Critical Factors for Dynamic Capabilities in Open Government Data Enabled Organizations

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ABSTRACT
Open data (OD) is increasingly considered as a core resource for many organizations in the emerging data economy. Open data-driven organizations (ODDOs) like any other organizations must develop capabilities for competitiveness and agility in addition to processes for creating value from OD to survive. While questions about the extent to which OD could be used for competitive advantage has been raised in past studies, no previous study has investigated the salient factors for agility in a dynamic data ecosystem. This paper bridges the knowledge gap by developing an operationalization of the Dynamic Capability Theory for ODDOs. As a first step towards determining the critical factors for developing dynamic capabilities (DCs) in these organizations, we analyzed the information gathered from an expert interview on the saliency of the different aspects and stages of dynamic capability in developing the agility of an up-stream organization or OD supplier in the data ecosystem. Our findings suggest that critical factors for DCs differ for organizations in the upstream and downstream sectors, albeit some core elements are shared across sectors in data ecosystem.

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

Keywords
Open Data, Open Government Data, Dynamic Capabilities, Dynamic Capability Theory, Dynamic Capability Framework, Competitive Advantage of a Firm

1. INTRODUCTION
The increasing number of ODDOs – ODDOs are both public and private organizations using OD as the main resource to develop products and services – and their centrality in the new data economy; calls for scholarly works on the competitiveness and survivability of these entities. Studies attempting to understand the required capabilities for value generation, competitiveness and agility like [1] are emerging. Specifically [2] examined conditions for using OD for competitiveness in companies, while [1] elaborated on the different kinds of value capabilities required for producing and capturing value in ODDOs and businesses. In these studies, Resource Dependency Theory and Capability Constructs were used as analytical frameworks. However, research on the how data-driven organizations develop the necessary agility or dynamic capability to cope with the rapidly changing data ecosystem and marketplace are yet to be carried out.

This study attempts to provide a better understanding of the important factors for developing DCs in this category of organizations and firms.

In the area of firm competitiveness, the Resource-based View (RBV) has been an influential theoretical framework for understanding how competitive advantage within organization is achieved and how that advantage might be sustained over time [3] [4][5][6][7][8]. It assumes organizations as collections of specific physical, human and organizational resources [9][10] which are "Valuable, Rare, Inimitable and Non-substitutable" (VRIN) [11] that can be used to implement value-creating strategies [12] [3]. However, RBV has been criticized for conceptual vagueness and for its adequacy in a context characterised by unpredictable change [3][10], termed high-velocity or dynamic markets [11].

In high-velocity markets, where the competitive landscape is shifting, organizations must continually reconfigure, gain and dispose internal and external competencies and resources to meet the demands of a shifting market [3] and maintain the source of sustained competitive advantage [11]. This has led to the concept of DC [3][13]. DCs develop systemic coherence while recognizing the unique features of each market's environment to facilitate customization of individual market strategies and adapt, integrate and reconfigure internal and external resources to match opportunities in the global marketplace [12].

The paper operationalizes Dynamic Capability Theory for ODDOs and identifies the critical factors for agility in these organizations. Our work attempts to the emerging literature on capabilities and specifically DCs in ODDOs some guide for both researchers and practitioners on what factors matter most in enabling agility in these class of organizations or firms.

2. THEORY BACKGROUND
2.1 Business Capability Types and Model
Bhatt and Grover [14] highlight the importance of business capabilities for competitiveness. There are different definitions and conceptualizations for the concept of business capability in the research literature, extensive experience from practice clearly indicates that the concept represents the business capacity to perform successfully a unique commercial activity [15] [16]. Brits [17] defines capability as a particular type of a resource whose function improves the productivity of other resources. This

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implies that resources can represent a cluster of elements that constitute a capability. Townsend and Cairns [18] identified three fundamental business capability attributes: 1) ability or the current business competence, 2) self-efficacy or belief in one's 'capability' to perform satisfactorily, and 3) shared appropriate values which entail sharing values across business such as trust and valuing diversity. [19] looks at general organizational capabilities at five stages: stovepipes, integrated organizations, nationwide portal, inter-organizational integration, and demand-driven, joined-up government which allows government agencies to benchmark their position, realize their role in the formation of a joined-up government, develop the necessary capabilities, and adopt centrally developed infrastructural facilities aimed at moving to the next stage. Moreover, in the study completed by [1] and [14], three types of business capabilities are introduced in [13] - Value Capabilities, DCs and Competitive Capabilities [14]. In [1], the authors present a comprehensive study of these three types. In the same study, an OD Value Capability Matrix was developed. Examples of capabilities associated with each of the three capability types are shown in Table 1[1]. Each of the capability categories is described in details.

Table 1. **Business capability types** [1] [14]

Value capability	Dynamic capability	Competitive capability
-Individual/competences -Business process -Organization -IT infrastructure -Management/ governance -Technological	-Process innovation -Knowledge mgt. -Manufacturing performance -Supply chain integration	-IT (Strategic choices) management -Manufacturing strategy -Business operational (Localization/ Internationalization)

As can be seen in Table 1, four types of capabilities are associated with DCs:

- *Process innovation* - is required to improve the processes for the production of new product or output [1] [20].
- *Knowledge management* - encompasses identifying and mapping intellectual resources within the organization, generating new knowledge for competitive advantage, making vast amounts of corporate information accessible, sharing of best practices, and technology [1] [21] [22].
- *Manufacturing performance* - are characterized by the set of practices in use for the manufacturing system [1] [23].
- *Supply chain integration* - enables organizations to share information with their chain to create supply partners information-based approaches for superior demand planning, for the staging and movement of physical products, and for streamlining voluminous and complex financial work processes [1] [24].

In Figure 1, we show that the affect different capability types has on the competitiveness of an organization [1][14][25][13][17] [13][10].

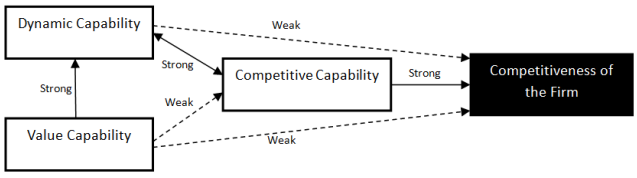

Figure 1. Role of business capabilities on the competitiveness of an organization

In classifying capabilities, it is important to distinguish between those that have value and those that can be a source of competitive advantage. Value capability is necessary for the competitive advantage to occur but value capability alone does not lead to competitiveness of an organization. Bhatt and Grover [14] argue that competitive capabilities are not only valuable but heterogeneously distributed and difficult to transfer. Further, Bhatt and Grover [14] argue that competitive capability is a major source of competitive advantage of an organization. On the same page, [4] claim that an organization is said to have a competitive advantage when it is deploying its DCs sufficiently. For example, an organization has competitive advantage if it is formulating and implementing a strategy, which is not simultaneously implemented by many other organizations and where these other organizations face significant disadvantages in acquiring the resources necessary to implement this strategy.

Although value and competitive capabilities are important, we also need to recognize the dynamic nature of both. Organizations that are involved in such (dynamic) activities have greater absorptive capacity and can build and renew value and competitive capabilities, which could be a source of competitive advantage. For example, knowledge management which is a dynamic concept involves accumulation, sharing, and application of knowledge which could be heterogeneous across organizations, and thereby also a source of competitive advantage [14].

2.2 Dynamic Capability Theory

DCs have their antecedents in the RBV of the organization [11]. They are those specific physical (e.g., specialized equipment, geographic location), human (e.g., expertise in chemistry), and organizational (e.g., superior sales force) resources that can be used to implement value-creating strategies [9]. They include the local abilities or competencies' that are fundamental to the competitive advantage of an organization [3] [26]. Distinctive processes support the creation, protection, and augmentation of organization-specific resources and competencies [12]. If an organization possesses processes, resources, and competencies but lacks DCs, it has a chance to make a competitive return for a short period, but superior returns cannot be sustained. The possession and deployment of DCs provide the business enterprise with a chance to generate superior profitability over the longer run. When organizations are dynamically competitive, management will be active at sensing and seizing opportunities [27].

According to [12], "DCs are derived from an organization leveraging its internal and external resources which in turn enhance its power in its global relationships, thereby enabling it to coordinate inter-organizational activities and respond rapidly, in a flexible manner, to global competitors' strategies". Therefore, the organization has to be continuously alert and in a process of identifying and exploiting new opportunities in order to transform its resources effectively into new competitive advantages [26].

2.2.1 Dynamic Capability Constructs

A study by [28] advances the argument that the capabilities of an organization rest on three main constructs: organizational **processes**, **position**, and the **path/strategies** available to it and these capabilities can provide competitive advantage. Teece [29] also identified the core building blocks of DCs under the tripartite rubrics of processes, positions, and path/strategies. Below, we

classify the dynamic capability types (Table 1) according to the three main constructs.

1) Process

According to [28], the organizational process is refered to as the way things are done in the organization or what is called the organization's 'routines' or 'patterns' of the practices being performed in the organization. To better understand and achieve the necessary capabilities for renewing organizational processes, two types of general DCs are required: 1) DCs related to Process Innovation and 2) Knowledge Management. Both types are presented below.

Process Innovation **-** The organization's processes use resources – specifically the processes to integrate, reconfigure, gain and release new resources – to match and even create market change [11] [3]. Processes embed the strategy and business model of the organization into the day-to-day routines of employees and leadership skills and ability of the organization's top management to design, develop, implement, and modify these routines in order to adjust to changing environments, and also to shape the (business) environment [29].

More frequently, in dynamic markets, it makes sense to use DCs to build new resource configurations and move into new competitive positions using a path-breaking strategic logic of change [3]. Although often neglected, jettisoned resource combinations that no longer provide competitive advantage are also critical DCs as markets undergo change [3]. The organization's processes and positions collectively encompass its capabilities or competencies. According to [30] "DCs are built rather than bought in the market", and they include organizational processes or 'routines' that are employed to reconfigure or to combine the organization's resources and paths which are the choices open to the organization today and likely to be in the future. The main four processes are *reconfiguration* - transformation and recombination of resources and resources; *leveraging* - extending a resource by deploying it into a new domain; *learning* - allows tasks to be performed more effectively and efficiently; and *integration* - ability of the organization to integrate and coordinate its resources and resources). Similarly, Teece [29] identifies the three classes of processes that are relevant to DCs: *integration*, *guided learning*, and *reconfiguration*/*transformation*.

In the same vein, Teece [31] identified technological, complementary (technological or otherwise), financial, reputational, market structure, and institutional resources. Teece and Pisano [28] further claim the importance of external integration and sourcing, integration of external activities and technologies, and reconfiguration of resources on the competitiveness of the organization. In rapidly changing environments, there is obviously value in the ability to sense the need to reconfigure the organization's processes, and to accomplish the necessary internal and external transformation [28]. The processes of organizational renewal are essential for the long-term survival and prosperity of the business organization. Enterprises must also combine the exploration of new opportunities with exploitation and renewal [27]. This requires constant surveillance of markets and technologies and the willingness to adopt best practices. In this regard, benchmarking is of considerable value as an organized process for accomplishing such ends [28].

Knowledge Management **-** The essence of the DCs approach is that competitive success arises from the continuous development, alignment, and reconfiguration of organization-specific resources [27][12]. This broader organizational capability is concerned with how organizations create and/or access new knowledge [8] [14] [12], search, explore, acquire, assimilate, and apply knowledge about resources [12][6], opportunities, and how resources can be configured to exploit opportunities [27], and how organization makes investment choices, and achieve necessary business model and organizational transformation. This is referred to as the 'intensity of organizational learning', which involves accumulation, sharing, and application of knowledge [14]. Some scholars including [32] suggest that whilst market-based learning enables the organization to learn what the market needs, the organization must acquire knowledge from other sources to develop leading edge innovative products and services that will fulfill organization's needs. This is called 'acquisition' and is one of the additional knowledge acquiring capability of a organization for speedier internationalization. Following this analogy, [32] suggests that a organization's capacity to acquire new knowledge depends on its internal knowledge base that directly relates to its internally focused learning activities.

In addition, in a fast-paced competitive environments where technological and market change rapidly, resource coordination, resource orchestration, creation of critical co-specialized resources, and adapting effectively to the changing environments are of several elements of a organization's DCs and are the central economic activities which are often difficult to achieve. However, to address the rapidly changing environment, there is the need for organization to engage in trading activities, and for managers to decide what investments are to be made, what resources are to be purchased, how to integrate, build, and reconfigure internal and external competences, and how complementarities are to be achieved [27].

2) Position

The position is referred to as the current endowment of technology and intellectual property and organization's customer base and upstream relations with its suppliers [28] and is enhanced if the resources meet the RBV criteria. The way in which resources need to be deployed is likely to be dynamic [31] as in globally competitive environments, positions alone are generally of fleeting value [28]. To better understand and develop the necessary capabilities for renewing organizational position in the market, two types of general DCs are essential: DCs related to Manufacturing Performance and Supply Chain Integration. Both types are presented below.

Manufacturing performance **-** Technological and non-technological opportunities and know-how allow innovation in all areas of value creation. In addition, they support superior organizational performance including manufacturing of products and services in several ways. First, organizations that emphasize technological know-how are better at adapting to and growing in new markets. Second, organizations that emphasize technological and non-technological know-how generate knowledge in greater amounts for more efficient retrieval that they can apply to address internal and external environmental challenges [32]. However, addressing Technological and non-technological opportunities involve maintaining and improving technological competencies and complementary resources and then, when the opportunity is ripe, investing heavily in the particular technologies and designs most likely to achieve marketplace acceptance [33].

Supply Chain Integration **-** To achieve the effective coordination of inter-organizational relationships, on a global basis that can provide a organization a competitive advantage [12], decision makers need information on changing consumer needs and technology. Such information is not always available, or if it is available, is likely to be incomplete. Managers are of course decision makers and they must collect information, analyze it, synthesize it, and act upon it inside the organization [27]. The manager skills in coordinating and resource allocating capabilities featured in the DCs shape markets, as much as markets shape organizations however, these alone do not shape markets and provide information manager needs to implement goals. The organization and managers also require organization-level responses by competitors, suppliers, and customers [27] [12]. The network relationship specifically with the suppliers plays a significant role in enhancing the supplier network, sensing and seizing opportunities, knowledge creation, resource configuration and integration and know-how exchange [27] [33].

3) Path / Strategy

Path is refered to as the strategic alternatives available to the organization [28]. Authors of [12] highlight both internal (RBV) and external (Market Based View) resources which provide the power basis necessary for developing strategies. To better understand and achieve the necessary capabilities for renewing organizational path or strategies, Managerial Strategic Functions or capabilities are required. Managerial Strategic Functions is presented below.

Managerial Strategic Functions - Once an organization is established, continuing to succeed in an open competitive economy requires high management and employees skills with capacities to combine and integrate [8][27][26]. In particular, managers must think strategically and execute flawlessly [27] to access niche markets and for building market positioning [32] if they want to succeed [27]. They must also figure out how to harness competences [11] and the skills of highly skilled employees who play a much more significant role in creative success and performance of the organization. Survival of a organization is not only about executing well but, about figuring out where to put resources, realizing opportunities and then moving on when competition arises [27]. Such capabilities, if built, constitute the DCs of a organization through allowing managers to strategically combine, recombine, and reconfigure resources and resources inside and outside of the organization's boundaries in order to generate and exploit strategic internal and external organization-specific competences [27]. Not many managers have the necessary skills, and fewer still succeed in building them into their businesses [27] [11].

2.2.2 Linking constructs to the types

From the DC Theory literature, we identify three core constructs: *Process*, *Position*, and *Path* or *Strategy*. Based on extensive literature review of the domain, we have found sub-constructs and related dimensions to each sub-construct. In addition, previous studies show and investigate four types of DCs (Table 1). Here, we categorize DCs into five types (see Section 2.2.1): *Process Innovation, Knowledge Management, Manufacturing Performance, Supply Chain Integration,* and *Strategic Managerial Function.* In Table 2, we establish relations between the three main DCs constructs, DCs types, DCs sub-constructs and their respective dimensions.

2.3 Three Stages of Dynamic Capabilities

Drawing on existing empirical findings [34], we identify three main stages for DCs: 1) Adaptive capability, 2) Absorptive capability and 3) Innovative capability.

Adaptive Capabilities (Search/ Variations/ External Observation) **-** DCs which monitor the environment, to discover external knowledge [35] and new possibilities. Searching for new ideas in this manner can provide an insight into how existing problems or new challenges may be managed and solved. To reveal the potential in the environment may be said to be the core of all entrepreneurial and innovative activities. An organization must have the ability to appraise the environment so as to constantly develop new ideas and business opportunities. This adaptive ability to appraise markets and technologies, and the willingness to adopt best practice, are therefore important [26]. In addition, adaptive capabilities can also help to trigger and guide strategic renewal processes [36].

Table 2. DCs constructs linked to the dynamic capability types

Three Constructs of DCs [28] [29]	**Dynamic Capability Types** [18]	**Sub-Constructs** [30] [29]	**Dimensions**
Process	Process Innovation	Integration	Integrating and Adapting Resource; Combine the Exploration of new Opportunities with Exploitation and Strategic Renewal
		Leveraging	Extending, Building and Releasing Resources by Deploying it into a new Domain; Leveraging Critical Co-specialized Resources; Innovative Capability
		Reconfiguration	Transformation, Recombination, and Reconfiguration of Resources; Jettison un-necessary Resources; Quick Response to Strategic Renewal; Innovative Capability
	Knowledge Management	Learning and Knowledge Mngt.	Coordinate Resources; Resource Alignment; Resource Orchestration; Resource Continuous Development; Search, Explore, Configure, Acquire, Share, Assimilate, Accumulation, Integrate, and Apply knowledge; Strength Organizational Learning; Disseminate Information; Unlearning Routines; Unlearning Knowledge-based Practices; Creativity and Idea Management; Integrate Internally Generated Information
Position	Manufacturing Performance	Technology	Seize Technological Opportunities, Acquisition
		Intellectual Property	
	Supply Chain	Customer Relationship	Positive Relationship and Quick Response to Customers
		Upstream Relationship	Positive Relationship and Quick Response to Upstream Suppliers
Path / Strategy	Strategic Managerial Function	Strategies	Deploying Resources to Support Market Needs; Constance Surveillance of Market and Technologies; Make Timely and Market-Oriented Decisions; Niche Market Access; Adopt Best Practices; Benchmarking; Alliancing

Absorptive Capabilities (Selection/ Evaluation/ Acquisition) - DCs which recognize the value of new, external information, assimilate it, and apply it to commercial ends [34]. Knowledge may be acquired through external contacts and connections. However, the acquisition of new knowledge is very time consuming and challenging as there may be considerable risks involved in investing in new acquired knowledge [26]. Yet, the expectations of advantages derived from new ideas may be achieved by analysis and debate concerning the values and risks. The ideas are evaluated on the basis of previous experience, expertise, and capabilities [26]. Stronger ability of learning from partners, integrating external information and transforming it into organization-embedded knowledge are the outcome of organizations with higher absorptive capability [34].

Innovative Capabilities (Routinisation/ Implementation/ Reconfiguration and Renewal) - DCs comprise product development routines, development and launch of new profitable products and services, strategic decision-making, introduce, combine or modify resources, and integrate new resources [26] with innovative behaviors and processes [34]. This includes implementing newly approved initiatives to change within the organization and provides the opportunity to reorganize the organization's resources and the possibility to experiment with new ideas [26]. In this stage, organization puts the ideas from the selection phase into place in a competitive business platform. Thus, the process ends in a form of utilization through the implementation of the ideas [26]. Authors of [34] suggest a range of possible innovative alternatives, such as developing new products or services, developing new methods of production, identifying new markets, discovering new sources of supply and developing new organizational forms.

3. OPERATIONALIZING DYNAMIC CAPABILITY THEORY FOR ODDOs

In this section, we define what DCT constructs (Process, Position, and Path) means in each the dynamic capability stages – Adaptive, Absorptive, and Innovative. In Table 3, we specify nine conditions for agility of Open Data Dynamic Capabilities (ODDCs) following the descriptions in Section 2. In addition, corresponding propositions are provided to succinctly capture these conditions.

Adaptive Position Capabilities (Sense and Search) – ODDCs which monitor the environment, to discover external knowledge [35] and new possibilities for positioning ODDOs in the OD industry. This capability includes: Search for knowledge that can be acquired from OD ecosystem such as maturity of the existing OD ecosystem; Strength of the OD-driven organizational Learning skills and capabilities; OD product/service Intellectual Property; Network analysis of OD actors (businesses, government bodies and civil society actors); Learn about structure of the OD market and knowledge about the level of engagement of the organization with OD agencies, other organizations and developers.

Proposition 1: The organizational ability to sense the need to reconfigure position of the organization in the market positively affects the agility of ODDOs' positioning in the market.

Adaptive Process Capabilities (Sense and Search) – ODDCs which monitor the environment, to discover external knowledge [35] and new possibilities around processes for adding value to OD products and services. This capability includes: Search for and knowledge about the list of compatible licenses and knowledge on the number of businesses or other organizations using/seeking/demanding OD.

Proposition 2: The organizational ability to sense the need to reconfigure OD value-added processes positively affects the agility of ODDOs' processes.

Adaptive Path Capabilities (Sense and Search) – ODDCs which monitor the environment, to discover external knowledge [35] and new possibilities for formulating new and reformulating existing OD strategies. This capability includes: Knowledge on OD marketplaces; Knowledge on the actors who have stopped releasing/using OD; Knowledge on actors using OD in existing field versus actors entering new fields and their purposes and knowledge about the types of datasets most published and used, types of actors most involved and types of outputs most produced from OD.

Proposition 3: The organizational ability to sense the need to reconfigure organizational OD strategies positively affects the agility of ODDOs' strategies.

Absorptive Position Capabilities (Seize and Select) – ODDCs

Table 3. OD definition: dynamic capability constructs vs. dynamic capability stages

	Adaptive Capability	**Absorptive Capability**	**Innovative Capability**
Position	The ability to sense the need to reconfigure current endowment of open (linked) data technology, intelectual property and OD-driven organization customer base and upstream relations with OD suppliers from OD ecosystem.	The ability to seize the knowledge from OD ecosystem and to recognize OD market and technological opportunities in order to develop organization's scarce open (linked) data technological and non-technological resources to support market needs and gain advantage over rivals.	The ability to use knowledge from OD ecosystem to enhance and develop difficult-to-trade know-ledge OD resources and resources complementary to them, as well as its reputational and relational resources which determine OD market share and profitability at any point in time.
Process	The ability to sense the need to reconfigure OD existing value-added processes by learning from OD ecosystem.	The ability to seize and integrate the external knowledge and information an OD-driven organization possess about the OD ecosystem in order to reconfigure the existing value-added processes.	The ability to transform the knowledge and information acquired from OD ecosystem into OD-driven organization-embedded knowledge in order to develop new value-added processes. This also includes balancing between existing value-added processes and the acquired value-added processes.
Path	The ability to sense the need to reconfigure the OD strategies in order to accomplish effective exploration and exploitation of OD strategies and the necessary internal and external transformation.	The ability to seize and assimilate knowledge acquired from OD ecosystem to develop OD strategic solutions and decisions.	The ability to deploy the knowledge from OD ecosystem to re-shape the past OD strategies and shape new OD strategies to be used in the future.

which recognize the value of new, external information and knowledge, assimilate it, and apply it [34] in ODDOs positioning in the OD industry. This capability includes: Seize open (linked) data technological opportunities, OD product/service acquisition; Measure of the centrality in openness in policy; Measure of the centrality of technology and data to government policy and Discovering new sources of OD supply and investment in open (linked) data technology.

Proposition 4: The organizational ability to seize external knowledge and opportunities from OD ecosystem regarding OD market and ecosystem positively affects the agility of ODDOs' positioning in the market.

Absorptive Process Capabilities (Seize and Select) – ODDCs which recognize the value of new, external information and knowledge, assimilate it, and apply it [34] in the ODDOs in order to develop and enhance OD value-added processes. This capability includes: Seize the appropriate license/s; Organization-level technology absorption; Measuring how and why OD is being used and analyze the OD related applications and tools.

Proposition 5: The organizational ability to seize external knowledge and opportunities from OD ecosystem regarding existing OD value-added processes positively affects the agility of ODDOs' processes.

Absorptive Path Capabilities (Seize and Select) – ODDCs which recognize the value of new, external information and knowledge, assimilate it, and apply it [34] to reformulate OD strategies. This capability includes: Identifying new strategic OD product/service and market for OD products and services; Identify the right/strategic marketplace; User's affordability of services and products/infrastructure; Increase value; Lowered cost; improve experience; Focus on specific types of projects (business/social/environmental...); Focus on the scale of output (local, national, international) and focus on the types of project output (report, data, software...).

Proposition 6: The organizational ability to seize external knowledge and opportunities from OD ecosystem regarding existing OD strategic solutions positively affects the agility of ODDOs' strategies.

Innovative Position Capabilities (Reconfigure and Implement) – ODDCs which recognize the absorbed knowledge and opportunities for innovative solutions [34] for positioning ODDOs in the OD industry. This capability includes: Integrating and adapting OD; Extending, generating and releasing OD by deploying OD into a new domain; Leveraging critical co-specialized OD (datasets); OD transformation, OD (dataset) recombination, and reconfiguration of OD; Jettison un-necessary OD (datasets); OD alignment, orchestration and continuous development; Deploying OD (datasets) to support market needs and positive relationship and quick response to OD customers to upstream OD suppliers.

Proposition 7: The organizational ability to use knowledge acquired from OD ecosystem to reconfigure organizational position in the market positively affects the agility of ODDOs' positioning in the market.

Innovative Process Capabilities (Reconfigure and Implement) – ODDCs which recognize the absorbed knowledge and opportunities for innovative [34] processes for adding value to OD. This capability includes: Developing new OD value-added process in order to add value to OD; Extent of adoption of OD legal and regulatory standards; Validating how and why OD is being used and improve existing activities around OD.

Proposition 8: The organizational ability to use knowledge acquired from OD ecosystem to reconfigure OD value-added processes positively affects the agility of ODDOs' processes.

Innovative Path Capabilities (Reconfigure and Implement) – ODDCs which recognize the absorbed knowledge and opportunities for innovative [34] OD strategies. This capability includes: Combine the exploration of new opportunities with exploitation and strategic renewal; Quick response to strategic renewal; Constance surveillance of OD market, ecosystem and open (linked) data technologies; Adopt best practices around OD; Benchmarking strategy for OD; Develop new OD products and/or markets, through aligning strategic innovative orientation with innovative behaviors and value-added processes; Ease of reuse.

Proposition 9: The organizational ability to use knowledge acquired from OD ecosystem to reconfigure OD strategies positively affects the agility of ODDOs' strategies.

Data should be discoverable and understandable by humans and machines. Where data is used in some way, whether by the originator of the data or by an external party, such usage should also be discoverable and the efforts of the data publisher recognized.

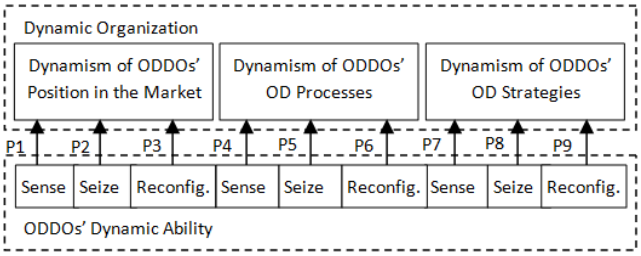

Figure 2. Research hypotheses

4. Case Study

This section describes findings from the use of the operationalization in Table 3 in investigating the available DCs and their relative importance at the Irish Marine Institute; one of the major players in the upstream sector of the Irish OD Ecosystem. This case is used to validate our DCT operationalization and identification of critical factors based on expert opinion.

4.1 Context - The Marine Institute

The Marine Institute with over 10 years of experience in data cataloguing is an agency which operates under the aegis of the Department of Agriculture, Food and Marine (DAFM), and the national agency, responsible for undertaking marine research and development that critically informs policy, regulatory objectives, management and sustainable development strategies for Ireland's marine resources. The Marine Institute Act states that the Institute will have the following general functions:

> *"to undertake, to co-ordinate, to promote and to assist in marine research and development and to provide such services related to marine research and development that in the opinion of the Institute will promote economic development and create employment and protect the environment"*

4.2 The Interviewee

The interviewee has a Degree in Geography and Economics from Trinity College Dublin and a Masters in Geographic Information Systems for Business and Service Planning from the University of Leeds. He is a senior data and information management specialist in the Marine Institute with 13 years' experience in the application of GIS and data services to marine environmental data. He was directly responsible for publishing 130 datasets on the Irish National OD Portal (data.gov.ie).

4.3 Marine Institute's ODDCs

During the interview with Marine Institute, a variety of ODDCs and identified.

1. Dynamic capabilities for positioning

Adaptive Position Capabilities – Marine Institute's DCs include: Searching for existing OD Products and services, technological opportunities, potential government agencies, potential partners for collaboration, skills and expertise necessary, existing interest groups or agencies, future market.

Absorptive Position Capabilities – Marine Institute's DCs include: Marine data collection; developing agreement with other government agencies for data services; identifying new technologies, platforms and applications; Identifying skills and expertise required.

Innovative Position Capabilities – Marine Institute's DCs include: Producing as much marine data as possible; leading provider of data on marine environment and Data Cataloging in Ireland; Feeds information into making decisions and support growing resources of marine environment; Experts for technologies for provision of online services; Brand recognition; Generate economic activities; Facilitate data to aid other agencies for their decision making.

2. Dynamic capabilities for processes

Adaptive Process Capabilities – Marine Institute's DCs include: Searching for existing knowledge from outside organization in order to identify potential processes, OD standards and European directives, linked-data opportunities, data management tools, set of requirements to develop prototypes, best practices around adding value to data and processes, agencies and companies for resource exchange and integration, other potential project resources; aquaculture process opportunities; discovering new online cataloging systems.

Absorptive Process Capabilities – Marine Institute's DCs include: Assess and evaluate processes, platforms, and applications in order to define potential tools for adding value to marine data; Adopting new online cataloging systems such as GeoNetwork; assessing and identifying series of best practices (W3C best practices); Open license for Marine Institute; Developing a set of technical requirements and specifications for developing the planned prototype; adopting appropriate data standards such as ISO19139 (Data Standardization) and ISO 19156 (Observation and Measurements); adopting appropriate European Directives such as OD Standard for Inspire Directive, Standards for Marine Strategy Framework Directive, and Data Standards for Water Framework Directive.

Innovative Process Capabilities – Marine Institute's DCs include: Improve marine data management processes; data cataloging; data management processes (using generic marine related Data Models); software development and project management processes; linked marine data; connecting to processes of agencies; develop and enhance internal processes; utilizing defined specification to develop the prototype further; added value to data through new prototype and initiatives such as Ireland's Marine Atlas, Irish Spatial Data Exchange, Ireland's Digital Ocean, Ireland's Marine Renewable Energy Portal and connecting to Ireland's OD Portal; utilizing evaluated tools such as ERDDAP to add value to marine data and enhance data cataloging; Encourage and enhance Marine Institute Data License (existing for 11 years); developing new application that handles standards; developing new application that deliver data to user.

3. Dynamic capabilities for path/strategies

Adaptive Path Capabilities – Marine Institute's DCs include: Searching for smart strategies from potential and influential actors/players and experts in the industry; searching for best practices around strategies in general and data strategies in specific; Seeking new and unique expertise; organize workshops for strategic decision making; Searching for other organization's advanced projects In order to identify new areas and new knowledge.

Absorptive Path Capabilities – Marine Institute's DCs include: Assessing and evaluating identified actors/players and experts and connect with them; Developing new expertise; Adopting best possible collaborative approach; identifying and assessing series of best practices that could help organization's expert groups to define strategic areas and decisions; define strategic objectives or areas to tackle during the workshop; assess and evaluate new knowledge gained from existing projects and develop new objectives for organization.

Innovative Path Capabilities – Marine Institute's DCs include: Big and leading contributor of environmental data in Ireland; Strengthening marine environment status; Close and constant collaboration with companies and continuously providing them with the data being produced; open and constant communication with expert groups within organization; Working with and in parallel with big Irish players such as Sustainable Energy Ireland and Department of Communication Energy and Natural Resources; Provide high quality support services for marine food safety; use marine data for service area collaborations; acting as one primary communication forum between agencies; directive driven organization; standard driven organization; strengthening the organization brand; high level and educated employees; share capabilities within organization and with other agencies; strengthening the collaborative environment; Organization's expert groups to make smart decisions; adopting OD strategy best practices; moving from 3 (CSV) star to 5 star (linked-data); adopting other organization's strategic best practices; follow and maintain citation strategy; encouraging organization's employees to use best practices for their tasks; making sure all data are of high quality and available online; easy and usable data; more datasets; other project connectivity; always use powerful tools; always be ahead of other agencies; always monitor market; Access resources from other agencies; to grow jobs in sector.

After carefully analysing the interview, in table 4, we present a set of critical factors for developing ODDCs.

Table 4. Critical factors for developing ODDCs

		Adaptive Capability	Absorptive Capability	Innovative Capability
MA for downstream organizations	**Position**	• Discovering the OD market niche • Discovering and identifying potential collaborators and projects	• Developing agreement with other agencies for collaboration and data services • Absorption of new technologies, platforms and applications • Introducing new OD products or services • Developing OD Business Model	• Producing as much valuable data as possible • Brand recognition • Generate economic activities • Facilitate data to aid other agencies for their decision making
MA for upstream organizations	**Process**	• Discovering Data Management Tools and Processes, OD online cataloging systems, OD standards and related European Directives, and Linked-Data opportunities • Discovering OD best practices • Discovering Data Licenses • Discovering successful (Relational) Data Models	• Define and assess Tools, Processes, Platforms, and Applications to add value to the Data • Define and assess appropriate European Directives • Define and assess series of best practices • Define and assess OD license • Define and assess appropriate Data Standards Define and assess appropriate (Relational) Data Model	• Adopt Tools, Processes, Platforms, and Applications to add value to the Data • Improve Data Cataloging Process and (Relational) Data Model • Improve Data Management, Software Development, and Project Management Processes • Alliance-based processes • Heavily utilize well-known and completed projects for adding more value to the OD product or service and to fasten the customer-supplier communication (Sufficient delivery) • Active participation to the Local and National Portals
Applicable for downstream organizations Applicable for upstream organizations	**Path / Strategy**	• Strategic coordination/collaboration (Strategic Alliances) • Seeking new and unique data/OD strategic solutions from potential and influential actors/players, successful national and international level projects, and experts in the industry • Discovering best practices on data/OD strategies • Discovering differentiation strategies	• Define strategic objectives through knowledge gained from existing projects, partners and OD products and services • Define and assess best possible strategic collaborative approach • Assess and evaluate identified actors/players and experts in the field • Identify new domain experts • Define and assess series of OD strategic best practice • Define and assess unique strategy for differentiation	• Strengthening the collaborative and communicative environment – Internally and externally (Expert groups, projects, and resources) • Educated human resource – Domain specific education • Continuously provide available and easy-to-use high quality OD products and services and support • Differentiating OD products and services • Maintain standard-driven organization status • Constantly magnify and strengthen organization's brand • Use organization's capabilities to identify areas of collaborations • Share capabilities and resources within organization and with other organizations • Generating OD strategic best practice out of employed ones • Promote and use citation strategy for OD products and services • Constantly monitor market for powerful tools

5. DISCUSSION

Operationalization - Scholars have endeavoured to integrate literature areas on RBV and DCT however, there have been many ambiguities. According to [34] "*The leading efficiency approaches to business strategy are the resource-based and the DCs approach… It is not obvious to me how these two literatures will play out – either individually or in combination.*"

On one hand, the validity of the RBV has been questioned in number of key aspects such as the "definitions, the linkage to market dynamism and the mechanisms of transforming resource advantage into competitive advantage" [34]. On the other hand, the concept of DCs, has not overcome such definitional issues and that DCs are simply processes and therefore does not lend us further understanding of the difference between DCs and processes. Some scholars identify DCs as structured and persistent in a given organisation while others identify DCs as emergent and evolving. Given the mixed use and interpretation of DCT and organizational DCs, we thought we would encounter significant challenges in conducting this research.

Despite existing critiques and ambiguities in literature on RBV, DCT and DCs, we have found these three paradigms not as challenging as presented in the literature and we have been able to join them very adequately and generate an easy-to-understand dynamic capability framework taking into an account essentialities of the two theories and the DCs of the organization. The framework can be utilized by all types of organizations specially ODDOs regardless of their size and maturity levels. However, we encountered number of challenges in identifying the critical aspects of the theories and the organizational DCs for addressing the objectives of our study but, relying on our experience and knowledge in the domain, and by utilizing the critical aspects identified, we developed a framework that can address critiques and ambiguities exist in the literature.

Application - *Positioning* - Upstream and leading organizations have already positioned themselves in the market. The expert groups and top management team at the organization should conceptualize perceptions of customer's expectation and translate them in a way that the OD products and services fit the desire and need of the customers perfectly. In this regard, defining organizational position in the market is mostly applicable (MA) for downstream organizations, new entrants to the industry and small organizations. Smaller organizations need to work significantly toward developing and refining organizational positioning by defining niche market. Downstream organizations are usually entrepreneurs with interesting ideas and independent capabilities (as they rely on their own or their small team's capabilities). Therefore, new OD products and services can perfectly emerge in a short period of time as small organizations do not need to go through production line-related administrative burden.

Process Development - New OD products and services may be associated with risks. In this regard, many organizations regardless of being upstream or downstream levels are encouraged to form business alliances to share resources, processes and capabilities and to quicken the pace of and reduce risks associated with innovation. Upstream and leading organizations should constantly seek and discover powerful data management tools, platforms and technologies and reconfigure their existing value-added processes due to the fact that many downstream and small organizations rely on the OD products and services they provide. In this regard, engaging in process configuration and reconfiguration is highly recommended and MA to upstream organizations. Furthermore, downstream and small organizations are more likely to grow faster as they are more open to changes and quickly adopting technologies, processes and tools. Therefore, it is necessary for upstream organizations to provide base resources and infrastructures.

Strategy Development - Every organization has a well-defined approach to formulate organizational strategies. Some organizations renew their strategies on a yearly bases and some are open to new strategy on a daily bases. However, this is not limited to leading and upstream organizations. Decision regarding this is considered as one organizational strategy which may work out well for some organizations and in the others not. However, the maturity of an organization plays a significant role in when to formulate or reformulate strategies. Nevertheless, a systematic analysis of both external and internal environment is necessary for such action. It is the leadership and the expert groups of every organization that effect both formulation and implementation of the strategy as strategy formulation is normally a top down process and requires to set the direction of the future. The very visible difference is that, in the upstream and leading organizations, the top management team and experts groups unlikely to involve employees in the strategy formulation. While in downstream and small organizations, top management team and experts groups foster higher levels of employee engagement lead to strategy formulation and implementation. It is important to recognize that strategy must go hand in hand with processes. Strategy needs to be consistent, coherent, and embrace innovation. While it is necessarily shaped by the legacy of the past, it also shapes the path ahead. Strategy will determine which products to make, which customers to target, how to deploy the organization's resources, what the optimal timing will be, and how to keep competitors at bay.

Critical Factors - Organizations entering OD industry are more conscious about specific ODDCs rather than generic ones. This maybe because OD is fairly a new competitive environment and specification matters and small changes have impressive influence on the market while generic DCs matters in a more general turbulent environment where changes to the general resource base enable an organization to deal with environmental velocity. In this regard, critical factors for developing ODDCs (table 4) revealed in our study are applicable for small and large ODDOs which provide them with more information and knowledge on capabilities required in positioning, developing strategies and to lead more effective data management activities and processes. Critical ODDCs affect ODDOs' performance through systematically altering resources, technologies, processes, and strategies.

However, there is no blueprint for success therefore, ODDOs regardless of being at upstream or downstream, need to recognize and utilize the successful experiences or what is so called "best practices" of other organizations. It is very essential to develop a collaborative and communicative environment with other organizations and use organization's capabilities to identify areas of collaborations. In OD industry, being connected to a network of organizations plays a significant role in the success of the organizations in the network as shared resources and capabilities can lead to innovative OD products and services [37] [38] [39]. ODDOs' managers and experts groups should constantly monitor

the market for changes in order to move toward the dynamic market and be able to be ahead of the competitors. ODDOs must establish strategies to ensure desired participation rate and those organizational technological and human resources are used in a way that innovative OD products and services are produced. In addition, the ODDOs should increase the number of domain-specific experts as in OD industry, domain knowledge is very vital as many OD products and services are domain specific.

However, success happens in an environment with learning, sharing, and collaborating culture.

Recommendations **-** Our study proposes number of recommendations. 1) Adopting best practices of other organizations, 2) Have scientist work on the data related tasks such as data cataloging and analysis, 3) Experts in the domain to work on the domain data (Data Expertise and Domain Expertise: e.g. Health experts to work on health related data), 4) Connecting to other agencies and expanding the network, 5) Share resource and expertise both internally and externally, and 6) Establish and promote the culture of "More Time, More Data, More Quality".

Moreover, our study supports more investment in developing DCs and harnessing expertise as these are strongly linked to the competitiveness of an organization "*through selling knowledge and technical expertise*" said the interviewee. In addition, our study suggests ODDOs to renew their resources on a regular base however, the interviewee said:

"*In Marine Institute, we try to renew on a yearly bases. This is dependent on the up-coming projects, collaborations, communication, and especially new people in the agency. New people come with new ideas and capabilities. New idea can lead to a change. New capabilities allow agency to identify weak areas in the agency. In Marine Institute, we believe in changing the way we operate and handle tasks when there is a need to change and strengthening the weak areas."*

6. CONCLUSION

The major motivation for conducting this study was the fact that, despite recent efforts to facilitate research and progress on open government data and theoretical convergence in the DC literature, ODDCs remains vague. Our study combines a DC perspective with OD perspective and based on our case study of Marine Institute, our intent was to provide and document a set of critical factors for developing ODDCs so that upstream, midstream, and downstream ODDOs can use for building the dynamic aspects of their organization. Therefore, we confirm and identify ODDCs as emergent and evolving.

Our study further confirms that, OD value capabilities are pre-requisite for developing ODDCs and ODDCs has strong affect on defining OD competitive capabilities and competitiveness of an organization. Furthermore, our study addressed upstream (The Marine Institute is an upstream ODDOs) and downstream ODDOs and it revealed that OD upstream organizations put more emphasis on developing their value-added processes and renewing OD strategies while OD downstream organizations should double their efforts in understanding niche market and identifying their position in the industry as well as developing their organizational strategies. Based on our own observation, we believe that midstream organizations such as data mediators are more concerned about enhancing the value-added processes as they are heavily involved in the role of creating an enabling environment for the practice of OD as well as the promoters of OD and defining their position in the market (Figure 4). In this regard, our study suggest emergence and entrance of more midstream and downstream ODDOs as our case study revealed that "*the small and new organizations can grow faster as they are more open to changes and adopting new technologies and strategies*."

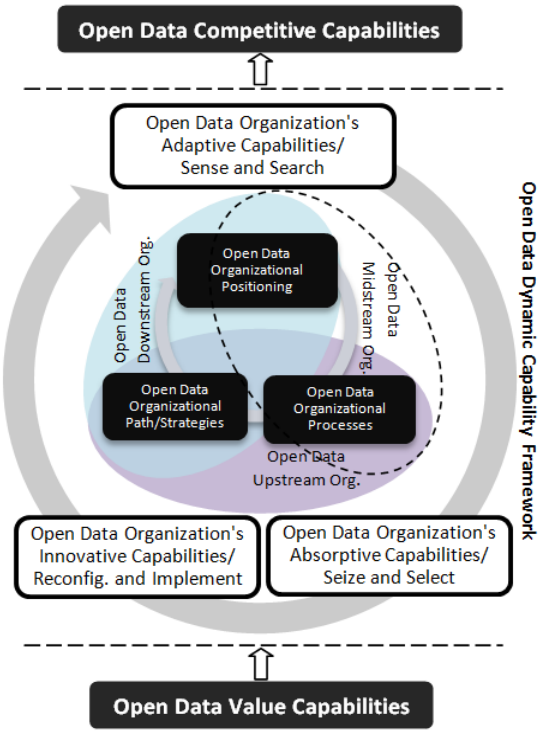

Figure 4. Dynamic capability re-new process

In conclusion, the study for the first time in the dynamic capability literature shows that the process of renewing ODDCs is also a structural cycle and upstream, midstream, and downstream ODDOs' point of interest varies (Figure 4). In addition, our result encourages further research on the core tenets and consequences of ODDCs.

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