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DESIGNING STRATEGY DIMENSION OF THE ORGANIZATION BASED ON BIG DATA ANALYTICS CAPABILITY

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Abstract

Big data attracts the attention of many enterprises. Many companies invest in big data technology but it is however, observed that they face some challenges. Technical and social dimensions play an important role in adapting to new technologies. The organizational researchers have developed models to explore possible areas to be improved. Strategic alignment is regarded as a major success in organizational design literature. The strategy directly affects the technology itself and other dimensions such as organizational structure, process, organizational culture and human resources. This study aims to concentrate on how to align big data analytics capability (BDAC) with the strategy, drawing on resource-based theory (RBT) and organizational design. A big airline company has been selected as a case study to investigate the possible relationship between BDAC and strategy. The interviews and the collected documents show that the company should align BDAC with the strategy by focusing more on customer-centric applications.

Keywords: Big data, big data analytics capability, organizational design, strategy.

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1. Introduction

In the age of the Industry 4.0, the speed of technology development is changing from day to day and it is predominantly dominated by nine technologies. These technologies are autonomous robots, simulation, horizontal and vertical system integration, the industrial internet of things, cybersecurity, the cloud, additive manufacturing, augmented reality and big data and analytics (Rüßmann et al., 2015; McKinsey & Company, 2015). Although there is no a common definition, big data is defined as a phenomenon that enables rapid access to a wide range of data types (Laney, 2001). Big data, Gartner's Top Strategic and one of the Most Critical 10 Technologies of the next five years, is regarded as the new raw material of the 21st century (Savitz, 2012a, 2012b). Some studies state that it is the next "management revolution" (McAfee & Brynjolfsson, 2012) or "next big thing in innovation" (Gobble, 2013).

Drawing on resource-based theory (RBT), big data analytics capability (BDAC) is defined as an organizational capability to achieve a competitive advantage in a big data environment (Davenport, 2006). BDAC is effective at making the right decision at the right time, improving risk management, determining market segmentation and niche markets, monitoring product development, detecting fraud and making production processes more efficient (McAfee & Brynjolfsson, 2012; Columbus, 2016; McGuire, Manyika, & Chui, 2012). It is also stated that BDAC effected strategy has a positive impact on sustainable competitive advantage (Wixom, Yen, & Relich, 2013) and the alignment between BDAC and strategy is a key in firm performance (Akter, Wamba, Gunasekaran, Dubey, & Childe, 2016). Moreover, organizational alignment is regarded as a major factor in the adoption of big data analytics (Kiron & Bean, 2013). Kates and Galbraith (2010) stated that the goal of organizational design is creating superior organizational capabilities to gain competitive advantage. Previous studies also showed that other than technical aspect, other dimensions of organizational design should be considered in order to benefit from BDAC (Galbraith, 2014; Grossman & Siegel, 2013; Chang, Kim, & Park, 2017). Thus, by drawing on RBT and organizational design literature and by conducting a case study for an airline company, this study addresses the following research question: "How can the airline align BDAC with strategy?"

To address the research question, this study conducts interviews with analysts and managers of both business and IT side of the company. The related documents from the company's website and the annual reports are also collected and analyzed to test and support the results of the interviews.

2. Literature Review and Theoretical Framework

2.1. Resource-Based Theory

Resource-Based Theory (RBT) states that an enterprise should try to achieve a competitive advantage by developing its resources and capabilities. Barney (1991) classifies the resources of an organization as physical resources, human resources and organizational resources. Physical resources include land, machinery, physical technology, geographic location of the facility. Human resources include training, experience, evaluation, intelligence and relationship levels of managers and employees. Organizational resources include critical aspects such as formal-informal planning, reporting structure, control and coordination mechanisms, and communication with the environment. (Barney & Clark, 2007). Capability is defined as the use of tangible and intangible resources together in a coordinated

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manner (Grant, 1991). Similar resources can be found in many organizations, but what distinguishes a company from its competitors is its ability to use these resources in a coordinated manner. Ulgen and Mirze (2013) indicates that the capacity of the resources to be used in a coordinated and specified manner shows the capability of the organization. Resource heterogeneity and imperfect mobility are two main assumptions of RBT (Barney & Clark, 2007). The heterogeneous distribution of resources assumes that different enterprises have different resources and/or capabilities while imperfect mobility means that resources and capabilities do not change from organization to organization in the short term.

It is known that companies have strategies in order to achieve a competitive advantage over their competitors. Competitive advantage is defined as producing more economic value than competitors in the sector where the enterprise is located (Barney & Clark, 2007). The resources and capabilities that can be found in every company provide a competitive advantage to the enterprises for a limited period. Sustainable competitive advantage (SCA) is possible when resources and capabilities have some characteristics (Barney, 1991; Ulgen & Mirze, 2013). Barney (1991) has developed the VRIO (value, rare, imitate, organized) framework in order to conceptualize SCA. Resources and capabilities should be as valuable as possible to meet the opportunities and threats in the environment. They should also be as rare as a small number of enterprises can have and they cannot be imitated without having to be at a very high cost. Finally, they should be well organized in a coordinated manner with politics and procedures. Competitive advantage is possible by organizing valuable, rare and imitated resources and capabilities for the enterprise (Rothaermel, 2012). Organizational capabilities are defined as the collective capability of an organization, talent and expertise set (Smallwood & Ulrich, 2004). Organizational capabilities are only possible if organizations manage more than one person's ability in harmony. In this way, enterprises will be able to transform their technical work knowledge into performance generating results.

2.2. Big Data Analytics as a Capability

Big data is defined as a phenomenon that allows rapid access to a wide range of data types and enormous size (Laney, 2001). International Data Corporation (IDC) (2012) describes three characteristics of the big data concept as data itself, data analytics and presentation of analytical results (as cited in Gantz & Reinsel, 2012). The data itself is expressed as “big data”, while the data analytics and analytical results are named as “big data analytics” (BDA). IDC defines big data as the next generation technology and architecture designed to produce economic value from high volume data that enables high speed exploration and/or analysis (Gantz & Reinsel, 2011). In another definition, which focuses on data sources, big data is defined by large data, purchase records, GPS signals, social media content, digital photos and videos, sensors etc. (Schroeck, Shockley, Smart, Romero-Morales, & Tufano, 2012). In the literature, researchers generally define the big data concept through the words V’s; volume, variety, velocity, value and veracity. (Kwon & Sim, 2013; Gantz & Reinsel, 2012; Gandomi & Haider, 2015).

The big data concept refers to the data itself and the dimensions it carries, while BDA refers to the data itself, as well as the technological infrastructure that enables the data to be obtained, the software that provides inferential inferences and the tools that provide the analysis (Kwon, Lee, & Shin, 2014; Lamba & Dubey, 2015; Loebbecke & Picot, 2015). BDA is defined as the process of analysing unstructured data set to provide undiscovered inferences, capture inter-data correlations and other useful information (Tachizawa, Alvarez-Gil & Montes-Sancho, 2015). Kiron, Prentice, and Ferguson, (2014) state that BDA

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applications contribute to the operational processes, strategic decision making and performance improvement of the enterprise.

RBT is widely used in the informational technology (IT) field (Bharadwaj, 2000). It is stated that IT has an important role in obtaining SCA (Ashrafi & Mueller, 2015). Pavlou and El Sawy (2006) point out that competitive advantage can be achieved through compliance of IT-based resources with other organizational resources. Big data analytics capability (BDAC) as an IT concept is defined as an organizational capability to achieve a competitive advantage in a big data environment (Davenport, 2006). Kiron et al. (2014) defines BDAC as the capability to achieve competitive advantage by using data management, infrastructure and human resources capabilities. BDAC is also defined as the use of big data in strategic decision making (Lavalle, Lesser, Shockley, Hopkins, & Kruschwitz, 2011). BDAC indicates the ability to determine the optimum wage, identify quality problems, determine the optimum inventory level and identify loyal customers (Davenport & Harris, 2007). It is stated that BDAC is effective at making the right decision at the right time, improving risk management, determining market segmentation and niche markets, monitoring product development, detecting fraud and efficient production processes (McAfee & Brynjolfsson, 2012; Guangting & Junxuan, 2014; McGuire, Manyika, & Chui, 2012). It is also said that BDAC effected strategy has a positive impact on SCA (Wixom et al., 2013).

The studies developed under the RBT generally collect BDA resources under three categories: tangible resources, intangible resources and human resources. The tangible sources of BDA include data itself, data acquisition-processing technology (Hadoop, NoSQL, etc.) and time and monetary investment. These tangible resources alone will not constitute a competitive advantage. Intangible and human resources are also needed to create the competitive advantage. Data-driven organizational culture and organizational learning are thought as intangible BDA resources, while managerial and technical capabilities are BDA human resources (Gupta & George, 2016).

2.3. Strategy as an Organizational Design Dimension

Organizational design is defined as the organization of resources and people to achieve the desired goals (Greenwood & Miller, 2010). Kates and Galbraith (2010) describe the organizational design as the process of designing the structure, processes, reward system and human resources in line with the determined business strategy. After the contingency approach, organizational design has been defined by additional dimensions. Daft (2015) collects organizational design dimensions under two categories as structural and contextual. Structural dimensions include formality, specialization, hierarchy of authority, centralization, professionalization and personnel ratios, while contextual dimensions include scale, technology, environment, strategy and goals, and organizational culture. Another model in the literature is the Star model of Kates and Galbraith (2010). According to this model, there are five important elements in determining the design of the organization. These elements are strategy, structure, process, human resources and reward system. Schatten (2014) collects the design dimensions of the organization under 5 dimensions: strategy, structure, processes, organizational culture and human resources. A similar approach takes place in the study of Chang, Kim, and Park (2017). In this study, organizational design dimensions are collected as strategy, management, processes, reward system and human resources.

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Strategy is to determine the long-term goals and objectives of an enterprise and to plan for the activities by providing its resources in this direction (Chandler, 1977). Strategy is the engine of the organizational design and has a critical importance. Daft (2015) states that strategy affects the connections between technology, human resources policy, culture and organizations. Accordingly, the organization should be designed according to the company's competitive strategy. The aim of strategy determination is to achieve competitive advantage (Kates and Galbraith, 2010). Competitive advantage is defined as an enterprise offering customers more valuable products and services than its competitors through lower prices or better services (Porter, 1998). The strategy that is believed to bring a competitive advantage to the company is determined by evaluating external environmental factors (customer, supplier, competitor, substitute product, possible competitors) and internal environmental factors (development of resources and capabilities) (Ulgen & Mirze, 2013). The aim of organizational design is to achieve a competitive advantage by developing organizational capabilities as an internal environmental factor (Kates & Galbraith, 2010). Accordingly, other organizational dimensions (structure, processes, culture and human resources) should be designed by the organizational capabilities and in line with the strategy (Daft, 2015). Kates and Galbraith (2010) argue that different strategies require different organizational capabilities, and different organizational capabilities require different organizational designs.

2.4. Strategy-Big Data Analytics Capability Alignment

Under the strategy context, BDAC, an IT concept, is defined as an organizational capability to achieve a competitive advantage in a big data environment (Davenport, 2006). Strategy-driven BDAC is reported as generating value for businesses (Wixom et al., 2013; Agarwal & Dhar, 2014; McAfee & Brynjolfsson, 2012). Schroeck et al., (2012) observed a positive relationship between the use of BDA on real-time data and the competitive advantage and differentiation.

Mazzei and Noble (2017) presents a three-tier framework as indicating that big data phenomenon reaches beyond the improvement of traditional firm capabilities. They view BDA not only as a functional tool, but also an evolutionary strategy development embraced by a growing number of successful firms. Davenport et al. (2012) state that leaders of these companies use data as central to their organizational strategy and choose to concentrate on data flows rather than data blocks. Past studies also focus on the importance of BDAC-business strategy alignment (Agarwal & Dhar, 2014; McAfee & Brynjolfsson, 2012). Kiron et al. (2014), state that the alignment of strategy and capability (data management, technology and talent) is a key in achieving competitive advantage. Akter et al. (2016), in their study, found a moderating effect of BDAC-strategy in relationship between BDAC and firm performance. Constantiou and Kallinikos (2014) point out that big data contributes to the competitive strategy of an organization by making possible the development of innovative services. Raguseo (2018) lists the strategic benefits of big data as creating a competitive advantage, aligning IT with a business strategy, improving customer relations, establishing useful links with other organizations, enabling a quicker response to change and providing better products or services. Woerner and Wixom (2015) state that big data support strategy by providing new data, new insight and new action. Big data strategy specifies the goal for big data. Enhancing products or services in order to have a competitive advantage is decided by big data analysis (Chang, Kim, and Park, 2017).

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Galbraith (2014), by introducing Star Model, focuses on the relationship between BDAC and strategy. He states that companies are applying a dual strategy for implementing BDAC. The first strategy is building a digital capability to make better and faster decisions. This type of strategy also enhances existing products. The second strategy is digital business. In this strategy, the companies use data and analytics to create insights and custom reports and become a new profit center. For implementing these two strategies, Galbraith (2014) says that other dimensions of organizational design should be modified. This is parallel with what Kiron and Bean (2013) say: “Organizational alignment is key to big data success”.

3. Research Method

The aim of this study is to concentrate on how to align BDAC with the strategy. To achieve this objective, an international airline company is selected for the application purpose. Kiron et al. (2014) state that the alignment of strategy and capability is a key in achieving competitive advantage. Akter et al. (2016) also found a moderating effect of BDAC-strategy in relationship between BDAC and firm performance. Davenport (2014), lists travel and transportation as one of the suitable sectors for big data applications, because, customer analytics and loyalty, capacity and price optimization and predictive maintenance analytics are the areas where air transport has the potential to benefit from big data (IBM, 2014).

The airline we studied serves with a passenger and cargo fleet of 335 aircraft. It has a very extensive network by flying to 124 countries, 307 cities and 311 airports. It is in the growth trend and the number of passengers grow year by year. In 2004, the total passenger carried was about 12 million and the number was 30 million in 2010 and around 70 million in 2017. Passenger name record (PNR) data, ticketing data, departure control systems (DCS) data, customer loyalty program data, website data and competitive data are the main data sources that the airline company works on. The airline operates nearly 1000 flights in a day from its hub airport. Based on this information, it can be said that the airline is a big enterprise and its data is expected to meet the dimensions of big data which are volume, variety and velocity (Laney, 2001).

A case study has been performed for this study. Case studies are qualitative research methods that try to answer "how and why" questions that allow the investigator to examine the depth of a phenomenon or event that s/he cannot control (Yin, 2002). More than one data collection methods (interviews and documents) have been used to meet reliability criteria. Interviews have been made with two middle-level managers and two analysts in a semi-structured way. In order to balance the different aspects of big data concept, the sample is selected from both business (customer) side and IT side (provider). The first manager is responsible for Reservation Systems Management and represents business side of the big data analytics while the second manager is Data Solutions Manager which is an IT role. The first analyst works as a big data analyst under the same department as the second manager. Finally, the second analyst works as a business analyst in Revenue Management and he is also the customer of big data analytics. The following questions are directed to participants to investigate the possible alignment between BDAC and strategy: “What are the airline’s big data resources?”, “What are the existing big data projects?”, “What is the company’s competitive strategy?”, “What are the company’s IT functional strategies?”, “Do

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the big data projects originated from the company's mission, goals, and strategies?". Each interview was held on a different day and lasted 20-25 min. and it takes totally two weeks to be completed. Participants' answers to the questions were noted carefully and supplemental documents were asked when it is needed. Annual reports and the airline's website have been used as data sources to support the results of the interviews. Content analysis method, one of the most used methods in qualitative studies, has been used to analyze the data collected by the interviews and the documents.

4. Findings

The interviews with IT side reveals that the company has huge data set including PNR, ticketing, pricing, reservation, DCS, flight, loyalty as well as social media and competitive data. As an example, the average number of created PNR per day is nearly 250,000 and the average number of updates in these PNRs is about 350,000. Each PNR contains itineraries, POS (point of sale) and transactional history data including booking, cancelling, reissue, partial cancellation etc. The size of other data (ticketing, DCS, pricing) also increases proportional to number of PNRs. Each new created PNR or ticketed reservation results in huge amount of data. The company uses several big data tools which are Hortonworks & Cloudera, NiFi/MiNiFi, Storm, Spark, Couchbase Data Platform, and Apache Kafka Service. Apache Superset and Big Data Streaming Analytics Manager applications have been planned to be used in the near future. The company also uses several data presenting tools such as Qlikview, Qlicksense, Tableau and Microsoft Power BI.

The interviews with IT and business sides have also uncovered that the airline company currently does not use any big data application yet. However, there are existing projects which require big data analytics. One of them is Real Time Agency Activities Analyser. By this project, the airline company tries to catch the activities of the agencies that use different general distributions systems (GDS). Agency activity data with its huge volume cover valuable information for airlines. "Which markets were requested?", "What was the offered price?", "What was the response of the agency", "Does the agency abuse the system? are sample questions that the agency activity data can answer. By tracing these huge data, the airline company aims to calculate look to book ratios, the actual unconstrained demand, performance of the agencies and also any possible agency abuses. The project is at the last phase and cutover will be done in less than one year. The other big data project is Electronics Data Feed (EDF) which aims to obtain ticket revenue data just at the time of ticketing. The velocity of ticketing data flow is very crucial for airline companies. Airlines want to know as soon as possible how much tickets they sold or how much money they earned so they will optimize the inventory to get maximum revenue. By this project, more accurate revenue estimation will be available and price and marketing strategies will be adjusted in real time. The EDF project has been planned to end in 3 months. The last big data project is Web Activity Analyser. In this project, the airline company aims to watch the customers' activities on the website and communicate with them by offering special promotions based on collected website activities. By this customer relations management (CRM) project, the airline company plans to reach incremental passenger and revenue and also increase the number of loyal customers. This project is also planned to cutover in one year.

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The generic strategy of the airline is determined as differentiation. The mission of the airline on its website is stated as "to become the preferred leading European air carrier with a global network of coverage thanks to its strict compliance with flight safety, reliability, product line, service quality and competitiveness, whilst maintaining its identity as the flag carrier of the country in the civil air transportation industry." The airline has announced its strategies and strategic focus as sustainable growth and profitability, business excellence and efficiency, brand awareness and preferability, customer orientation, adding value to employees, corporate social responsibility and innovative life. Based on this information and the phrase of "We fly to more countries than any other airline", it can be said that the company follows the differentiation strategy.

In the annual report of 2017, IT functional strategies have been stated as service-focused IT transformation, two fast IT models, information management and security, digitalization, simplified IT processes and employee focus. The defined targets of the Information Technology Center have been announced as creating technological knowledge, improving technological processes, improving standards (product or service quality), improving efficiency, reducing costs (time and manpower) and commercializing technological knowledge (patenting the knowledge and products). One of the main topics for corporate development and information technologies is stated as digital innovations and big data and business intelligence applications. The airline company plans to be able to conduct agency and passenger behavior analyses, cost-expense comparisons, past period analyses, and error analyses by using BDA methods. It is stated that currently an information infrastructure aimed at analyzing reservation, agency, passenger, and detail levels has been created.

Despite existing big data projects are planned to support the company's competitive strategy, both business and IT sides have stated that these projects are not fully generated from the company's competition strategies. The projects are generally originated from IT-related business departments.

5. Discussion and Conclusion

Based on the interviews made and the documents collected, it can be concluded that the airline company does not benefit from big data applications yet. The company has not turned big data analytics to a revenue generating mechanism nor to differ itself from competitors. There are mainly three projects that require big data concept and in one year, all of them are planned to cutover. These projects have revenue generating potential. However, for an airline that follows the differentiation strategy, it has more to do. The differentiation strategy requires to offer different solutions that meet customers' needs and expectations. BDAC is an effective tool to contribute to the differentiation strategy. Since air transportation is a service sector, customer experience plays a crucial role in competition. The airline company should work on the applications that touch the customer experience. Because the customer experience is not limited to in-flight anymore. The experience starts with searching for an optimum price on the website and then continues with booking, ticketing, making possible changes on ticket, flying (seat selection, meal and entertainment), and finally arriving to home or hotel. The differentiation strategy directed BDAC should offer creative solutions to this full picture in order to have a SCA. In the aspect of technical resources, the company has huge and rich data set and also adequate big data tools to develop BDA. PNR, ticketing data, DCS, web, social media and the loyalty program are the main data resources

that BDA can be built on and the company has advanced software programs to execute analytics on them. It can be concluded that the company has adequate resources to build BDAC and it should align BDAC with its strategy by focusing more customer centric applications.

This study concentrates on the alignment between BDAC and strategy. In order to answer the question of how to build the strategy aligned BDAC in the organization, other dimensions of organizational design can be analysed. While the aim of the organizational design is to gain a competitive advantage through the alignment between organizational dimensions and the capabilities, it is a good idea to explore the possible effects of organizational structure, process, organizational culture and human resources on BDAC. Conducting such a broader research may help to see the full picture of the organization in order to build strategy aligned BDAC.

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