

## A Dynamic Capability Perspective to Understanding the Typology of Big Data Capabilities. Evidence from a Ghanaian Health Insurance Firm

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Big data has become a key competitive advantage tool for firms. Big data is disrupting several markets by causing firm to rethink and change their traditional way of handling and using data within and outside. This makes big data possess dynamic capabilities. Given that only few predominantly big technology firms have been able to fully adopt big data to obtain benefits. This research grounded in the theoretical lens of dynamic capabilities examines the constituents or typology of big data capabilities that are needed by firms to adopt big data. The research proposes a hierarchical model for the typology of big data capabilities which is made up technological capabilities, human skills capabilities and organisational capabilities as the core capabilities of big data capabilities. Beyond the second order capabilities, first-order capabilities and resource base or zero-order capabilities are proposed. An investigation of a health insurance firm implementing big data in Ghana is used to evaluate the suggested model and identify challenges in the development of the big data capabilities as experienced by the health insurance firm.

**Keywords:** big data capabilities, dynamic capabilities

### 1 Introduction

According to IBM, we create about 2.5 quintillion ( $2.5 \times 10^{18}$ ) bytes of data every day, so much that 90 percent of the data in the world today has been created in the last two years (IBM, 2011). This data comes from everywhere: climate sensors, social media, hospitals, digital pictures and online videos, online purchases, mobile data, chips embedded in gadgets, corporate information systems and GPS signals, to name just a few. These very large amounts of data which comes in structured, semi-structured and unstructured forms along with the intrinsic value that can be extrapolated from them using analytics, algorithms, and other techniques is called “big data” (Kwon, Lee & Shin, 2014).

Analysing such big data is becoming a keystone of competitive advantage, new waves of productivity growth, agility, innovation and an answer to questions that were previously considered beyond the reach of businesses and government (Zhang & Yue, 2013). Characterized by volume, variety, velocity, veracity and value (Chen et al., 2012), industry practitioners believe that big data is the next ‘blue ocean’ in nurturing business opportunities. There is a growing academic and practitioner literature on the opportunities to generate benefits through big data-driven decision making (Rousseau, 2012).

Kwon et al. (2014) indicate that unlike technology firms (e.g., Google, IBM, and Apple) who are at the forefront of big data and thus highly confident about its business potentials, a lot of firms are still undecided in adopting big data. This may be due to a lack of relevant understanding and experience which points to the need for more research to comprehend issues pertaining to big data adoption including the big data capabilities that are needed along the adoption path (Kwon et al., 2014).

Big data is seen as a disruptive technology (Needham, 2013) which is affecting several markets in several industries by causing firms in those industries to rethink and change their traditional way of

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handling and using data within and outside the firm (Sathi, 2012). This disruptive, turbulent or dynamic changing nature of big data suggest that, the big data possess dynamic capabilities (Wamba et al., 2016; Akter et al., 2016).

Grounded in the theoretical lens of dynamic capabilities this research intends to examine in the constituents or typology of big data capabilities that are needed by firms to adopt big data.

## 2 Towards a Typology of Big Data Capabilities

The nature of big data capabilities have been variously discussed through the literature (Kwon et al., 2014; Janssen, Estevez & Janowski, 2014; Wamba et al., 2016 ; Akter et al., 2016; Gupta & George, 2016; Wang, Kung & Byrd, 2016; Wang & Hajli, 2016). The studies have depicted big data as having a multidimensional perspective to big data capabilities. The different dimensions give rise to big data capabilities having a typology of several capabilities. Table 1 shows the

<u>Study</u>	<u>Theory Used</u>	<u>Type of Analysis</u>	<u>Big Data Capability (Dimensions)</u>
Kwon et al. (2014)	Resource Based View, Isomorphism		Data Management Capability
Wang & Hajli (2016)	Resource Based Theory, Capability Building View		Analytical Capability, Speed to Insights Capability, Predictive Analytic Capability, Interoperability, Traceability
Wamba et al. (2016)	Resource Based View, Sociomaterialism	Hierarchical Model	Infrastructure Flexibility, Management Capability, Personnel Expertise Capability
Akter et al. (2016)	Resource Based View, Sociomaterialism	Hierarchical Model	Management Capability, Talent Capability, Technology Capability
Gupta & George (2016)	Resource Based Theory	Hierarchical Model	Tangible, Human Skill, Intangible
Janssen, Estevez & Janowski (2014)			Data Management Capability
Wang, Kung & Byrd (2016)			Analytical Capability, Data Management Capability, Decision Support Capability, Predictive Capability, Traceability
Kiron, Prentice & Ferguson (2014)			Organizational Culture Capability, Analytical Capability
Davenport et al. (2012)			Management, People, Technology
Barton & Court (2012)			Management Capability, Technology Capability, Data Science Capability

From the literature, big data capability is seen by some authors as a having a hierarchical order of sub capabilities which culminate into other capabilities as they combine or are configured into other higher order capabilities (Wamba et al., 2016; Akter et al., 2016; Gupta & George, 2016).

Using resource based view (RBV) and sociomaterialism (Wamba et al., 2016; Akter et al., 2016), big data capabilities is perceived as a third order capability construct consisting of the second order capabilities - Infrastructure Flexibility, Management Capability and Personnel Expertise Capability (Wamba et al., 2016). Akter et al. (2016) also suggest that big data capabilities is a higher-order capability and a multi-dimensional construct consisting of Management Capability, Talent Capability,

Technology Capability as a second order capability. Whereas Wamba et al. (2016) sees connectivity, modularity and compatibility as first order capabilities that make up the Infrastructure Flexibility, Akter et al. (2016) sees them as Technology Capability. Similarly, Wamba et al. (2016) sees technical knowledge, technology management knowledge, business knowledge and relational knowledge as the first order capabilities to Personnel Expertise Capability while Akter et al. (2016) sees them as Talent Capabilities. Both studies agree that big data capabilities are dynamic capabilities.

The studies (Wamba et al., 2016; Akter et al., 2016) fail to look at the zero-order capabilities (i.e. the resources) (Winter, 2003; Wang & Ahmed, 2007) that come together to form the first-order capabilities which subsequently leads to the second order capabilities and finally big data capabilities as a third-order capabilities. This flaw may be due to the positivist approach used in the study by Wamba et al. (2016) and Akter et al. (2016). The positivist approach is quite objective in its approach compared to a critical realism philosophical stance which looks underneath the layers of the reality to ascertain causal mechanisms and nature of the reality that is observed (Mingers, Mutch & Willcocks, 2013). Thus from a critical realist viewpoint, a review of the literature to clearly establish and understand the typology of big data capabilities from the zero-order constructs (i.e. the resources), to the first-order, then the second-order and finally the third-order at which big data capabilities occur as a dynamic capability is key. This will help firms that want to adopt big data to have a clear understanding of the resources and capabilities needed to develop big data capabilities.

Furthermore using resourced-theory, big data capabilities is also proposed in the literature as having a hierarchical model in its formation from its resources (Gupta & George, 2016). The resources are grouped as Tangible Resources, Human Skills and Intangible Resources. The Tangible Resources refers to the internal data, external data, big data technologies such as Hadoop and NoSQL as well as other basic resources such as time and investments that firm need to adopt big data. The Human Skill refers to the managerial skills in the form of analytic acumen as well as the technical skills such as big data specific training and education that a firm needs to adopt big data. The Intangible resources on the other hand refers to the data-driven culture as well as the intensity of organizational learning that a firm possess in its quest to adopt big data. A critical look at Gupta & George (2016) hierarchical model in comparison to other authors (Wamba et al., 2016; Akter et al., 2016) shows that managerial and personnel capabilities have been lumped into one as human skills. In addition, Gupta & George (2016) only looks at the zero-order constructs (i.e. the resources) and subsequently moves to second-order capabilities as being Tangible, Human Skills and Intangible without showing the other hierarchical levels suggested by (Wamba et al., 2016; Akter et al., 2016).

This suggest a lack of clarity in typology of big data capabilities as being proposed by advocates of the hierarchical model approach to big data capabilities. Perhaps this lack of clarity in looking at big data capabilities might be that, Gupta & George (2016) looks at the resources in their static form from an RBV perspective whereas the other authors (Wamba et al., 2016; Akter et al., 2016) looks at the changing nature of the resources to form other capabilities in the hierarchical model. Probably a new typology which looks at big data capabilities starting from the resource level or zero-order construct to first-order capabilities, second order capabilities and finally the third order capabilities where Wamba et al. (2016) sees as being a dynamic capability might be necessary.

### 3 The Hierarchical Order of Capabilities to Obtain Dynamic Capabilities

Dynamic capabilities are responses to the need for change or new opportunities, and the changes can take many forms. The change may involve the transformation of organizational processes, allocations of resources, and operations. The changing allocation and utilization of resources is a critical part of dynamic capabilities. These resources-which are assets and capabilities- can include human capital, including managers and employees, technological capital, knowledge-based capital, and tangible-asset-based capital, among others. Dynamic capabilities can be improved over time or can decay. But ironically, they can also remain at an unchanged level even as they continue to induce change. They can take on multiple roles in organizations, such as changing resource allocations, organizational processes, knowledge development and transfer, and decision making. Based on this changing nature of dynamic capabilities, several authors in trying to identify dynamic capabilities have suggested that dynamic capabilities result out of a hierarchical order of capabilities (Collis, 1994; Winter, 2003; Zahra et al., 2006; Wang & Ahmed, 2007; Ambrosini, Bowman & Collier, 2009).

Collis (1994) proposed four categories of capabilities. These are the resource base, the ability to improve firm activities, the ability use other resources to develop novel strategies before competitors and

learning-to-learn capabilities. Winter (2003) in advancing the idea of a capability hierarchy suggest three levels of capabilities. The hierarchy begins with the "zero-level" capabilities or the resource base. First-order capabilities that allow for a change in zero-order capabilities to occur then follows. Finally, dynamic capabilities follow based on the outcome of organizational learning. Zahra et al, (2006) proposes two levels of capabilities namely substantive capabilities -which gives a firm the ability to solve a problem- and dynamic capabilities – which allows a firm to manipulate its substantive capabilities. Wang and Ahmed (2007), also identifies four hierarchical levels of capabilities in relation to competitive advantage. The first is the "zero-order" which refers to the resources which are the foundation of a firm and the basis for firm capabilities. The next level is the 'first-order' capabilities which are likely to result in improved performance, when firms demonstrate the ability to deploy resources to attain a desired goal. Core capabilities or second-order capabilities are the next level which are a bundle of a firm's resources and capabilities that are strategically important to its competitive advantage at a certain point. The final level is dynamic capabilities which emphasize a firm's constant pursuit of the renewal, reconfiguration and re-creation of resources, capabilities and core capabilities to address the changes in their environment. Ambrosini, Bowman and Collier (2009) build on previous hierarchies and suggest that aside the resource base there are three levels of dynamic capabilities: incremental, renewing, and regenerative capabilities.

Dynamic capabilities hence result out of a progression of capabilities along a hierarchical order as demonstrated by the various authors (Collis, 1994; Winter, 2003; Zahra et al., 2006; Wang & Ahmed, 2007; Ambrosini, Bowman & Collier, 2009) on dynamic capabilities. Combining the capability hierarchical orders as proposed by the various authors suggest that the most exhaustive hierarchical order that can be built based on the resources and a combination of the resources to form higher order capabilities is a four level hierarchical order. The hierarchical order starts off with the zero-order level (Wang & Ahmed, 2007; Collis, 1994; Winter, 2003) where the resources form the foundation of the firm; followed by the first-order level (Wang & Ahmed, 2007; Collis, 1994; Winter, 2003) where a combination of the zero- order level resources results in improved performance when the firm demonstrates the ability to deploy the combined resources to achieve a desired goal; then the second-order level (Wang & Ahmed, 2007; Collis, 1994; Zahra et al, 2006) which is referred to as core capabilities in where the first-order level capabilities are bundled together as a new form of capability when directed towards the firms strategic direction; then finally the third-order level (Collis, 1994; Winter, 2003; Zahra et al., 2006; Wang & Ahmed, 2007; Ambrosini, Bowman & Collier, 2009) where dynamic capabilities is achieved by firm constantly pursuing the renewal, reconfiguration and re-creation of resources, capabilities and core capabilities to address the changes in their environment.

Thus to develop a typology for big data capabilities which is considered a dynamic capabilities by several authors (Wamba et al, 2016, Akter et al, 2016), the four level hierarchical order suggested will be used. Fig 1 shows the typology of big data capabilities based on a review of big data literature.

This research suggest that big data capabilities is a dynamic capability which consist of three sub core capability dimensions namely technological capabilities, human skills capabilities and organisational capabilities. The technological capabilities consist of infrastructural capabilities, data management capabilities and analytical capabilities as first order capabilities. The human skills capabilities consist IT skills capabilities, data science capabilities and business analytic capabilities as first order capabilities. The organisation capabilities consist of management capabilities, organisational cultural capabilities and data ethical capabilities as first order capabilities. The resources -assets and capabilities- which make up the various first order capabilities are shown in Fig. 1.

Based on the typology of big data capabilities as proposed in Fig. 1, this research investigates the various sub dimensions of big data capabilities in a Ghanaian health insurance firm which is currently implementing a big data system.

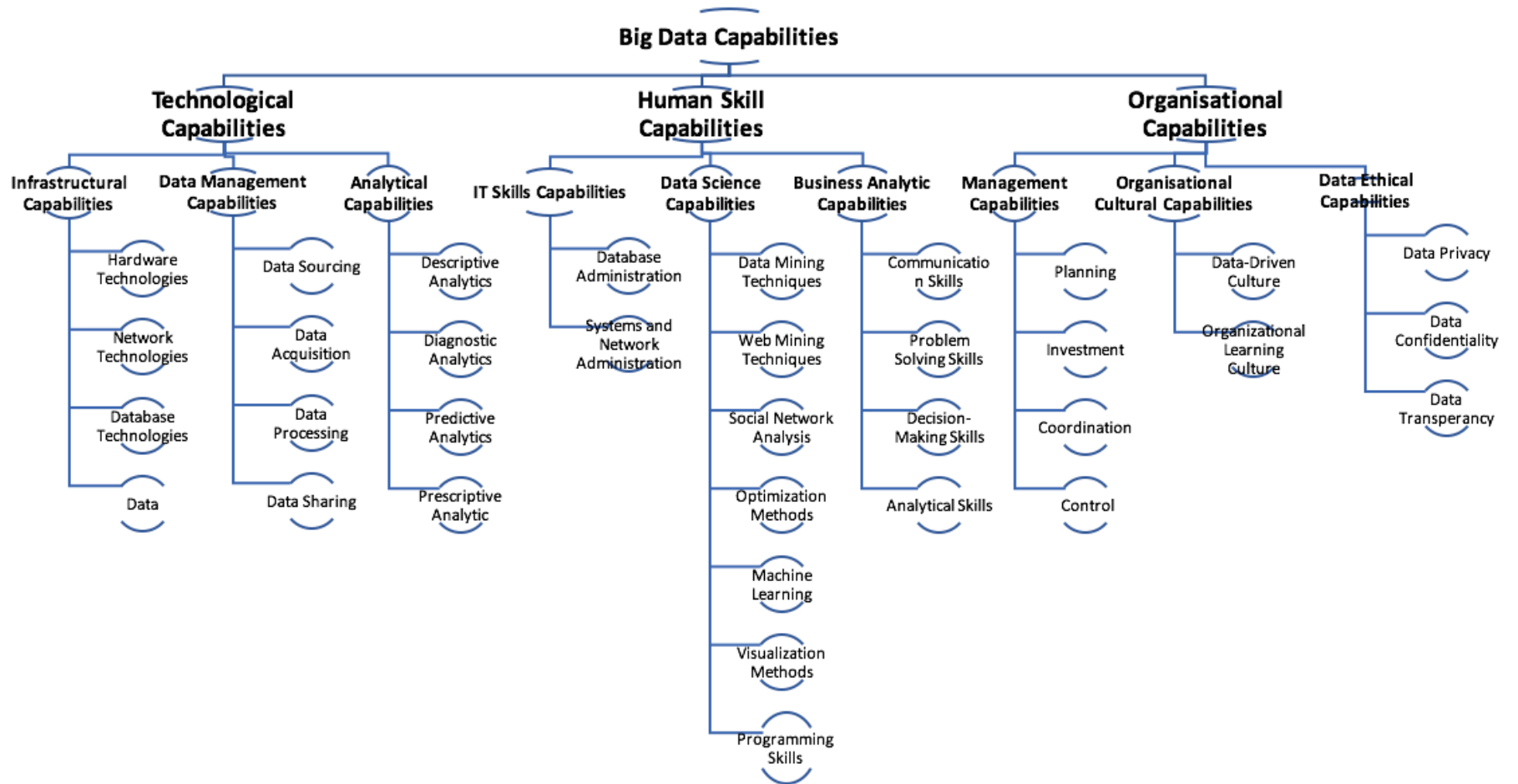


Figure 1. Typology of Big Data Capabilities from Firm Resource Base to Dynamic capabilities

## 4 Research Methodology

To carry out this research, the study proposes to employ a critical realism (CR) philosophical stance and qualitative methods to unearth structures and mechanisms of big data capabilities and their attending benefits (Mingers et al., 2013). The choice of CR will enable an IS researcher to unearth the big data capability constituents needed for a firm's adoption of big data. Bhaskar (2010) argues that these constituents are not apparent in the observable pattern of events, and can only be identified through the practical and theoretical work of the social sciences. As a result, CR gives way for the complex and detailed unearthing of structures of a social reality like the capabilities needed for the adoption of big data. To unearth the big data capabilities constituent, critical realism adopts a retrodution research methodology (Bhaskar, 2010). Retrodution enables the CR researcher to establish the basic conditions for a phenomenon, such as for big data capability to exist. Hence, without these conditions big data capability will not exist.

CR is supportive of methodological pluralism - quantitative or qualitative data collection methods- as it acknowledges that a variety of objects of knowledge exist and each of these objects requires different research methods to unearth them (Carter & New, 2004). For the purpose of this research a qualitative research methodology is adopted. Qualitative methods within CR have a more profound role, as they are more capable of describing a phenomenon, constructing propositions, and identifying structured interactions between complex mechanisms. Thus for a deeper understanding of the typology big data capabilities are formed and developed a qualitative research methodology will be much suited.

Several CR researchers have identified the case study method as the best approach to explore the interaction of structure, events, actions, and context to identify and explicate causal mechanisms (Ackroyd, 2010; Easton, 2010; Miles, Huberman & Saldaña, 2013). Thus the study will employ a case study research design with a qualitative research methodology.

## 5 Research Design and Methods

The purpose of a research design is to make sure that as unambiguously as possible the research problem is effectively addressed by the evidence found. A qualitative research design was used to assess the big data capabilities from a dynamic capabilities perspective of the top Ghanaian private health insurance firm -Nationwide Medical Insurance- which is currently implementing a big data system.

Case study explores a case through in-depth data collection. The study employed the use of interviews, focus group discussions and observations as data collection tools to give a greater understanding of the big data capabilities phenomenon being studied. The interviews and focus group discussions consisted of open-ended questions that focused on the various dimensions in the typology of big data capabilities in the health insurance firms. Populations for the interview and focus group discussions consisted of a purposive sample of various groups that interact with the big data system that is being implemented by the health insurance firm.

The exact sample units were determined after a pilot study of another health insurance firm which is at the early stages of implementing a similar big data system. The units of analysis were made up of the staff in the IT, Claims, Business Development Unit (BDU), Actuarial, Membership, Health Service Providers (HSP) Unit in the health insurance firm. Other units of analysis were the Chief Executive Officers and technology suppliers of the health insurance firms.

The interviews and focus group discussions were supplemented with documentary evidence. The documents include those publicly available and those provided by the interview and focus group participants.

## 6 Evidence from Nationwide Medical Insurance

Nationwide has over the years been managing the data of health insurance claims from its service providers through its intranet based software called NatMed. The claims that are inputted into the intranet software of the company takes almost 90 days to convert from manual papers into digitized form for a given batch of claims before finally adjudicating them to detect fraud and process for payment. This voluminous task is as a result of large volumes of varied types of claims data that Nationwide receives

from their 521 health service provider network. This has made analytics performed on the digitized data mostly a bit outdated and not reflective of the real case on the ground. This late analysed data does not help Nationwide to know its real state of affairs at any time. For example in 2013, the firm's late analysed data prevented it from being able to forecast the changing trend in the Ghanaian economy when it comes to health care service cost, as it astronomically increased due to dollarization and inflation. This led to the firm making huge losses. Besides the varied nature of data from the different service providers, the large volumes of the data compounds the difficulty in fully handling the analytics associated with the digitized data. This has made it difficult for the company to expand its services to the general public for fear of not being able to control the services they offer to such customers.

Monitoring the claims utilization, plans and benefits of that nationwide seeks to the general public will be difficult to handle due to the lack of control and monitoring systems on the ground. In addition, the shear volumes of data to be collected in varied forms from varied service providers with different conditions to enforce further aggravates the problem Nationwide needs to overcome. The IT head comments that

*“Our processes are causing us to change because our members are increasing and we can't go on entering claims manually that means we have to increase our overhead costs at the claims unit. We realize that the cost of health care keeps on increasing so that is the external pressure. People are not able to renew their insurance. There is a need for us to check attendance or cost and industry wise we are now becoming choked. We are going after the same people and so we need to change our portfolio a bit. In changing that portfolio we need to put in systems in place. First we use to go to corporate bodies to insure their staff, now we are going after the ordinary person who is not formally employed and before you can do that you need to have a system that can check the person's attendance and adjudicate claims in real-time”*

To overcome this problem Nationwide in 2014 adopted a big data approach to identify, collect, store, manage and analyse data from its varied service providers. To do this, Nationwide went in for a big data insurance claim system called Rx Claim which integrates with the NatMed system that is used on the intranet of Nationwide. The solution involves the setup or integration of the Rx Claim system at the health service providers end through relevant APIs as well as a web based platform. The Rx Claim system works both online and offline (O2O) due to the developing country context or environment that Nationwide finds itself in.

Data from the Rx Claim system based on certain protocols are exchanged in real-time between Nationwide's NatMed system and the service providers using APIs and web services. The data collected comes as structured, semi-structured and unstructured. The structured data include membership data, corporate, family and individual data, health plans and benefits data, disease diagnosis related data, drug prescription data, HSP payment and claims data, WHO generic, therapeutic, ICD 10 and ATC coding data. The semi-structured data mainly comes in the form of XML and JSON. It includes disease adjudication rules, multiple diagnosis data, dental related data from HSPs, log files from HSPs, GPS data from mobile application, SMS data, member feedback data and mobile clicks data by members. The unstructured data includes diagnostic document data, laboratory document data and medical notes document data. The data uses both RDBMS and NoSQL databases to handle the data. The RDBMS consist of MySQL and Microsoft SQL. The NoSQL databases are mainly hosted in cloud due the high cost of setting up data centers at Nationwide as well as the need for Nationwide to focus on its core business instead of focusing on technology.

The system does real-time validation checks, fraud detection, benefit limit enforcement as well as real-time analytics at the service providers end and at Nationwide's end. This has led to great improvement in the data analytics that Nationwide carries out. Furthermore, Nationwide through the Rx Claim system introduced a mobile app and a web-based internet version of the system which is used by members on nationwide health plans to check their health and insurance records in real-time throughout the entire country. The mobile apps also gives members, the ability to interact with service providers and the insurance company in real-time. The mobile app predictively suggests the nearest service providers to members as well as give them value added services such as descriptive, diagnostic, predictive and prescriptive analytics to members on their health in real-time. The big data system has greatly increased the payment plan of insurance claims to health service providers as well the collection of premiums from corporate institutions and general public as a whole.

This big data approach has greatly given Nationwide the much needed competitive advantage it requires to dominate the dynamic market space in the health insurance industry it finds itself. Nationwide based on the big data system is now confident and is expanding its business to the general public since it

can control and interact with the general public in real-time and still process and analyse the large volumes of varied data it encounters.

Nationwide as a result of the big data system and its integration with the internal NatMed system has been going through the process of developing big data capabilities by acquiring certain big data technologies and as well as its technical processes. Some of the technologies have involved using and reconfiguring existing infrastructure owned by Nationwide to handle the big data system. In other cases, Nationwide has had to acquire new infrastructure such as cloud computing systems to deal with the big data.

The development of the big data capabilities has also led Nationwide to acquire new human skills by upgrading the skills of its existing staff as well as employ the skills set of other people. The development of data science capabilities and business analytic capabilities has been very challenging for Nationwide. There is an acute shortage of data science skills on the Ghanaian market. Though business analytic skills exist within Nationwide, they are embedded in different departments namely IT, Actuarial and BDU. A participant of one of the focus group discussions comments on this as saying;

*“...NoSQL has been around for long but a lot schools in Ghana do not even know it or let alone teach it. We need data scientist who can manipulate NoSQL databases. May be it is high time the schools change their curriculum to teach NoSQL. NoSQL is the future of databases. The earlier the better for the schools...”*

Nationwide has undergone a lot changes and has developed certain organisational capabilities such as the reliance of the firm on data from the Rx claim system to make real-time decisions. This has led to Nationwide creating a data-driven culture as well developing its organisational learning using big data. Nationwide as a result of the big data system has created a greater awareness in the firm for data privacy, transparency and confidentiality due to the sensitive nature of the health data as well as data collected from members through the mobile app. It has also created new policies to govern its big data capture and use at the health service provider systems and the use of the mobile app by its members. Managerially, Nationwide's top management seems to push for more creativity like the big data system and invest in such innovations while pushing staff to depend on the innovations in their work. This managerial approach has greatly help the big data system to succeed.

## 7 Discussions

The data gathered on Nationwide as depicted in the case study suggest that for most parts, Nationwide's hierarchical model of the typology of big data capabilities follows what this research has proposed. However, there are some bottle necks for which Nationwide as a health insurance firm must address to be able to derive the maximum benefits out of developing big data capabilities.

For technological capabilities more data sources must be gradually encouraged to join the mix of data portfolios so as improve insights derived from big data. Beyond that a drive towards more prescriptive analytics should be encouraged to further make nationwide more profitable by cutting down cost based prescriptive analytics for the firm and its clients.

With respect to human skills capabilities there seems to be a lack of data science skills in the firm. In addition, business analytic skills seems to be scattered in the firm with the resources involved distributed among different departments at Nationwide. Perhaps this is a reflection of the need for academic institutions in developing countries such as Ghana to equip students with relevant skills to become business analyst and data scientist. This urgent need for data science and business analytic skills cannot be underscored since it has been predicted that by 2018, even the United States alone despite its advancement will face a shortage of 140,000 to 190,000 people who have deep analytical skills (Manyika et al., 2011). In addition, Manyika et al.( 2011) predicts a shortfall of 1.5 million data-savvy managers with the know-how to analyse big data to make effective decisions in the USA.

Beyond the skills set, the desires of management as well as the leadership or managerial styles which reflects in the planning, investment, coordination and control greatly influences the development of big data capabilities. This calls for the need to ensure that management skills among top management are regularly upgraded to be in line with the firms big data vision and strategies to have the best possible influence from top management.



## 8 Conclusions

This research has through a review of the literature on big data capabilities established the need to have hierarchical model of the typology of big data capabilities. The hierarchical model per the literature reviewed suggest a model which begins at the resource base of the firm and rises through the first order capabilities to the second order capabilities and finally the third-order capabilities at which big data capabilities assumes a dynamic capability nature.

Based on the hierarchical model, the research establishes that big data capabilities is made up of three core second order capabilities namely technological capabilities, human skills capabilities and organisational capabilities. The technological capabilities consist of infrastructural capabilities, data management capabilities and analytical capabilities as first order capabilities. The human skills capabilities consist IT skills capabilities, data science capabilities and business analytic capabilities as first order capabilities. The organisation capabilities consist of management capabilities, organisational cultural capabilities and data ethical capabilities as first order capabilities. The resources -assets and capabilities- which make up the various first order capabilities are shown in Fig. 1.

An analysis of the typology of big data capabilities indicate that for most parts of the evidence obtained in this research is in tandem with the typology of big data capabilities proposed by this research. However, there is the need to look for more data sources and move analytics towards prescriptive analytics. In addition, there is the need for firms and academia to collectively help train the needed data science and business analytic skills which is seriously in short supply. Finally, management must constantly be oriented to develop managerial skills which are in support of a firms big data vision.

For future research direction, a deeper understanding of the dynamic capability process that occur in the development of big data capabilities will give a much clearer understanding to firms seeking to adopt big data. Furthermore, an understanding of the antecedents that influence the dynamic capability process to generate big data capabilities will help firms know what influences their adoption of big data. Finally, there is the need for research into the kind of data science and business analytic curriculum being taught by academic institutions in developing countries to help suggest ways for it to meet the demands of industry.

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