Capability Model for Open Data: An Empirical Analysis

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ABSTRACT[1]

Creating superior competitiveness is central to open data organization's survivability in the fast changing and competitive open data market. In their quest to develop and increase competitiveness and survivability, many of these organizations are moving towards developing open data capabilities. Research-based knowledge on open data capabilities and how they relate to each other remains sparse, however, with most of the open data literature focusing on social and economic value of open data, not capabilities required. By exploring the related literature on business and organizational capabilities and linking the findings to the empirical evidence collected through the survey of 49 open data organizations around the world, this study develops an open data capability model. The model emerged from our deductive research process improves both theoretical and practical understanding of open data capabilities and their relationships required to help increase competitiveness and survivability of these types of organizations.

CCS CONCEPTS

Information systems, **Model development and analysis, Reference models**, *Business rules*, *Business-IT alignment*, *Performance*, *Implementation management*

KEYWORDS

Open Data Organizations, [Big] Data Capability Model, Value Capability, Dynamic Capability, Competitive Capability, Types of Capabilities

1 INTRODUCTION

In an era of increasing competition, uncertainty and turbulence of the environment, as well as the complexity and globalization, the organization must constantly adapt and improve its products and services. This is due to constant increasing expectations of the environment, specifically stakeholder to the organization. Therefore, organizations are forced to seek ways of achieving these expectations and to achieve long-term competitive advantage and competitiveness [1]. In the age of market globalization and internationalization, those organizations survive that have the ability to compete. These organizations know and can exploit their organizational capabilities well [2].

As the field of open data evolves towards maturity and data volumes grow exponentially and becoming the lifeblood of many organizations and flows behind almost every decision, open data organizations must know how they can manage this complex mass of data in a way that leads to competitiveness [1]. As suggested by [2], if open data organizations want to compete and survive, they should know open data capabilities and be able to exploit these capabilities very well.

In spite of high investment in developing open data and big data technical and infrastructure capabilities, large numbers of these organizations fail at open data. In 2015, PwC surveyed 1,800 organizations globally. The result shows that only 4% of these organizations are set up for success, 23% derive no benefit whatsoever, 43% obtain little tangible benefit, and 75% of them lack the capabilities to use and generate value from open data [3]. In addition, in 2016, Higher Education Data and Information Improvement Program (HEDIIP) in UK has published the result of their Data Capability project which was commissioned in December 2014 [4]. According to the findings based on the 122 responses to the Data Capability questionnaire, majority of the organizations lacks clear understanding about data and open data capabilities and their existing capabilities are limited to very simple processes and activities. Lack of capabilities puts these organizations at risk [4].

Despite availability of existing work in data and big data capabilities [5], [6], [7], [8], [9], [10], [11], [12], no effort has been done in developing a one-stop capability model for open data organizations that captures all the capabilities necessary for value creation from open data, increasing agility, and achieving competitiveness in these types of organizations as well as relationships between these capabilities.

Therefore, in our study, we investigate the existing literature on business and organizational capabilities and we develop a capability model for open data. As empirical evidence in this

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specific research field has been equivocal, we collected through a survey of 49 successful open data organizations around the world, evidence showing that open data organizations are more interested in developing some capability more than the others. There are capabilities related to 1) Open Data Related Individual Competences, 2) Open Data Value Chain Performance, and 3) Open Data Product and Service Strategies.

2 LITERATURE REVIEW

Many organizations today wonder what exactly organizational capability means and why it is so important [13]. Brits (Brits 2006) [13] defines capability as a "special type of a resource whose function improves the productivity of other resources". The capability is a more "holistic, broad-based concept that includes the additional elements of values and self-efficacy as core components and it describes how an individual or organization ability in a confident manner to problems in new and unfamiliar circumstances as well as in familiar situations" (Townsend and Cairns 2003). In the literature, three types of organizational capability areas are identified and described based on the well-known edicts of Resource-Based View, Dynamic Resource-Based Theory, and Theory of Competitive Advantage. The three capability areas include 1) Value capabilities, 2) Dynamic capabilities, and 3) Competitive capabilities [14]. Below, we briefly describe each capability areas and its core elements.

2.1 Capability Areas

2.1.1 Value Capabilities
The creation of 'value' is the key in every organization. 'Value' in the products and services is what makes customers and end users satisfied and loyal with the organization's offering [15]. Capabilities are required for every organization to develop this 'value'. This includes capabilities that are characterized by value, heterogeneity, and imperfect mobility. Value capabilities include all capabilities which assist an organization to deliver the organization value to the customers. While value capabilities are not the source of competitive advantage, they are necessary to produce customer value. Value capabilities includes: Individual Competences, Business Processes, Organizational capabilities, IT and Technological Infrastructure, and Management and Governance capabilities [6] [14].

2.1.2 Dynamic Capabilities
The majority of the studies on dynamic capability assert that dynamic capabilities are the ability of the organization to renew its capabilities to deal with rapidly changing environments (Helfat and Peteraf 2003). [16] defines dynamic capabilities as "a firm's capacity to deploy resources, usually in combination, using organizational processes, to effect a desired end". Dynamic capabilities allow the organization to search and explore, acquire, and assimilate new resources and capabilities that can help the organization to develop new opportunities (Bhatt and Emdad 2001). Dynamic capabilities include: Process Innovation, Knowledge Management and Organizational Learning, Value Chain Performance, Relationship Infrastructure, and Management Functions [5] [14].

2.1.3 Competitive Capabilities
This strategic level capability includes all he capabilities that foster the organization's competitive advantage and allow organizations to stay competitive and outperform competitors. Competitive capabilities are the key to the success and profitability of the organization [17] [18]. Because, as the level of

dynamics in business environments increases, the development of strategies that will differentiate the organization from its competitors becomes the key success factor [2]. Competitive capabilities include: Enterprise Infrastructure Strategy, Product and Service Strategy, Business Development Strategy, and Relational Rent Strategy [7] [14].

### 2.1.4 Summary
Table 1 shows the capability types and areas.

Table 1: Three Organizational Capability Types

Value Capabilities	Dynamic Capabilities	Competitive Capabilities
▪ Individual Competences ▪ Business Processes ▪ IT and Technological ▪ Organizational ▪ Management and Governance	▪ Process Innovation ▪ Knowledge Management and Organizational Learning ▪ Manufacturing Performance ▪ Supply Chain ▪ Management Agility	▪ IT Strategy ▪ Manufacturing Strategy ▪ Business Development Strategy ▪ Relational Rent

2.2 Capability Relationships

2.2.1 A Top View Model
In classifying capabilities, it is important to distinguish between those that have value and those that can be a source of competitive advantage. Following the agility of the organization, value capability is necessary for the competitive advantage to occur but value capability alone does not lead to competitiveness of an organization [17]. [19] and [2] claim that an organization is said to outperform competitors and eventually have a competitive advantage when it is deploying its dynamic capabilities sufficiently. [17] argue that competitive capabilities are not only valuable but heterogeneously distributed and difficult to transfer. Therefore, competitive capabilities are necessary for organizations to thrive in a longer term [20]. As can be seen in Fig. 1, developed from the literature, there should be a dialogue between Dynamic Capabilities and Competitive Capabilities as they serve each other's objectives, while there is a one way dialogue between Value Capabilities and Dynamic Capabilities.
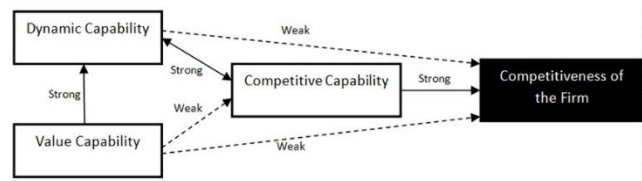
Figure 1: Impact of capability types

2.2.2 Value Capabilities to Dynamic Capabilities
Some researchers have framed the discussion in terms of if and how value capabilities are impacting capabilities for the agility of the organization [14] [21] [22] [23]. Organizations increasingly rely on value capabilities both for generating value for their customers and for increasing agility. In this regard, IT and

Technological Infrastructure has been described as an important organizational capability that can be an effective source of value and it can provide organizations with the ability to share information across different functions, innovate business processes, and allow organizations to respond quickly to environmental threats and exploit and leverage business opportunities [14]. As the Resource-Based View argues, IT and Technological Infrastructure offer benefits when they are embedded in specific organizational setting [21]. IT and Technological Infrastructure capabilities make feasible innovation and continuous improvement of products and services by enabling organizations to redesign products and services in a manner that exploits their infrastructure capabilities [22]. Organizations with strong individual competences and expertise are more likely able to 1) understand and perform technical tasks and integrate technical aspects of the organization and business processes more effectively to develop successful products and services, 2) communicate and work with business units more efficiently, and 3) anticipate future business needs of the organization and innovate valuable processes and new product and service features before competitors [22]. IT and Technological Infrastructure capabilities are critical to Knowledge Management and Organizational Learning of the organization which involves accumulation, sharing, and application of knowledge [24] [22]. IT and Technological Infrastructure capability is seen as a key tool in Knowledge Management processes [23]. Furthermore, through embedding IT and Technological Infrastructure capabilities into a supply chain system, the organization is able to enhance channel-specific assets through effective information exchange and better coordination and communication with supply chain stakeholders. The improvement in supply chain capabilities through IT and Technological Infrastructure capabilities allows the organization to learn and respond to market changes better and quicker than competitors [21]. In addition, the results show that individual competences actually improve new product and service development performance through knowledge management and organizational learning [25]. Despite existence of every type of capabilities, it is the function of every management and governance team to integrate and embed specialized skills, capabilities, and knowledge into a common tasks and processes in the organization [18].

2.2.3 Dynamic Capabilities to Value Capabilities

Development of IT and Technological Infrastructure capabilities require the intensity of learning/Knowledge Management and Organizational Learning and assimilation of an organization's information requirements [24]. Organizations that have strong learning capabilities can leverage feedback cycles of experience more effectively, thereby building stronger IT and Technological Infrastructure capabilities. We would also argue that a high level of learning intensity allows an organization to rapidly change its IT infrastructure, IT business experience, and the state of the relationship infrastructure to meet its future business application needs [2] [24] [22]. In addition, technical and business skills and competences evolve through intensity of learning. Knowledge is the primary resource for individuals in the organization [18] and its role especially becomes critical when rapidly changing environments require organizations to incorporate knowledge that can be used to improve technical and business skills and expertise [24]. The alignment of intensity of learning with existing competence will provide the advantage of knowledge assimilation and deployment [24]. The intensity of learning is

considered to increase an organization's problem-solving capacity and its behavior in ways that lead to improved performance at the individual, cultural, team, communication, and organizational levels [22] [23]. Organizational capability may be unique to a specific firm, which can be developed through organizational learning [26].

Furthermore, Supply Chain capabilities are able to transform IT and Technological Infrastructure-related capabilities into higher value for an organization. The investment in the supply chain system needs to be coordinated throughout the channel partners in order to realize the full potential of IT and Technological investment in the supply chain system [21].

2.2.4 Dynamic Capabilities to Competitive Capabilities

Process innovation or what is called by [27] 'process reengineering' in service and product industry includes incremental improvement and is the step by step adoption of technologically new or significantly improved production methods, tools, techniques, and processes [28] [2]. These new or revised methods, tools, and techniques result in changes in the production and creation of products and services [2]. With that in mind, it could be observed that process innovation occur during the interactions of one process against its competing process over time [29]. Process innovation leaves product and service functionality unchanged, while lowering the cost of production by a constant percentage [30]. Successful process innovations induces extra productivity growth at any point of the process [28][25] and lead to reductions in both the cost and price of the product and service, eventually increasing profit levels and, in turn, increasing the attractiveness of product and service innovation [28]. Therefore, a tight connection between business strategy and process vision is a must. This link can make process innovation capabilities a key vehicle for developing and implementing business strategies which is an important source of competitive differentiation for organizations. This is a very important capability area because organizations that are successful at process innovation are likely to be successful in the market they operate [28].

On the other hand, organizations that have superior knowledge capabilities do better on identifying potential business partners to initiate and maintain strategic relationship with to acquire useful knowledge, resources, and capabilities to meet its future business needs [24].

The management experience and agile mindset is the main vehicle for stimulating and directing changes in the organization. Management capabilities in the dynamic landscape allow formulation, integration, and implementation of technical strategy and business strategy to develop reliable and cost-effective systems for the business, and anticipate business and consumer needs sooner than the competitors [24] [31]. Top managers' innovativeness makes them more likely to adopt exploration orientation over exploitation orientation in innovation. This relative-exploration orientation is a key mediator that can transform top managers' innovativeness into better financial performance [32].

2.2.5 Competitive Capabilities to Dynamic Capabilities

There are two possible tensions in process innovation: 1) between competing processes (from the external view, e.g. my current process vs. my rival's process) and 2) between adoption of existing processes and creation of new ones (the internal view, e.g. my current process vs. my improved process). For any of these to happen, business level strategic reasoning is required to support

the innovation action [29]. Thus, it can be said that process innovation must occur within a business strategic context [28]. Consequently, when making decisions regarding business strategic resource allocations, strategic team tend to allocate a greater amount of valuable resources and capabilities to innovation activities (e.g. process innovation) [32].

In the context of increasing competitiveness, organizational collaboration or relational capital [1] or relational rent [7] [33] is becoming a universal instrument of pro-ethical management oriented to harmonization of organization's goals and objectives with justified expectations of external and internal stakeholders. Relational capital refers to the value of the relationship between the organization and its environment [1] [33]. The results show that relational capital is a critical source of product and service innovation and actually improves product and service innovation performance [34] [25].

2.2.6 Intra-capability Relations

Organizations with strong individual competences and expertise are more likely able to understand and perform technical tasks and integrate technical aspects of the organization and business processes more effectively to generate value for the customers [22]. Evidence from the last decades shows that organizations can successfully engage in both product and service development and performance and process innovation and create relationships between the two [35]. A better product and service innovation capability can create products with higher value than those of competitors [26]. Also, organizational knowledge management and learning capabilities is critical to product and service performance and innovation. Organization with innovative knowledge is able to introduce innovative products or services, potentially helping it become a market leader [36][25]. Similarly, according to [37], knowledge management is one of the main resources responsible for results in terms of flexibility, expressed as innovation and responsiveness to clients in regard to product and service performance and improvement upon client's request. Higher level of knowledge management and integration from multiple sources and multiple partners throughout the supply chain is required to perform the supply chain tasks effectively and efficiently, a [21]. Moreover, intensive use of knowledge management capabilities enables information to be identified, captured and capitalized as input to business process development and innovation [37][38]. [37] highlights the importance of incorporating intellectual capital as a nodal capability in the pursuit of process efficiency and flexibility. Therefore, [37] proved that there is a relationship between knowledge management and business process improvement and that process innovation or improvement is dependent on the availability of both internal and external knowledge and learning to the organization. Organization that begins with superior knowledge; it is more likely to gain further knowledge because of its prior knowledge [24].

At the strategy level, business strategy is so important to an IT and technological strategy. A focused, driven business strategy will lead to the most efficient application of IT expenses as the result of the appropriate IT strategy implementation. With no IT strategy, an enterprise inherits an IT and architectural maze that becomes so expensive to maintain and support for business constituents, they will eventually rebel at the high costs and suboptimal service that IT provides [39] [21]. Relationship infrastructure reflects the ability of the IT group to understand business needs and create a partnership with business groups to exploit new business opportunities. The relationship infrastructure constitutes a source of competitive advantage for the firm [24].

2.3 The Initial Capability Model

Our initial capability model is derived from the literature presented in sections 2.1 and 2.2. From section 2.1, we used the capability areas and capability types. From section 2.2, we identified relationships or links between each capability area and capability types. A total of 32 relationships is identified and presented in Table 2.

Table 2: Initial Capability Model

Value Capabilities	Link Having Relation	Other Capabilities
Individual Competences	→	Manufacturing Performance Knowledge Mngt. Org Learning Manufacturing Performance Business Processes
Organization	→	Individual Competences
IT/Technological Infrastructure	→	Process Innovation Manufacturing Performance
IT/ Technological Infrastructure	↔	Supply Chain IT/Technological Strategies Knowledge Mngt. Org Learning
Management and Governance	→	IT/ Technological Infrastructure Knowledge Mngt. Org Learning
Dynamic Capabilities	**Having Relation**	**Other Capabilities**
Process Innovation	↔	Manufacturing Performance Business Development Strategies
Process Innovation	→	Manufacturing Strategies
Knowledge Mngt. Org Learning	→	Knowledge Mngt. Org Learning Individual Competences Organization Manufacturing Performance Supply Chain Relational Rent Strategies Process Innovation
Supply Chain	→	IT/ Technological Infrastructure
Management Function	→	IT/Technological Strategies Business Development Strategies
Competitive Capabilities	**Having Relation**	**Other Capabilities**
Business Development Strategies	→	IT/ Technological Strategies
Relational Rent Strategies	→	Manufacturing Performance Business Development Strategies

3 METHODOLOGY

3.1 Research Objectives

The objectives of this research are 1) to provide a conceptual approach to develop an organizational capability model for value creation, agility, and competitiveness and 2) to refine the developed model for open data based on empirical evidence collected through the survey of 49 open data organizations around the world. The new capability model helps research and practice community to understand capability areas that are important for open data organizations and the relationship between them. The capability model for open data provides a foundation that would support our future research for development of capability architecture for open data.

3.2 Research Method

In this research, qualitative research method is adapted. Following this method, we primarily reply on existing literature and theories to develop our initial model where we later refine following our qualitative data from our empirical study of 49 open data organizations.

3.3 Research Approach

In this research, we explore deductive research approach. Deductive research approach explores a known theory or phenomenon and tests if that theory or phenomenon is valid in a given circumstances. It starts with analysis of existing work and a theory and then it leads the researcher to formulate and develop hypothesis to be tested which either lead to a confirmation or a rejection of the hypothesis. Moreover, deductive reasoning can be explained as reasoning from the general to the particular [40]. This research uses existing work and theories from business domain and develops a model and a set of research propositions for testing the relationships for its applicability in the open data context. Following this approach in our study, delivers number of stages including: 1) Analysis of existing work and theories, 2) Developing a model, 3) Formulating hypothesis/propositions, 4) Testing the hypothesis/propositions, and 5) Refining the theory or existing work if needed. Stages 4 and 5 will be covered in our future work and therefore not within the scope of this research.

3.4 Research Design Process

3.4.1 Literature Review

Our first attempt in understanding concepts in the domain and the topic under study is the review of the existing literature. We used keywords such as "open data organization", "open data capabilities", "organizational capabilities", "business capabilities", "capability model", "impact of business capabilities", and "capability development" to search for relevant articles, reports, and other written materials in the domain. We also heavily rely on our previous research on 'open data capabilities and models' [6], [5], [7]. From our previous research, we extract the three capability areas and capability types. By review of the literature in business and organization domains, we identify possible relationships or links between different capability areas and capability types. A total of 32 relationships are identified in literature.

3.4.2 Research Survey and Sample Size

Based on the capability areas captured in our initial capability model (Table 2), we developed an online survey. In 2015, we collected Dataset of Open Data Impact Map (opendataimpactmap.org). Dataset includes 1,500 organizations around the world that use open data in some form. We were only interested in for-profit organizations that use open data as their primary resource to create new product or service. A total of 222 organizations were identified and contacted to participate in the study. A total of 49 organizations completed the full survey (giving us a response rate of 22%). In our survey, we asked the organizations to identify which capability areas they develop and are important to them as one open data organization.

3.4.3 Analysis and Synthesis – Filtering and Confirming

To analyze and synthesis the capability model for open data that includes capability areas, capability types, and relationships between capabilities, we employ two phases: *1) filtering* and *2) confirming*. Our first phase includes two filtering stages. In the first stage, out of the 32 relationships identified in the literature, we only selected those relationships that have been mentioned by two or more scholars. This stage left us with 21 relationships out of the 32. The second stage of filtering includes elimination of relationships that are the results of 'alignment theory' (IT and Technological Infrastructure capabilities impacting IT and Infrastructure Strategies). The second stage left us with 20 relationships out of the 21. In our confirming phase, we used the data collected from our survey to identify those capabilities and relationships that are important to open data organizations. This helps us to revisit and refine our initial model to a capability model that can better represent the desire and needs of open data organizations. In addition, suggestions and comments from participants highlight the importance of using concepts (capability names) that are more relevant to open data context. The refined model will reflect participant's comments.

4 FINDINGS: THE REFINED CAPABILITY MODEL

In this study, literature review and the data collected from the survey of 49 open data organizations support us in developing and understanding a capability model for open data organizations (Figure 2). Table 3 is the result of our *filtering process.*

Table 3: Filtering Process -Refined Capability Model

Value Capabilities	Link Having Relation	Other Capabilities
~~Individual Competences~~	→	~~Manufacturing Performance~~ ~~Knowledge Mngt. Org Learning~~ ~~Manufacturing Performance~~ ~~Business Process~~
~~Organization~~	→	~~Individual Competences~~
~~IT/Technological Infrastructure~~	→	~~Process Innovation~~ ~~Manufacturing Performance~~
IT/ Technological Infrastructure	↔	~~Supply Chain~~ ~~IT/ Technological Strategies~~ Knowledge Mngt. Org Learning
Management and Governance	→	IT/ Technological Infrastructure ~~Knowledge Mngt. Org Learning~~
Dynamic Capabilities	Having Relation	Other Capabilities
Process Innovation	↔	Manufacturing Performance Business Development Strategies
Process Innovation	→	Manufacturing Strategies
Knowledge Mngt. Org Learning	→	~~Knowledge Mngt. Org Learning~~ Individual Competences Organization Manufacturing Performance ~~Supply Chain~~ ~~Relational Rent Strategies~~ Process Innovation
~~Supply Chain~~	→	~~IT/ Technological Infrastructure~~
Management Function	→	IT/Technological Strategies Business Development Strategies
Competitive Capabilities	Having Relation	Other Capabilities
Business Development Strategies	→	IT/ Technological Strategies
Relational Rent Strategies	→	Manufacturing Performance ~~Business Development Strategies~~

However, in the context of open data, the importance of gaining and implementing capabilities might be different due to the fact that open data is a free resource and a new phenomenon and large number of organizations are still in the discovery stage. Our *confirming process* shows two findings: 1) the existing concepts are more general and can be used to represent capability areas in a business domain but not specific to open data organizations and therefore, some of the existing concepts do not

realize the nature of open data organizations (Manufacturing Performance Capabilities vs. Open Data Value Chain Performance Capabilities (commented by respondents and proposed by authors)), 2) open data organizations are more interested in some capability areas than the other and they aim at developing and implementing some capability areas but not all.

For the first finding, following suggestions and comments received from the respondents, authors proposed new concepts that can better represent capability areas for open data organizations. Table 4, presents the new concepts.

Table 4: Refining the Concepts

| General Business Concept		Open Data Concept
Business Processes	to	Open Data Processes
Management and Governance	to	Management and Data Governance
Manufacturing Performance	to	Open Data Value Chain Performance
IT/Technological Strategies	to	Enterprise Infrastructure Strategies
Manufacturing Strategies	to	Open Data Product and Service Strategies
Supply Chain	to	Relationship Infrastructure

For the second finding, Table 5 shows the results of the survey. Each open data organization was asked to choose capability areas that are more important to their open data organization. As can be seen from the table, in the Value Capability block, 32 out of 49 respondents report that Open Data Related Individual Competences are very important for creating value from open data. This figure follows by Open Data Technological Infrastructure. For agility of the organization, 26 respondents report that availability of capabilities for increasing agility in Open Data Value Chain Performance is very important. With very small difference, Knowledge Management and Organizational Capabilities seem to be the next important capability type for increasing agility in open data organizations. Surprisingly, Management Functions Capabilities in enabling agility in the organization received no attention from the respondents. For increasing competitiveness, 32 open data organizations agreed that strategic capabilities related to enhancing Open Data Products and Services can significantly improve competitiveness of this type of organization. Another surprising and unexpected finding is that open data organizations seem to be uninterested in developing strategic capabilities for their Enterprise Infrastructure.

Table 5: Confirming Process - the Importance of Open Data Capabilities

Capability Areas/Types	Responses
Value Capabilities	
Open Data Related Individual Competences	32
Open Data Processes	18
Open Data Technological Infrastructures	**22**
Organization	14
Management and Data Governance	15
Dynamic Capabilities	
Open Data Process Innovation	24
Knowledge Management/Org Learning	**25**
Open Data Value Chain Performance	**26**
Relationship Infrastructure	4
Management Functions	0
Competitive Capabilities	
Enterprise Infrastructure Strategies	0
Open Data Product and Service Strategies	**32**
Open Data Business Development Strategies	14
Relational Rent	**21**

Our refined and final open data capability model shown in Fig. 2 indicates that there exist three open data capability areas: 1) value capabilities, 2) dynamic capabilities, and 3) competitive capabilities. Each of the three areas is associated with other open data capability types. In addition, the refined open data capability model shows relationships between different open data capability areas which can indicate that capability areas are impacting each other and there is a clear sequence in developing and implementing open data capabilities in the open data organizations.
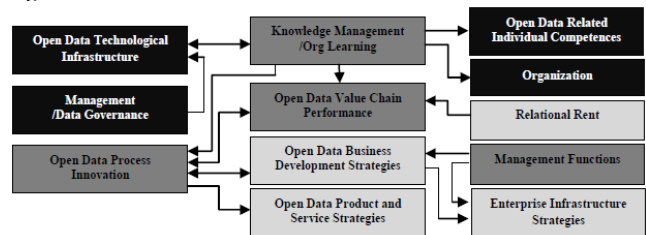
Figure 2: Capability model for open data organizations (black box-value capabilities; dark gray box-dynamic capabilities; light gray box-competitive capabilities)

5 DISCUSSION

Past studies on [open] data capability model shows that in order to compete and survive in the fast changing and competitive open data industry, open data organizations require capabilities for generating value for their clients from open data, increasing agility of the organization, and for competitiveness of the organization [41][4]. Transformation requires the development of these capabilities and development of capabilities require the organization to understand them. Despite the fact that, previous studies [5][6][7][11][42][43] attempted to develop open data capability model for value creation, for agility, and for competitive advantage, to the best of our knowledge, there has been no previous scholarly work has attempted to articulate a one-stop capability model for open data organizations and providing an empirical evidence that shows the most important open data capabilities to these organizations. However, number of existing works point out a capability model or framework for data and big data [8] [9] [10] [11] [12].

Insights from a scenario, interviews, and a survey study [11] reveals three areas where open data organizations need to build capability: 1) IT: Internet, cloud computing, and processing,

linking and other tools; 2) Information and Data: database with open dataset, company database, and company products and services; 3) Human: computer skills, finding and accessing open data, tool selection and use, data and result interpretation, and stakeholder network management. Our study also confirms these capabilities and adds to it by including other capability areas necessary for open data organizations. In addition, our study shows that IT and Information and Data could be grouped together and represents Data Technological Infrastructure Capabilities. The Human capabilities are similar to our Open Data Related Individual Competences. The relationships identified in our study can also show that there could be a possible link between Human, IT, and Information and Data capabilities presented in study by Zuiderwijk et al. (2015) [11].

In the recent empirical study completed by Dremel et al. (2017) [12], a capability model was developed for big data analytics. The model includes eight capability areas or what the authors called as 'competence fields'. The eight areas are: Customer Relationship Management, Partner Life Cycle Management, Product/Service Life Cycle Management, Enterprise Risk Management, Strategy Development, Transformation Competence, Enterprise Architecture and Process Management, and Information Management. Authors highlighted that the capability model provides a generic library of capabilities that can be used to assess a company's ability to successfully perform big data analytics. The model comprises no relationship or link between the capabilities. Despite the differences in both operational fields (open data organizations vs. big data organizations) and in their capability areas and models, both studies have some similarities and have some overlapping elements. Customer Relationship Management and Partner Life Cycle Management can be interpreted as Relationship Infrastructure Capabilities; Product/Service Life Cycle Management can be interpreted as Open Data Value Chain Performance; Both Enterprise Risk Management and Strategy Development can fit into Open Data Business Development Strategies and Other Strategic Capability Areas; Transformation Competence could be similar to Knowledge Management and Organizational Learning capabilities and other capabilities associated with Dynamic Capabilities; Enterprise Architecture can be categorized as Organizational Capabilities; and Process Management and Information Management can fit into Open Data Process Capabilities. The authors can use the relationships identified in this study and revisit and refine their model.

Agarwal et al. (2014) highlights that businesses understand that data offers enormous potential but, they have less understanding of exactly how to realize its promise [10]. Authors claim that by developing three core components in which each includes two key capabilities, organizations can put in place a framework for enabling and succeeding with data and big data. The three components are the Data Usage (two capabilities: Identifying Opportunities and Building Trust), the Data Engine (two capabilities: Laying the Technical Foundation and Shaping the Organization), and the Data Ecosystem (two capabilities: Participating in a Big-Data Ecosystem and Making Relationships work). Comparing the capability areas identified in our study and in the study by Agarwal et al. (2014), we understand that capabilities developed in our study are more specific in a way that it clearly identified capabilities for value creation, for agility, and for the competitiveness of these organizations. However, attempting to relate the capability areas in both studies, we can claim that Identifying Opportunities and Building Trust can both

relate to Business Development Strategic capabilities; Laying the Technical Foundation and Shaping the Organization can each relate to Technological Infrastructure Capabilities and Organization capabilities; Participating in a Big-Data Ecosystem and Making Relationships Work can each relate to Knowledge Management and Organizational capabilities and Relational Rent Strategic capabilities.

Exploratory interviews of 20 companies that have demonstrated some success in using transaction data to improve performance revealed three major elements: Context, Transformation, and Outcomes and according to the authors the three elements together produce value for an organization [9]. Context includes capabilities such as Strategic, Skill-related, Organizational and Cultural, and Technology and Data Factors. The Transformation element includes Analysis and Decision Making where the data is actually analyzed and then used to support a business decision. The last element is the Outcomes which are the events that change as a result of the transformation element. Outcomes include changes in Behaviours, Processes and Programs, and Financial Conditions [9]. This study presents a hierarchy for creating value for the organization. However, the areas of agility and competitiveness are not very well covered. However, we can relate some elements of the study to capabilities studied in this study. Strategic aspect can partially relate to Business Development Strategic capabilities as well as our other Strategic Capability areas in the strategic block however, we argue that strategic decisions are compulsory for achieving competitive advantage but not for creating value from the data for the organization. Skill-related, Organizational and Cultural, and Technology and Data Factors can all contribute to value creation and can relate to our capabilities in our Value Capability block. To some extent, Analysis can relate to Open Data Process Capabilities and Decision Making where data is used for making business decisions can relate to Business Development Strategic capabilities. Outcomes which include changes in Behaviours, Processes and Programs, and Financial Conditions refer to our Dynamic Capabilities block where data and information are used for the agility of the organization.

None of the above work developed sequence and relationships between the capability areas. In Table 6, we compare the presented work and our work.

Table 6: Comparison – Our Model and Existing Models

This Study	[11]	[12]	[10]	[9]
Value Capabilities				
Open Data Related Individual Comp.	Human	✕	✕	Skill-related
Open Data Processes	✕	Process Management and Information Management	✕	Analysis
Open Data Technological Infrastructures	IT and Information and Data	✕	Laying the Technical Foundation	Technology and Data Factors
Organization	✕	Enterprise Architecture	Shaping the Organization	Organizational and Cultural
Management and Data Governance	✕	✕	✕	✕

Dynamic Capabilities				
Open Data Process Innovation	✗	✗	✗	Change in Process and Programs
Knowledge Management/Org Learning	✗	Transformation Competence	Participating in a Big-Data Ecosystem	✗
Open Data Value Chain Performance	✗	Product/Service Life Cycle Management	✗	✗
Relationship Infrastructure	✗	Customer Relationship Management and Partner Life Cycle Management	✗	Change in Behaviours
Management Functions	✗	✗	✗	Change in Financial Conditions
Competitive Capabilities				
Enterprise Infrastructure Strategies	✗	✗	✗	✗
Open Data Product and Service Strategies	✗	✗	✗	✗
Open Data Business Development Strategies	✗	Enterprise Risk Management and Strategy Development	Identifying Opportunities and Building Trust	Strategy, Decision Making
Relational Rent	✗	✗	Making Relationships Work	✗

6 CONCLUSION AND PROPOSITIONS

This study developed a capability model for open data organizations. The model consists of three major capability areas for generating value from open data, agility, and the competitiveness of the organization. This study is the first attempt to develop a one-stop capability model for open data organizations. The developed model provides practitioners and open data organizations and start-ups to develop understanding around different capability areas and how they relate to each other. The sequence or the relationships provided can help them understand orders in developing and progressing with implementation of different capabilities. Moreover, insights from our empirical evidence collected from 49 open data organizations worldwide show that open data organizations intent to develop some capabilities more that the others. This can guide start-ups to prioritize resources and distribute fund accordingly. Moreover, the developed model provides governments with the bases to develop better and more informed strategic decisions to support opening up more data to both public and private organizations and to measure the performance of these organizations and perform benchmarking.

Our future work will focus on empirically testing the relationships between the capability areas developed in this work. We developed 16 propositions in which each proposition represents one relationship between two capability areas. In Fig. 3, we show the 16 propositions.
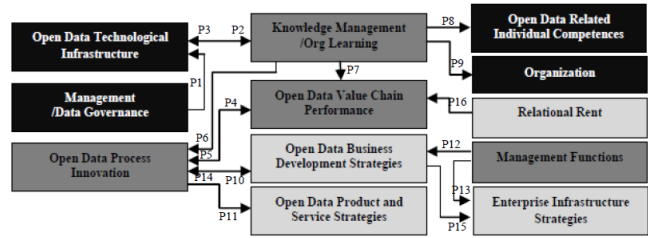

Figure 3: Research propositions

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