partnerships. IT clusters typically require strong collaboration amongst cluster members in the form of sharing information, and competition.

3. Indian IT clusters

Indian IT clusters in their early stages were modeled as low value satellite platform structures. In their initial stages, the clusters had the following features:

1. Strong local entrepreneurship and innovation with connections to MNCs,

2. Increasing requirements of software development from MNCs driven by the information and communication technology (ICT) revolution,

3. Vertical disintegration of activities in developed country firms propelled by global competition that led to MNC companies outsourcing their work to countries with low cost work force,

4. Unbundling of R&D activities.

Indian IT clusters have grown from a low value industry to a major player in the global ICT industry. The national output commands a 55% share of the global market for IT services. Fig 1. Captures the growth of IT industry exports in three sectors: ITES, Business Process Management (BPM), and Engineering and Research and Development (ER&D). An increase in BPM and ER&D activities indicates Indian IT clusters moving towards high-end value-added services. Another indicator of IT clusters moving up the value chain in India is the

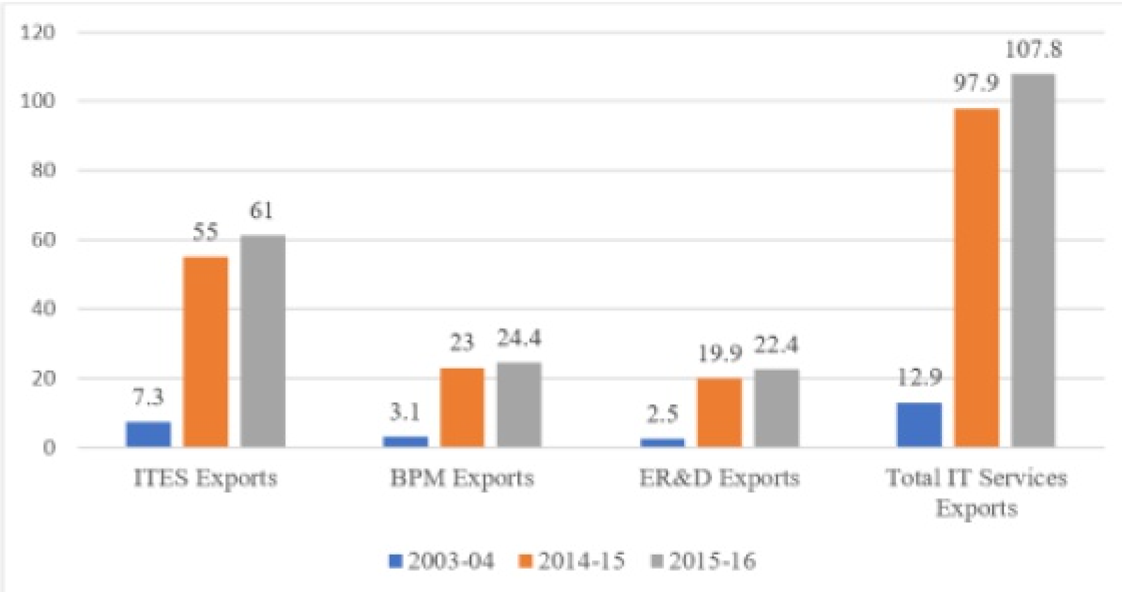

Figure 1. Indian IT industry Exports (USD)
Source: Rao & Balasubrahmanya, 2017 and Nasscom reports

increasing number of US patents accumulated by Indian companies (Rao & Balasubrahmanya, 2017).

3.1 Success factors of Indian IT clusters
According to Rao and Balasubrahmanya (2017) and Khomiakova (2007), the major contributing success factors for growth in Indian IT clusters are:

1. Vast pool of low-cost and high-quality talent fluent in English language

2. Presence of premier educational and innovation-based research institutions

3. Historical concentration of innovative high-tech firms from diverse industries with IT needs

4. Temperate climate

5. Entrepreneurial culture

5. Connections between local entrepreneurs and MNCs

6. Supportive state and local government policies, establishment of Software Technology Parks of India [STPI]

7. Indian expatriates and returning Indians with education and experience abroad and connections to MNCs

8. Attractive work environment with acceptable level of social infrastructure to raise a family

9. IT firms with operational excellence that have gained cost, quality, and security leadership, as well as a global delivery model

10. Chance

3.2 Prominent IT clusters in India
The Indian IT industry is organized into seven prominent clusters: Bangalore, National Capital Region (NCR), Chennai, Hyderabad, Pune, Mumbai, and Kolkata.

Several firms that develop computer software and provide information technology (IT) services have emerged in and around Bangalore, a city located in India’s southern state of Karnataka. The Bangalore cluster is the largest in terms of sales and exports. It also houses the most technically advanced firms and is known as the Silicon Valley of India.

The Bangalore cluster has moved up the value chain of IT services from a low-value to intermediate-level super cluster and is now at the threshold level of becoming a high-value cluster. There is an increased level of both intra-cluster interaction within Bangalore and extra-

Table 1. Factors contributing to success of Bangalore IT cluster

Factor Conditions:
- Presence of top-class scientific and engineering research/educational institutions
- Large number of private colleges
- Large number of engineering-oriented public sector firms
- Y2K demand offers opportunity for large number of employees, experience in US firms
- Dotcom bust in US caused many professionals to return home from US
- Bangalore's lower real estate costs, cosmopolitan culture and pleasant weather attracted young professional to the region

Demand Conditions:
- Mainly served sophisticated markets such as the US and Europe

Related and Supporting Industries:
- Limited availability and need of infrastructure for software development
- Targeted infrastructure support through technology parks
- Ecosystem evolves to support industry
- Good network of venture capitalists

Firm Strategy, Structure & Rivalry
- Managers in Infosys & Wipro aggressive in international expansion
- Started with low-cost advantage; but now increasingly built on quality and reliability
- Hybrid structure: Combination of off-shoring and on-site work
- Learning orientation of firms allow adaptation
- Competitive environment leads to attestation of certifications

Government:
- Liberalization in 1984 led to favorable Computer and Software Policy
- Government creates Software Technology Parks of India
- Communication gateway setup in 1991
- State government takes aggressive policy approach

Chance:
- Y2K problem in US firs creates demand for Indian Software professionals
- Dot-com bubble in US bursts

Non-governmental Actor:
- NASSCOM plays an active role in facilitating interaction between industry & government

cluster interaction between Bangalore and other clusters in India and abroad, due to diaspora and the influx of MNC affiliates, and the location of affiliates of Bangalore based Indian MNCs elsewhere (Rao & Balasubrahmanya, 2017).

Anil Nair et al. (2007) explained the factors behind the recent growth and success of Bangalore as a globally competitive IT cluster. We look at this using Porter's diamond model.

Ramachandran and Ray (2003) named the Indian states that are aspiring to develop IT clusters or have created IT clusters much later than Bangalore as later movers. The following table captures the focus areas, as well as the factors contributing to success in each of the remaining six late-mover clusters (Rao & Balasubrahmanya, 2017):

As can be seen from Table 2, Hyderabad is modeled as a state-anchored platform, NCR, and Chennai are modeled as satellite platforms, while Pune and Mumbai are modeled as hub and spoke platforms. Hyderabad, NCR, and Chennai are moving from low-value to intermediate level clusters in terms of quality of services produced, with many Global In-house Centers (GICs) serving ER&D, while Kolkata and Pune remain as low-value satellite model clusters. It does seem though, that Pune has the potential for increasing intra- and extra-cluster interactions in the future.

All seven clusters have educational and research bases, a supply of talent, diverse set of industries, and are located in and around large cities. These clusters are attractive places to work and raise a family with minimally expected amenities in the form of hospitals, schools, and other services (Rao & Balasubrahmanya, 2017). Most cities in India, including the above seven clusters, are plagued with infrastructural problems, such as traffic congestion, power outages, and rising housing costs (Rao & Balasubrahmanya, 2017). Not only that, India has a low score in application indicators, such as bandwidth per internet user, annual telecom investment, internet users per 100 people, access to wireless broadband, lack

Table 2. Factors contributing to success of the remain six late-mover IT clusters

Name of the cluster	Focus areas	Contributing factors
NCR (New Delhi, Gurgaon and Noida)	ITES and Business Process Outsourcing (BPO)	Has high absorptive capabilities for future growth to high-value clusters due to: 1. Premier educational institutions 2. Infrastructure and Institutional strength of the capital of the country 3. Many IT MNCs 4. Many manufacturing firms 5. Presence of GICs
Chennai	More hardware than software firms	1. Electronic Hardware Technology Park and Software Technology Park 2. Reputed educational institutions 3. Many MNCs, automobile and auto-parts companies 4. Presence of GICs
Hyderabad	ITES-BPO	It is the second largest cluster next to Bangalore. There is a lot of intra-cluster interaction and absorptive capabilities due to: 1. Pro-active government policies – setting up “Hi-tech city” 2. Reasonable infrastructure cost 3. Good educational institutions 4. Thriving bio-pharma sector 5. Influx of expatriates 6. Many IT MNCs 7. Growing number of GICs

Table 2. Factors contributing to success of the remain six late-mover IT clusters (cont'd)

Pune	Small home-grown firms producing software, embedded software in hardware and chip design	1. Hub and spoke model due to proximity to Mumbai 2. Temperate weather 3. Good educational institutions and vast pool of talent 4. Biotech research firms 5. Influx of expatriates 6. Growing number of MNCs 7. Growing number of GICs
Mumbai	IT Services, ITES-BPO	1. Industrial, commercial and financial capital of India 2. Manufacturing hub 3. Oldest and most successful IT park 4. Home to TCS – one of India's biggest IT services MNCs 5. Variety of industrial clusters 6. Many IT MNCs 7. Home of Bollywood 8. Presence of GICs
Kolkata	Initial stage of evolution	1. Good educational institutions 2. Large IT firms – domestic and multinational 3. Declining manufacturing sector 4. Very few IT MNCs

of high-speed connectivity, and others. (Rao & Balasubrahmanya, 2017).

4. The research gap and description of methodology used

Table 3 presents a framework for explaining the models, activities, success factors, and performance of IT clusters based on the above literature. Indian low value clusters are mostly modeled on a satellite platform that derives most of its clientele and activities from work outsourced by large firms or MNCs. They all have moderately supportive governmental policies and limited economic resources. The intermediate level clusters in the form of Hub and Spoke, Satellite, or State Anchored platforms, have greater absorptive capacity, greater intra- and extra-cluster interactions, and provide higher value-added services, such as BPM and ER&D. There are more GICs in these clusters, and valuable networks with expatriates as well. This allows knowledge transfer, absorption, and potential for future innovation and knowledge generation.

These clusters contribute significantly to economic growth in India. High value clusters such as India's Silicon Valley can be Hub and Spoke, Satellite, or State Anchored platforms. These have an advanced level of innovation, knowledge generation, intra- and extra-cluster interactions. These clusters are economic growth drivers that produce radically innovative, break-through technologies. So far, India does not have a high value IT cluster. Investment will follow ideas and growth. Therefore, venture capital investors are more active in the intermediate level and high value clusters.

So far, the literature has examined emergence, growth,

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Table 3. Nature, models, activities, success factors, and performance of IT clusters

Platform	Model	Activities	Level of interaction	Contributing factors	Access to VC funding	Absorptive capacity, innovation and knowledge generation
Low Value	Satellite Model	Outsourced from MNCs or large firms	Limited intra-cluster interaction	1.Vast pool of low-cost and high-quality talent with fluency in English language; 2. Presence of premier educational and innovation-based research institutions; 3. Temperate climate; 4. Attractive work environment with acceptable level of social infrastructure to raise a family; 5.Supportive state and local government policies;	Limited	No
Intermediate	Hub and Spoke/ Satellite/State -centered	Higher value-added services such as BPM and ER&D	Greater intra and extra cluster interactions	1. Vast pool of low-cost and high-quality talent with fluency in English language 2. Presence of premier educational and innovation-based research institutions 3. Historical concentration of innovative high-tech firms from diverse industries with software needs 4. Temperate climate 5. Entrepreneurial culture 6. Connections between local entrepreneurs and MNCs 7. Supportive state and local government policies 8. Indian expatriates and returning Indians with education and experience in the West and connections to MNCs. 9. Attractive work environment with acceptable level of social infrastructure to raise a family	Moderate to High	Higher level of knowledge transfer, absorption and potential for future innovation and knowledge generation
High Value	Hub and Spoke/ Satellite/State -centered	Innovative products and technologies	Advanced level of intra and extra-cluster interactions	1. Vast pool of low-cost and high-quality talent with fluency in English language 2. Presence of premier educational and innovation-based research institutions 3. Historical concentration of innovative high-tech firms from diverse industries with software needs 4. Temperate climate 5. Entrepreneurial culture 6. Connections between local entrepreneurs and MNCs 7. Supportive state and local government policies 8. Indian expatriates and returning Indians with education and experience in the West and connections to MNCs. 9. Attractive work environment with acceptable level of social infrastructure to raise a family	High	Advanced level of innovation, knowledge generation

and success of IT clusters. What are the factors that inhibit germination of all or some of the conditions mentioned in the above framework? No study has yet explored this important subject. Using a case study method, this research has explored if there are intrinsic conditions, contexts, and factors that impede the emergence and growth of an IT cluster. The use of a case study method aided this research because, "instead of relying solely on general knowledge of a problem domain, or making associations along generalized relationships between problem descriptors and conclusions, case-based reasoning is able to utilize specific knowledge of previously experienced, concrete problem situations (cases)" (Amodt & Plaza, 1994). In this specific research study, it allowed for a detailed and exhaustive investigation, using multiple sources of information, involving each of the essential elements and components of an innovation ecosystem, if they exist, that enable incubation of the factors in the aforementioned framework. Such a methodology is apt in this context because this is a relatively unexplored subject, and hence any finding can be further validated by replicating it in multiple cases to create a generalized theory.

Many studies (Nasscom reports; Rao et al. 2017; Khomaikova, 2007; Everest Group [3]) have identified Tier 2 and 3 cities as emerging IT clusters. Prominent among them are cities in Gujarat, Chandigarh, Coimbatore, Kochi, and Jaipur. The Gujarat IT cluster was chosen as the focus of this paper for two reasons. Firstly, Gujarat state contributes considerably to the country's overall development as the third-largest state economy in India in terms of gross domestic product and per capita income [4]. According to a 2009 report on economic freedom by the Cato Institute, Gujarat is the second most free state in India [5]. In 2010, Forbes' next decade list of the world's fastest growing cities included Ahmedabad, a major city in Gujarat, at number 3 after Chengdu and Chongqing from China [6].

Secondly, Gujarat has many enabling factors identified in the framework to help it become the next entrant in the IT industry, such as historical concentration of innovative high-tech firms from diverse industries with software needs, temperate climate, entrepreneurial culture, connections between local entrepreneurs and MNCs, supportive state and local government policies, and connections with the Indian diaspora. These factors will be discussed at greater length in the next section. However, despite all these favorable conditions, Gujarat has not yet been able to make a major mark in the IT industry. Therefore, the authors chose this state to conduct an in-depth case study analysis using multiple data sources. The authors applied our framework to Gujarat IT clusters to investigate the activities, model, and contributing factors as will be outlined in the following sections. The study involved primary data collection by way of surveys and secondary data sources including study of Gujarat IT policy and various other literature.

Primary data was collected by surveys through email, phone, and in person from 56 IT entrepreneurs, and 32 IT professionals working in private sector and government sector, both in and outside Gujarat. The questionnaire had both multiple choice and open-ended questions to compare IT clusters in terms of local government support, IT manpower, and facilities for IT employees at various locations. 147 people were approached for the survey, from which 96 responses were received, 88 of which were completed. The list of IT companies in Gujarat was obtained from a local telephone directory. For those outside Gujarat, the respondents were through contacts of the IT professionals approached.

The questionnaire was validated and corrected for ambiguities by testing on a small sample before conducting the actual survey. Appendix 1 gives the list of respondents.

5. Application of the framework to the Gujarat case

5.1 Level of activities in IT sector

Although Gujarat is industrially more developed in comparison with other states, such as Karnataka, Andhra Pradesh, Maharashtra, the IT sector [7] in Gujarat has a negligible share of the total Indian IT industry. In FY 2015-16, the size of the Gujarat IT industry was estimated around US$ 1.1 billion, compared with the total Indian IT market of US$ 146 billion. IT exports from Gujarat are worth US$ 400 million, compared with the total Indian IT exports of US $107.8 billion (DIPP, Government of India, 2017). When we compare this data with the response we received from our survey participants, we found that 77% of the IT entrepreneurs surveyed said they did not achieve their business target. When asked for reasons, they said most of them are falling behind their targets in a big way because of a lack of capabilities.

All of the respondents said that they are not ready for the uncertainties they are facing in the external environment of the IT industry (attrition rate, recession, etc.). While IT entrepreneurs feel that they have the capabilities to carry out IT contract jobs, IT professionals (59% of respondents) believe the IT sector in Gujarat is still not ready to take on contract jobs. Most firms in Gujarat are service oriented (IT enabled services), with few innovation-oriented industries. Total investment in Gujarat IT firms is also low. The respondents felt that incoming large IT companies to Gujarat, Foreign Direct Investment (FDI) in IT, and government policies can create IT clusters in Gujarat. Hence, the Gujarat IT cluster qualifies currently as a low-value, satellite model cluster.

5.2 Contributing and impeding factors

5.2.1 The IT talent pool in Gujarat

70% of IT entrepreneur respondents said their employees are Gujarati. It is well known that English is not a preferred language of communication amongst Gujarati; most Gujarat state board schools have Gujarati as the medium of instruction. Therefore, the IT talent in Gujarat are not fluent in English.

The primary survey also indicated (71% of respondents) that the IT curriculum needs a lot of improvement. 97% of respondents said there is a need to promote creativity, technical skills, and ideas, in the field of IT. The lack of requisite capabilities and competencies was also cited as a reason for non-achievement of business targets. The Gujarat IT talent pool is therefore not adequately skilled.

5.2.2 Presence of premier educational and innovation-based research institutions

Gujarat state has good educational infrastructure with premier institutes in management, fashion, design, infrastructure planning, and pharmaceuticals. However, academic institutions which support higher education such as PhDs in an IT field are fewer in Gujarat. Gujarat has 4.5% of the total undergraduate engineering seats in India, and only 3.4% of the total post-graduate engineering seats as per the figures published by the All India Council of Technical Education [8]. It has only five major engineering-focused universities showcased in the Vibrant Gujarat Summit.

5.2.3 Historical concentration of innovative high-tech firms from diverse industries with software needs

Gujarat is one of the most industrially progressive and developed states in India. According to IBEF, "Gujarat state contributes about a quarter to India's goods exports and accounts for 5% of India's FDI. It is the petroleum capital of India, world's largest producer of processed diamonds, third largest manufacturer of denim, and also a leader in industrial sectors such as chemicals, petrochemicals, dairy, drugs and pharmaceuticals, cement and ceramics, gems and jewelry, textiles and engineering, with 106 product clusters, 800 large companies and over 450,000 micro, small, and medium enterprises. There are 42 ports, 18 domestic airports, one international airport, and 60 notified special economic zones (SEZs). Large scale investment is expected in Gujarat as part of the US$ 90 billion Delhi-Mumbai Industrial Corridor (DMIC)" [9].

5.2.4 Entrepreneurial culture

The Gujarat region has been known for its business activities since ancient times (Peck, 2015; Mehta, 1991). Many Gujaratis have developed a penchant for trading, finance and accounting, from generation to generation. In the Gujarat government, a spirit of free trade and entrepreneurism has continued down the line.

5.2.5 Gujarati diaspora and network

Gujaratis comprise around 33% of the Indian diaspora worldwide, and can be found in 129 of 190 countries listed as sovereign by the United Nations [10]. However, there are not many returning from abroad, specifically in IT sector.

5.2.6 Government policies

Out of 20 operational SEZs in Gujarat, only 5 of them are IT-focused [11]. In 2017-18, four states, namely, Telangana (14%), Karnataka (40%), Maharashtra (20%), and Tamil Nadu (10%), account for 84% of total exports from registered units with Software Technology Parks of India (STPIs). The share of Gujarat was a mere 0.71% [12].

The state government has been constantly introducing initiatives via global events like the Vibrant Gujarat Summit, workshops, conferences, and other activities to promote start-ups Gujarat topped the startup ecosystem ranking by DIPP 2018 [13], partly in response to supporting 4,000 innovative student startups under a Student Start up Innovation Policy (SSIP) program, which is set to upscale 500 student startups in the next five years [14]. However, the percentage IT start-ups amongst these are few and far between. This is largely because Gujarat has grown due to its traditional businesses, with little inclination to become part of India's IT growth story [15].

All respondents to our survey, not surprisingly, felt that that Gujarat has insufficient IT infrastructure and fewer incentives for IT compared to AP and Karnataka. Das and Sagara (2016) have also observed that the early and successful states offer far more incentives as compared to late movers.

5.2.7 Attractive work environment with acceptable level of social infrastructure to raise a family

Although Gujarat presents a conducive environment to raise a family, it presents lifestyle restrictions. Gujarat is predominantly a vegetarian state. Even restaurants like McDonalds and Dominos were forced to serve only vegetarian food [16]. Singles [17] and families with non-vegetarian food preferences find it difficult to rent apartments. As well, Gujarat state prohibits consumption and sale of alcohol by law.

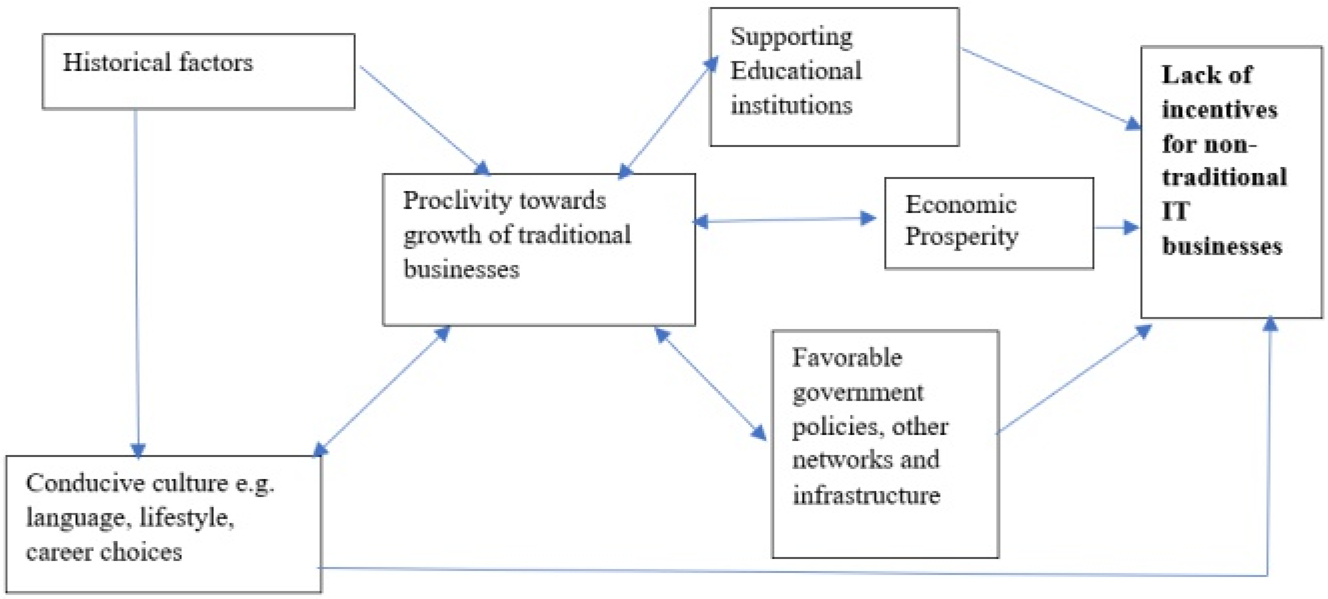

Figure 2. What impedes the success of late mover IT clusters despite economically favorable environments?

5.2.8 Sources of funding
The primary sources of funding are family and other sources, not venture capital. There is only one venture capital firm and one angel network in Gujarat.

6. Summary of key insights from the case study

It is evident from the above, that Gujarat has a thriving entrepreneurial culture, proactive business-friendly government, a diverse set of successful and prominent industries, good amenities to raise a family, and a thriving economy. However, all the contributing factors are conducive for traditional businesses, rather than for IT businesses. Khomaikova (2007) in her research concluded that the big seven IT clusters in India are cities of consciously planned communities for making various targeted innovations. Gujarat is also a state that is consciously planned and suited for traditional, non-IT businesses. The following figure thus summarizes the quandary wherein Gujarat's IT sector in particular, as well as other such similar prosperous regions in India currently find themselves.

7. Suggestions for future research

This paper has provided a new framework, not previously studied in Indian IT cluster research. It has addressed and answered an important question: What impedes the success of late mover IT clusters despite economically favorable environments? Recognizing and acknowledging this is the first step towards creating an environment that encourages the emergence and growth of IT clusters. This research study has been exploratory, and will require further investigation by replicating it in multiple additional cases to create a generalized theory. For future research, a quantitative, data driven, empirical investigation of similar cases can either validate or invalidate the framework identified in this study.

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Appendix 1. List of Private Sector IT Firms Approached for the Study.

Company Name	Type of Firm
Mobile VAS, Atlantica tower	Software Consultant
Bigapple Life, Goyal tower	Hardware, Dealers
Impress Software solutions	Software Consultant
M M K computers	Software, (Training Institute)
Hostway solutions Pvt. Ltd.	Software Consultant
IT consultancy Group	Software, Hardware
LOGIN INFOTECH Pvt. Ltd.	Software, (Training Institute)
Desai Services	Hardware, Dealers
Hard Rock Computers	Software Consultant
Patel Computer, Ahmedabad	Hardware, Dealers
Edge Softech	Software Consultant
Padma Computers Pvt. Ltd.	Hardware, Dealers
Embed Technologies Pvt. Ltd.	Software, Hardware
Siddhi computers, Ahmedabad	Hardware, Dealers
Labdhi Business Solutions	Software Consultant
Global Tech India Pvt. Ltd.	Software Consultant
Gateway Internet	Software Consultant
SoftGenie	Software Consultant
Kaanosh India	Software Consultant
ESN Technologies	Software Consultant
AARK Infotech	Software Consultant
Regius IT solutions Pvt. Ltd.	Software Consultant
Sagarsoft Inc.	Software Consultant
Softpro System	Software Consultant
DG computer Solutions	Software Consultant
Fortune (6)	Software, Hardware
Synergies Group Inc.	Software Consultant
Dashana Computer	Software Consultant
Magic Technologies Inc.	Software Consultant
Sai infotech System Ltd.	Software Consultant
Wildchild Studios	Software Consultant
Rapid solutions Pvt. Ltd.	Software Consultant
Multivision Technosys	Software Consultant

What impedes the success of late mover IT clusters despite economically favorable environments? A case study of an Indian IT cluster

Harini Mittal, Punit Saurabh, Devang Rohit & Kathak Mehta

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