

Digital Data Genesis – evolution over time Dynamic Capability and Information Systems

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Digital Data Genesis – evolution over time

Dynamic Capability and Information Systems

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Preface

The philosophy of this project

This report is the output of a research project co-financed by Grenoble Ecole de Management and Rhône Alpes French region. This study was conducted with the aim of understanding how Information Technology (IT) provides new opportunities to firms, specifically focusing on the role that such solutions play in the process and usage of digital data.

Digital data are the focus of this project since data can provide new opportunities for firms: they have become a torrent flowing into every area of the global economy. In such a context, companies may have to deal with a high volume of transactional data, capturing trillions of bytes of information about their customers, suppliers, and operations. Millions of sensors are embedded in the physical world in devices such as mobile phones, smart energy meters, cars, and industrial machines that sense, create and communicate data in the "digitalized" age.

Therefore, there is the need of understanding whether companies are ready for extracting value from digital data and for figuring out the more favorable conditions under which this happens.

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1. Introduction

In the last twenty years, Internet and modern enterprise information systems have provided new opportunities to firms. Even more, new emerging IT trends are capturing media attention and have been promoted by consulting companies. It is becoming imperative for companies to consider these new technological trends and appreciate the potential contributions of these trends to the success. Just to provide some examples, these trends are related to the widespread adoption of the mobile platforms, the Green IT movement, the open source software, the software delivered as a service modality, the cloud computing and the digital data genesis phenomena.

Given that the world and the way companies do business is changing thanks to the amount of data used and processed every day, in this report we will focus on the last mentioned trend: the Digital Data Genesis (DDG) phenomena and the DDG DC (dynamic capability) development[1]. Specifically, DDG DC refers to the process of choosing IT to generate and capture data natively in digital form, integrating this data in the appropriate business processes, and effectively managing data once produced. Digital data can come from any business process and can become the input in any downstream process, generally aiming to improve the organization's performance. Specifically, the ubiquitous and massive creation of digital data, pulled by the diffusion of sensors, and the consequent increase in the creation, storage, communication, and processing of information, are providing unprecedented opportunities for a new value creation in firms. These generated data could be made readably available or streamed, and appropriately transformed in customers' value-added services. The development of dynamic capacities requires time to transform organizations' investments, processes and skills into dynamic capacity. The dynamic capacity will be able to produce, over time, a competitive advantage.

Overall, the objective of this report is to provide empirical evidence about the process of digital data genesis capability development in firms, by looking at the more suitable conditions under which companies are able to develop such capability and whether they can profit from the usage of these digital data. In order to come up with such a goal, a survey analysis on a sample of mainly French and Italian companies has been conducted by interviewing sales managers since the sales department appeared as one of the most advanced

[1] In a few words, a capability is what a company is able to do.

departments in using DDG practices to improve customer relation[2]. These companies were then contacted again to measure the evolution over time of the conditions influencing the development of dynamic capacities, of the DDG itself, and of the changes in their competitive advantage.

The remaining part of this report is structured as followed: Chapter 2 provides an idea of the main features of the DDG phenomena; Chapter 3 includes details about the companies surveyed and the methodology followed; Chapter 4 shows the main results of this research study; Chapter 5 contains the conclusions of the study, and finally chapter 6 shows the further research that can be conducted in the future.

2. An emerging trend: the Digital Data Genesis

We are very rapidly moving toward a world characterized by digitalized events, transactions, and processes. For example, when a process is digitalized (e.g., a purchasing of a good on the Internet), it is carried out through a digital computer or device. Furthermore, when an entity is digitalized (e.g., the installation of "smart" electric meters), the company has the ability to access an informational representation of that entity (e.g., the demand for electricity in real time), and thus generate relevant data from it. Interestingly, all data are natively generated in digital forms. To understand this concept, consider three examples: the use of "Linky", the new ERDF electric meter; AirCasting, an open-source end-to-end solution for collecting, displaying, and sharing health and environmental data using a smartphone; and, finally, the SmartPile from SmartStructure, embedded data collector (EDC).

Looking at the first example, traditional electronic or electromagnetic meters, which demand human intervention for a large sample of simple operations (commissioning, meter reading, power change), are replaced by a "communicating" meter: Linky. Linky can receive and send remote data and orders from a supervision center with which it creates a permanent networking thanks to a data concentrator embedded to the transformer stations managed by ERDF. Thanks to this system, it is possible to follow the consumption of electricity in real time (and no more only estimations), giving the possibility to adapt the production consequently. In this case, Linky allows appraising the whole process flows. It drives to an offer of a better quality, closer of the real needs.

[2] See the following publication: Piccoli, G., & Watson, R. T. (2008). Profit From Customer Data By Identifying Strategic Opportunities And Adopting The 'Born Digital' Approach. MIS Quarterly Executive, 7(3), 113–122.

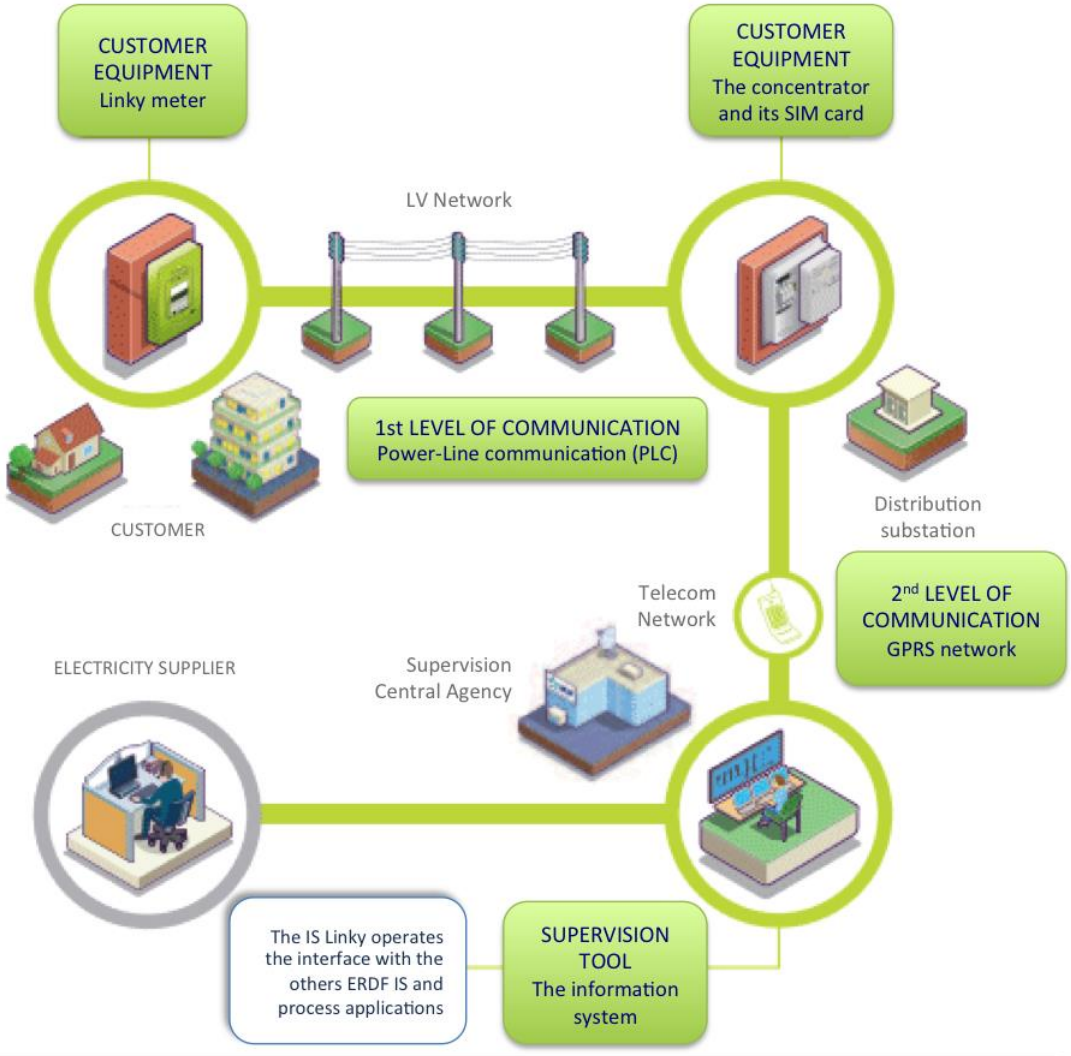


Figure 1 Example of supply-chain management for a supplying electricity company.

As we can see on Figure 1, information is transmitted at each stage of the supply chain: the Linky box by the client's home, the concentrator in the distribution station and, then, the electricity supplier. At each step, the information system of Linky provides key links with the other information systems of the company.

Looking at the second example, the Aircasting platform is made by sensors that are detecting any change in the environment and/or the element where they are embedded. In this case, the collected data allow to follow, in real time, the evolution of a situation, and so, to refine the decision-making. For example, AirBeam (developed by Aircasting), assesses the fine particulate matters in the atmosphere. Used by the US Environmental Protection Agency, these data allow to adapt measures taken in order to prevent and combat pollution and, finally, to improve inhabitants welfare.

Looking at the third example, the SmartPile Embedded Data Collector (EDC), from SmartStructure, is a collector data's system embedded in concrete when it is poured. In this way, it is completely embedded in the structure. Once putted in place, the EDC SmartPile communicates (without any thread) to the Work Station where data are gathered together. Sensors are used to assess concrete's quality during the pouring, the transportation and the installation of concerned structures. The controlling process of reinforced concrete structures is both a gain of time and of security concerning the final materials.

Beyond these three cases, examples of DDG phenomena are all around us. When we type search terms in Google we are generating data in digital form (i.e., data about what we are interested in as such as cloths, cars, etc…) and when we make a call with a mobile device we are generating data in digital form, too (i.e., data about our location, the person we call, what time we call, etc…).

Therefore, it is evident that the digital data generation is accelerating rapidly as the number of connected physical device increases (Figure 2). It follows that great opportunity exists for organizations for value creation fueled by this trend. However, in order to fully exploit such potentialities from digital data, a company has to develop the so called DDG dynamic capability (DC), which is the ability of a company to identify opportunities for digital data generation and to recombine internal existing resources and data to adapt to changing environmental conditions. Further details are provided in the following paragraphs.

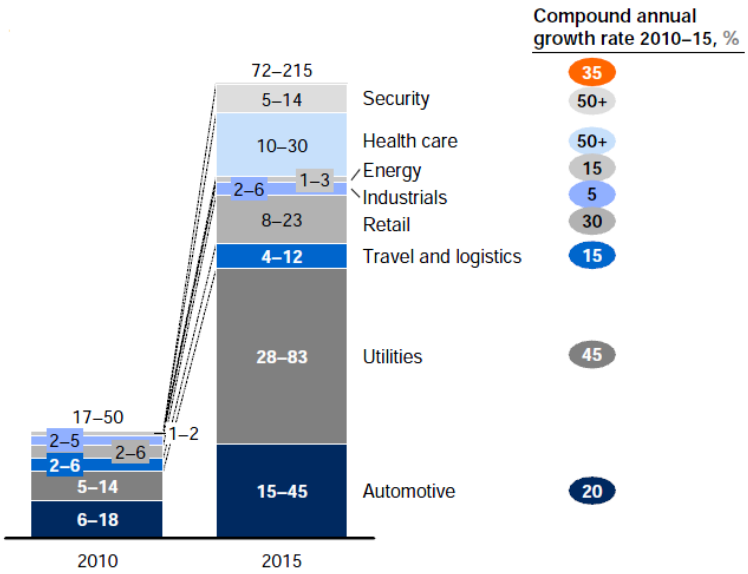


Figure 2 Estimated connected devices worldwide (in millions) (Piccoli, 2012)

As we can see in the Figure 2, the number of connected devices in the world is increasing dramatically. This increase should continue over time. Even excluding computers, digital tablet and Smartphones, by 2020 the number of connected devices should increase by 26 times. At the same time, the number of Smartphones, digital tablets and computer should increase up to 7.3 billion.

3. The companies surveyed and the methodology followed

The data used in this research project derive from a survey analysis carried out between 2011 and 2012 among 93 companies located in France, 18 in Anglo-Saxon countries and 96 in Italy for a total of 207 companies. The same companies were contacted in 2013 and 2014 to explore the evolution of their situation over time.

The surveys were conducted on five groups: 1) communications, electric, gas, sanitary services, public administration and other services; 2) wholesale and retail trade industry; 3) manufacturing and mining industry; 4) B2B service industry; 5) the other remaining industries, such as finance and insurance, transports and real estate activities. Table 1 shows the sample composition divided on the sector and on the size of the companies based on the employees' number.

Sector	**Number of companies**	**Percentage of companies**
Communications, electric, gas, sanitary services, public administration and other services	33	*15.94%*
Wholesale and retail trade industry	33	*15.94%*
Manufacturing and mining industry	79	*38.16%*
B2B service industry	37	*17.87%*
Other remaining industries	25	*12.08%*
Total	*207*	*100.00%*

Size in number of employees	**Number of companies**	**Percentage of companies**
1 to 9	29	*14.01%*
10 to 49	69	*33.33%*
50 to 199	56	*27.05%*
200 and more	52	*25.12%*
Total	*207*	*100.00%*

Table 1 Sample composition

Looking at the methodology, the activities conducted each year are the following: 1) questions formulation in 2008; 2) pilot tests in 2009; 3) sample design and contact with

companies in 2010; 4) data gathering in 2011 and 2012; 6) data analysis in 2012; 7) new data gathering in 2013 and 2014; 8) data analysis in 2014 (Figure 3).

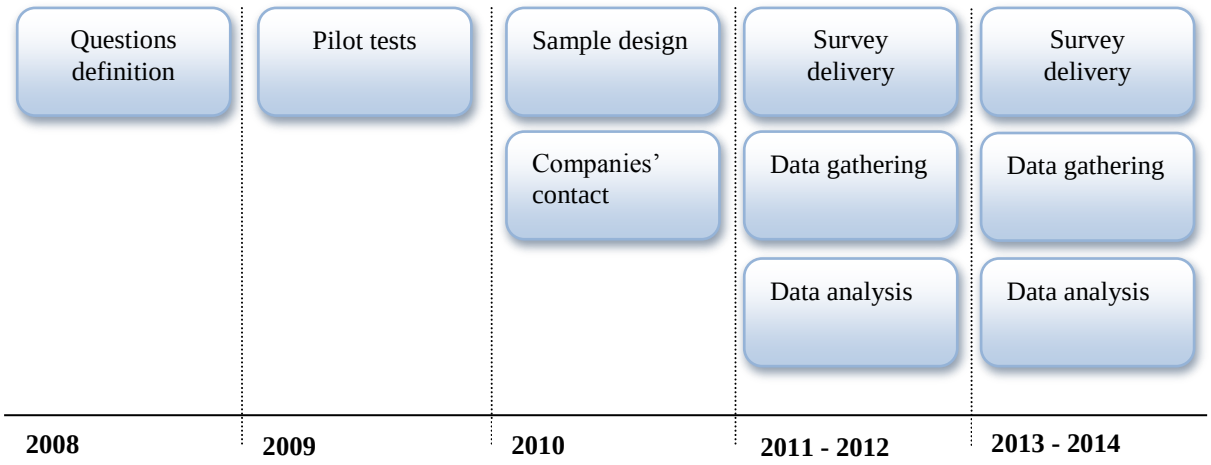


Figure 3 Methodology

Specifically, the survey questions were adaptations of questions formulated in other research studies. The final questions included in the questionnaire delivered to companies are shown in Appendix 1.

First, pilot tests were conducted in order to test the questions to include in the questionnaire. Then, companies to be surveyed were chosen and in general a first phone call was performed in order to inform about the goals of the survey analysis and to find participation agreement. A second phone call was accomplished to collect researched data. Phone call method was the main method applied but in some cases, self-assessment based on an online questionnaire or face to face interviews has been realized. Finally, data were gathered and analyzed with the statistical software SPSS. To know the evolution of these companies, they were all contacted by e-mail first, and then by phone to collect new data on the 2013-2014 period.

4. Unpacking the process of DDG capability development

In order to study the DDG capability development among companies and their impacts on the performance of firms, the conceptual model shown in Figure 4 has been tested. It can be divided in two main areas:

1. The first area includes the conditions under which companies are more likely to develop the DDG DC (organizational processes, firms' assets and firm history);

2. The second area covers the business value of the DDG DC development by looking at the relationship between the DDG DC development and the profitability levels of companies.

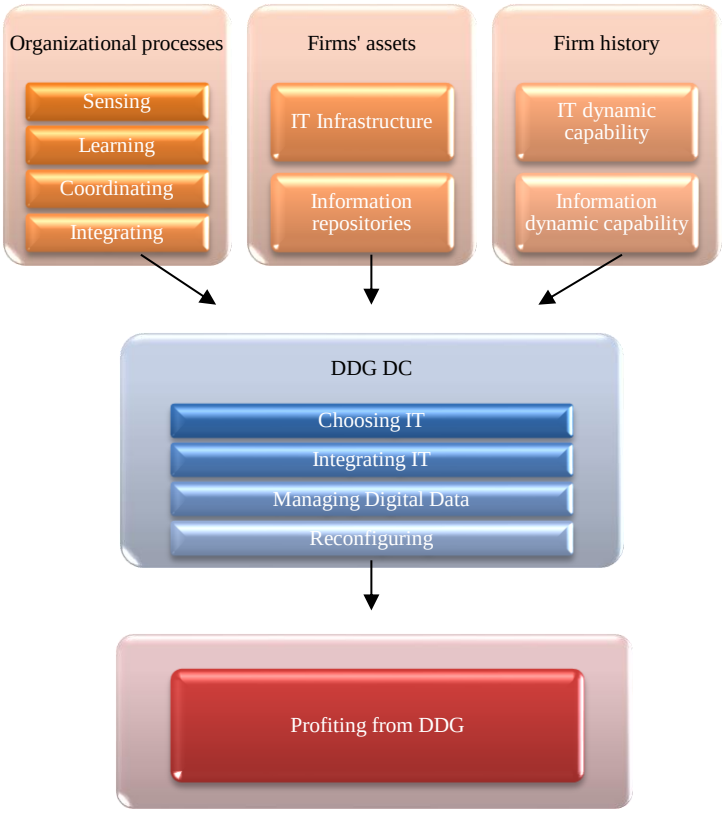


Figure 4 Conceptual model

4.1 The Digital Data Genesis Capability

In order to take advantage of the opportunities afforded by DDG, a company has to develop a DDG capability. This capability consists in a threefold process of (Figure 5):

1. *Choosing IT* to generate and capture data in its native digital form. Such IT may be an emerging IT: a new technology not commercially viable. Otherwise, such IT may be an enabling IT: an established technology used in an innovative application by the firm.
2. *Integrating IT* in the appropriate business processes (e.g., the data collected by the Linky box of ERDF to manage better the electric network organization).

3. *Managing the digital data* so produced (the ERDF computer systems identify the different using devices and the most energy-consuming devices in the aim to do some recommendations to customers).

A firm with a developed DDG capability is able to identify opportunities for digital data generation and to recombine internal existing resources and data in order to adapt to changing environmental conditions. The scope of possibilities in deploying new configurations also depends on the degree of *reconfiguring* of the ineffective DDG process into more promising one that better match the environment, in a faster and cheaper way than the competition.

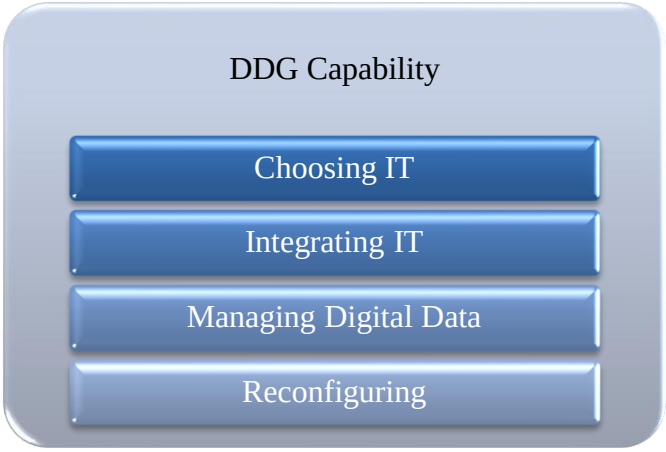


Figure 5 DDG Capability

Note that the DDG capability is linked to the generation and management of the data, not with its actual use for example in analytical processes. In other words, DDG is a prerequisite to being able to compete on analytics, and the outcome should be measured by a consistent ability to generate data in digital form.

In such scenario, IT is the enabler of the DDG capability as IT allows the natively creation of data in digital form. The recognition by the firm's IT personnel of the potential of emerging/enabling IT to generate and capture digital data and the good relationships between IT personnel and line management in integrating such IT within appropriate business processes is critical.

The DDG capability thus enables the firm to manage digital data and therefore take advantage of its ability to generate the data in digital form at its inception as described earlier. Conversely, the inability to manage digital data would negate the value of the data captured and its integration.

4.2 Diffusion of the DDG among surveyed companies

Looking at the diffusion patterns of the DDG in companies, 60% of surveyed companies declared that they made the DDG in 2011-12 and that this rate has increased in 2013-14 to about 75% (Figure 6). This increasing explains that companies always generate more and more data in digital form.

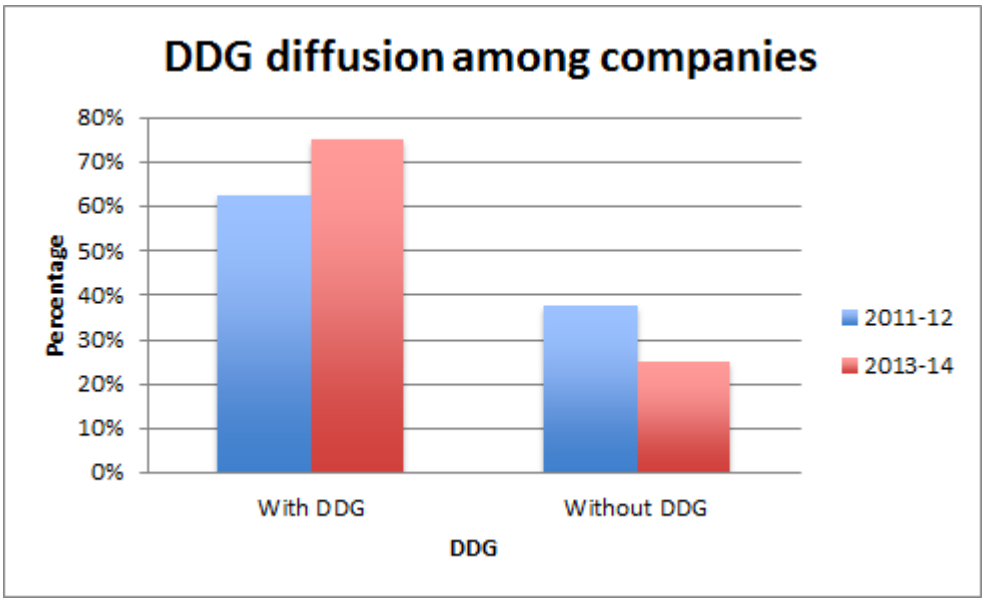


Figure 6 DDG diffusion among companies

The size and the sector of the companies do not influence the development of the DDG capability or phenomena. This means that the DDG phenomenon is diffused homogenously across companies and that the industrial specificities do not influence the DDG development in companies.

4.3 Conditions for Developing the DDG Capability

Once the extent of DDG phenomena across sizes and sectors is understood, the conditions under which companies can develop the DDG DC will be delineated. The starting point to understand the development of the DDG DC is represented by the three sources of dynamic capabilities development in rapid technological change environments[3] (Figure 7):

1. The organizational processes of coordination, integration, learning, and sensing;
2. The firm's assets, which define the firm-specific strategic position, such as the IT infrastructure and the information repositories;

[3] See the following publication: Teece, David J., Gary Pisano, and Amy Shuen. "Dynamic Capabilities and Strategic Management." Strategic Management Journal, Vol. 18, No. 7, 1998, pp. 509-533.

3. The firm's history, which accounts for the path dependent nature of capabilities, which refers to the IT dynamic capability and to the information dynamic capability.

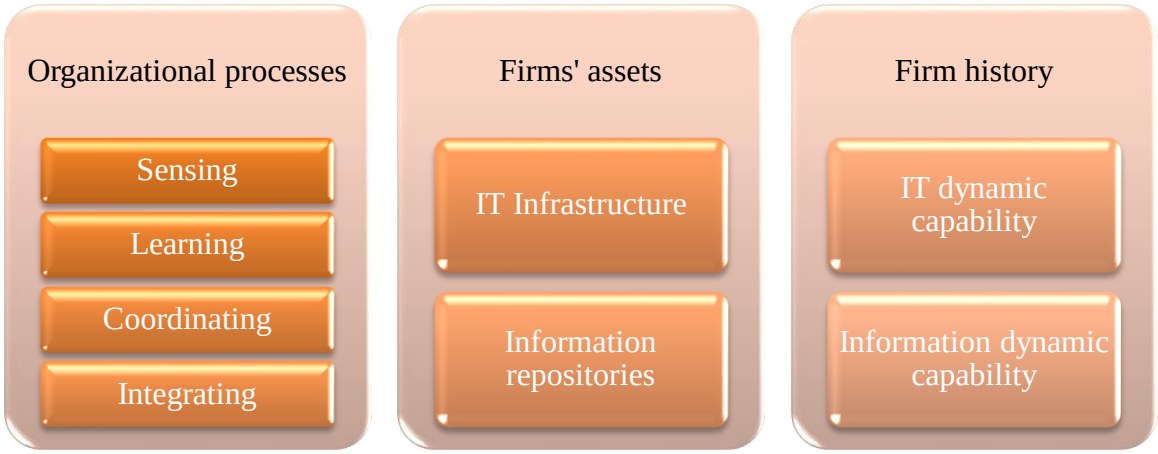


Figure 7 Conditions for Developing DDG Capability

Let's look at each of these sources in detail.

4.3.1 Organizational processes

The organizational processes of sensing, learning, coordinating, and integrating play a pivotal role in developing companies' capabilities when the opportunity or need arises[4].

Managers constantly sense, coordinate and integrate activities inside their organization within or between business units, and so the effectiveness and efficiency of internal coordination and integration is very important for strategic advantage. Beyond this static assessment on the efficiency and effectiveness of the organizational processes, the dynamics of the organizational processes emerge through learning. Specifically, learning is crucial as it enables tasks to be performed better and faster, through repetition and experimentation, and it facilitates the identification of new production opportunities. In a just-in-time (JIT) production chain, for example, learning allows the regular reduction of inventory levels over time.

The survey data highlights the role of the organizational processes of sensing, learning, coordinating, and integrating on the development of the DDG DC. As it can be observed in

[4] See the following publication: Maritan, Catherine A. "Dynamic Capabilities and Organizational Processes." In Dynamic Capabilities, edited by Constance Helfat. Blackwell Publishing, 2007.

Figure 8, the companies that have better organizational processes are more likely to develop high levels of DDG DC than the others. Indeed, the average level of the organizational process was 20% higher for companies that have higher DDG DC than for companies that have lower DDG DC in 2011-12. This gap stayed globally stable in 2013-14. Overall, such result demonstrates that the features of the organizational processes strongly impact on the DDG DC development and that it is a fundamental prerequisite. Companies without DDG keep globally slightly higher values than companies with a low capability in DDG (Figure 8).

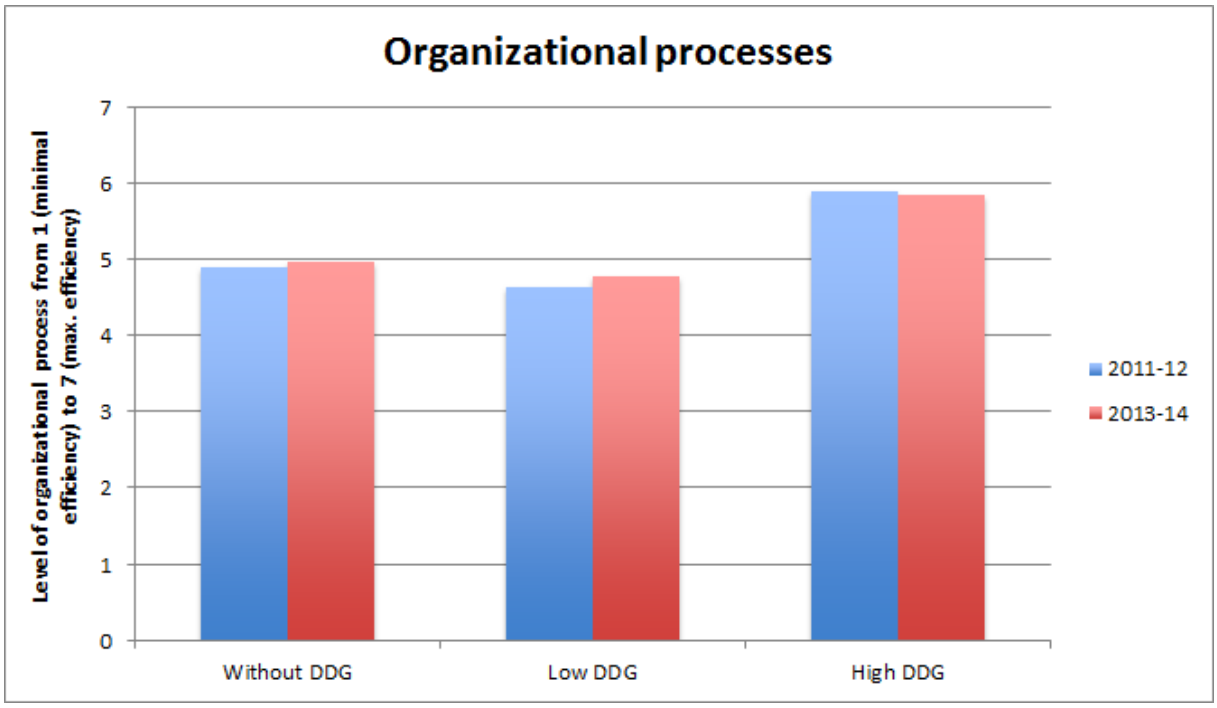


Figure 8 Organizational processes

4.3.2 Firm assets

Different kinds of assets can positively influence the development of new capabilities: technological assets, financial assets, reputational assets, structural assets, institutional assets, and market structure assets. As digital data genesis is based on IT to generate and capture digital data, the existing IT assets and their quality is primordial to the development of a strong DDG DC.

There are two main types of IT assets that are instrumental in the development of DDG DC: IT infrastructure and information repositories[5].

IT infrastructure is the base foundation of the IT portfolio, including technical and human assets, shared through the firm in the form of reliable services or functionalities (e.g., network services, broadband services, intranet/extranet capabilities, data management consultancy, storage area networks, centralized management of applications, service-level agreements, training in the use of IT).

For example, ERDF has progressively extended the reach of its IT infrastructure to deploy Linky meters use. After an experimentation with a small amount of meters (250 000 distributed on a rural zone and on the city of Lyon) intended for showing the ERDF control of the deployment process, the plan, who received the approval of the public authority should now become widespread to the whole territory with an objective of 35 millions of meters settled by 2020. Similarly, the collections of the personal data automatically send by user let TomTom, an itinerary planning software editor and mobile or embedded GPS navigation system provider, open its portfolio of contracts. In partnership with Allianz, TomTom developed the "Linked Allianz Services" that take the driver in charge in a quicker way in case of emergency, breakdown etc.

The second category of IT assets is the information repository, a collection of logically related data, organized in a structured form that is accessible and usable for decision-making purposes (e.g., collection of customer profiles, the product catalog, the daily sales data).

In this case, Aircasting, for example, works like a true platform of exchange, storage and sharing of data. The data collection that the company possesses increased its attractiveness for public institutions thanks to the traceability (of a chosen criteria) allowed by such a process, improving precision of forecasting. Similarly, the information repositories of ERDF were really important to improve the modulations of the electricity's demand and supply and its global offer. Thanks to that digital data's electricity index, ERDF was able to open its range of services, for example with a better integration of the electricity production by individual citizens.

[5] See the following publication: Piccoli, Gabriele, and Blake Ives. "IT-Dependent Strategic Initiatives and Sustained Competitive Advantage: A Review and Synthesis of the Literature." MIS Quarterly, Vol. 29, No. 4, December 2005.

The survey data reveal that companies that were able to develop higher levels of DDG DC had higher levels of firm assets. Even if the difference in the quality and the quantity of IT assets has decreased over time, the companies with a high DDG have the best IT assets both in 2011-12 and 2013-14. The difference between companies with a low DDG DC and companies with a high one is higher than 10%. On the another hand, the assets of companies without DDG increased in the time and finally exceeded in terms of quality and quantity the assets of companies with a weak DDG DC (Figure 9).

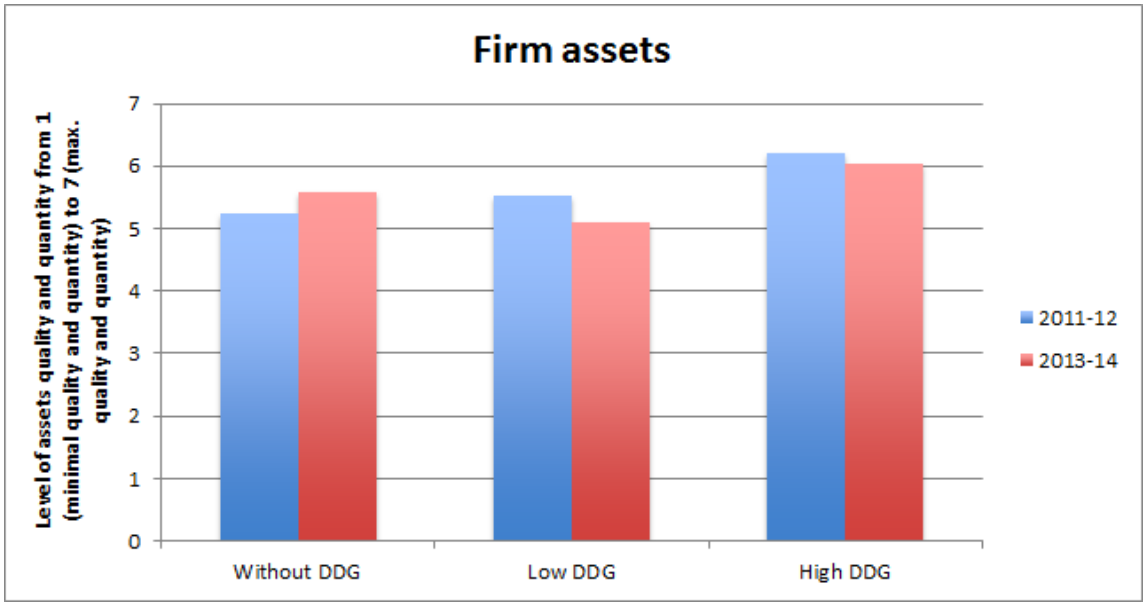


Figure 9 Firm assets

4.3.3 Firm history

Firm history explains the existing firm's position, and, at the same time, it influences the firm's opportunities ahead, framing the path dependencies that organizations face. Present capabilities depend and constrain new ones, because learning tends to be local and related to existing processes.

For example, TomTom's ability to negotiate with Allianz, bank and insurance company, depended on its ability to use personal data from drivers in real time. The company does not only give information about the destination of users but also on his way to drive (rough braking, excessive speed), information that could be really interesting for insurers but that could also increase the range of services available. Conversely, an organization can rarely develop new capabilities that represent a radical departure from existing ones. As a consequence, the development of the DDG capability depends on existing dynamic

capabilities closely related to DDG. As a consequence, the development of the DDG capability depends on existing dynamic capabilities closely related to DDG.

The survey data reveals the role of firm history on DDG capability. Our empirical data reveals that organizations with a favorable firm history (in terms of IT dynamic capability effectiveness and Information dynamic capability effectiveness) are more likely to develop DDG capability. Specifically, the average level of the firm history was around 20% more important in 2011-12 for companies which have a higher DDG DC than for companies that have a lower DDG DC (Figure 10), i.e. the last set of companies historically has less effective IT dynamic capability and less effective information dynamic capability. This gap stayed globally stable in 2013-14, even if, strictly speaking, companies with DDG have lost margins compared to companies without DDG. This fall is so important that companies with a low DDG capacity have now an historical IT capability and an historical information capability that are overtaken by companies with no DDG at all.

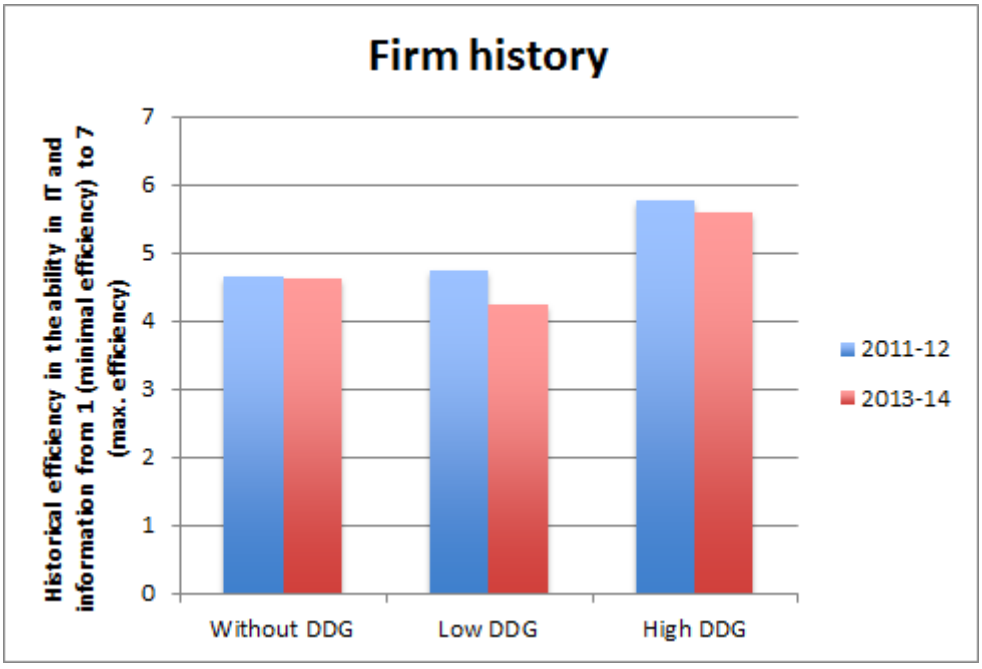


Figure 10 Firm history

More specifically, the information dynamic capability is part of the firm history and represents the ability to identify, collect, organize, and disseminate information. Information capability empirically refers to (1) the presence of a systematic process of information management, (2) the availability of information to ensure that the personnel perform its responsibilities consistently and to a high-quality level, and (3) the degree of trust in the organization's information sources. The existing information capability facilitates the

development of the DDG capability in managing the produced digital data. As a consequence, organizations wishing the development of DDG capability need good information management processes, they need to improve the availability of the information, and they need to instill trust in the organizational data sources. Otherwise, the data you get, thanks to your DDG capability, will be mismanaged, unavailable, or mistrusted.

Instead, the IT dynamic capability is the multi-dimensional and enterprise-wide dynamic capability to leverage IT[6]. The historical dynamic capacity to leverage IT will favor firm's IT personnel's ability to recognize the potential of emerging/enabling IT to generate and capture digital data. Good relationships between IT personnel and line management in integrating such IT within appropriate business processes is critical. The lack of IT dynamic capability would make the choice of which IT to integrate unclear, and could render later IT integration ineffective, so that digital data would be inaccessible or of poor quality, impeding its effective use.

In the case of Linky, the different ERDF's departments realized how digital data's index could improve the different offers and the global energy distribution and they worked together to develop a customer relationship management information system which could collect digital data on customer habits, particularly in terms of consumption. Then, they made these data usable to improve the integration of different available energy sources to the electric network.

4.4 Profiting from the DDG

Explaining the variation in the degree of success of business organizations is an evergreen issue in management. This is the reason why whether or not digital data provide a competitive advantage has been investigated in such study[7].

As it can be noted in Figure 11, among the companies surveyed, those that have developed high levels of DDG DC were on average able to achieve a higher competitive advantage than the competitive advantage of the companies that developed low levels of DDG DC. In such a

[6] See the following reference: Bharadwaj, A., Sambamurthy, V., & Zmud, R. (1999). *IT Capabilities: Theoretical Perspectives and Empirical Operationalization*. ICIS. Retrieved from file://D:/Documents/currentData/literature/KMv8.Data/PDF/2292765456S IT capabilities-4165351944/2292765456S IT capabilities.pdf.

[7] See the following publication for further information: Raguseo E., Vitari C., Piccoli G. (2012) *Gaining competitive advantage from digital data genesis dynamic capability: the moderating role of the environmental turbulence.* In: IX conference of the Italian chapter of AIS organization change and information systems: working and living together in new ways, Rome, 28-29 September 2012.

way, digital data create value. By a managerial point of view, managers should be more aware about the importance that digital data are acquiring nowadays and about the competitive advantage that they can gain by collecting and managing them. This advantage was about 25% higher and stayed stable in time between 2011-12 and 2013-14. A slight decreasing is, maybe, identifiable. It can be explained by the spreading of DDG in companies. The spreading of this innovation could have reduced the competitive advantage because other rival companies could have also started similar projects (Figure 11).

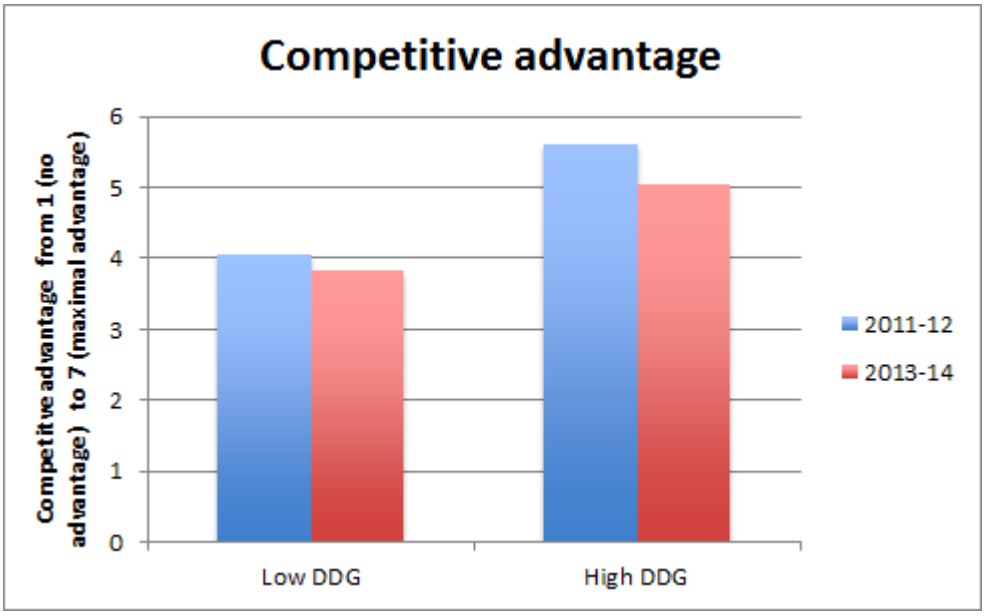


Figure 11 Competitive advantage

Investigating the companies that have effectively developed the DDG capability, we can find that some of them were really excellent in achieving a CA, while other with a similar DDG capability were having difficulties in transforming their capability in CA (Table 2). Overall, there are five types of companies:

1. "Type 1": companies that improved their DDG DC between 2011-12 and 2013-14 and that were able to transform this improvement in a substantial competitive advantage;
2. "Type 2": companies that had already developed DDG-DC in 2011-12 and that were able to keep it and then to achieve high levels of competitive advantage;
3. "Type 3": companies that had a low DDG DC in 2011-12 and that haven't improved their capacity with time and that now have a weak competitive advantage;

4. "Type 4": companies that have developed an important DDG DC in 2011-12 but that recently cut investment. This cut has had a negative impact on their competitive advantage.
5. "Type 5": companies that have strongly improved their DDG DC between 2011-12 and 2013-14 but that finally didn't succeed to convert this improvement in a competitive advantage.

We have not found yet any company with a high DDG DC in 2011-12 which kept DDG DC high over time and that didn't succeed to convert its capacity in a competitive advantage in 2013-14. However, some companies were unable to achieve a competitive advantage from the DDG DC probably for one of the several reasons:

- Probably they started recently in developing DDG capability and therefore they were not able to convert such capability into a competitive advantage, since they need time to achieve a measurable competitive advantage from the adopted technologies;
- they could be characterized by scanty strategic capabilities and vision;
- their DDG DC have been developed on a business activity that does not directly impact the competitive advantage, as there are several mediating processes that do not allow to convert the DDG DC into a competitive advantage;

Therefore, the following managerial recommendations can be given to "Type 1" and "Type 3" companies in order to:

- be fast in appropriately using the adopted technologies to convert recent DDG DC into competitive advantage;
- develop a strategic vision in order to understand the potential of the adopted technologies;
- diffuse the DDG DC throughout the other business processes where their impact on the competitive advantage is higher and more direct.

Type	DDG DC 2011-2	DDG DC 2013-4	Competitive advantage 2013-4	Companies percentage	Comments
1	Low	High	High	33%	These companies have improved their DDG DC and, over time, it seems that they've succeeded to convert their DDG DC into a competitive advantage
2	High	High	High	33%	These companies had a high DDG DC and kept it. It also seems that they have well protected their competitive advantage
3	Low	Low	Low	17%	These companies had low DDG DC and they still have a low DDG DC, which could be a reason for their weak competitive advantage
4	High	Low	Low	8%	These companies partly lost their DDG DC and it seems that their competitive advantage was negatively impacted by this reduction
5	Low	Low	Low	8%	These companies have improved their DDG DC but it seems they have not converted it yet into a competitive advantage

Table 2 DDG DC and competitive advantage

4.5 Clustering companies

In order to provide a comprehensive picture of the extent to which the surveyed companies have used data in digital forms, and the extent to which such companies have the appropriate antecedents, companies can be separated into eight main groups – Type A, Type B, Type C, Type D, Type E, Type F, Type G, Type H - according to their ability of developing low or high levels of DDG DC and their ability of developing its antecedents (Table 3).

Type A

The "Type A" companies have not developed antecedents, and therefore they have not invested in the organizational processes, in the firms' assets such as in IT infrastructures and information repository solutions, and they have low levels of firm history. As a consequence, they have not developed DDG DC.

What should they do?

They should first invest in the DDG DC antecedents, such as making investments in the organizational processes, in firms' assets and in developing IT dynamic capabilities and information dynamic capabilities, and then focusing on the usage of DDG DC for achieving a competitive advantage.

Type B

The "Type B" companies weren't able to make the conditions for adopting the DDG, and, consequently, they didn't invest in organizational process, firm assets (as IT structure and

information repositories) and they have an unfavorable history. However, they started DDG DC but their capacity is weak.

What should they do?

They first should developed the right conditions (antecedents) for DDG DC, for example by investing in organizational process, firm's assets, and developing DC in IT and information management. In such a way, they could get favorable conditions to improve their DDG capacity.

Type C

The "Type C" companies have strongly developed antecedents of the DDG DC but they have not found the right occasion to realize this potential by starting at least a first DDG project, even on a limited level, to exploit their potentiality.

What should they do?

They could do a pilot project to realize the advantages of DDG DC.

Type D

The "Type D" companies have developed antecedents, and they found the right opportunity to adopt the data in digital form (even though with low levels of DDG DC) and to exploit their potentiality.

What should they do?

They shouldn't lower their guard because we have assessed that a decrease of DDG DC can quickly decrease the competitive advantage.

Type E

The "Type E" companies have found other antecedents of the DDG DC which have not been identified by academics yet. These firms could be the source of important information in the understanding the way dynamic capabilities develop.

What should they do?

In the aim to reinforce their DDG DC, an attention should be brought to the three classical known antecedents of DC.

Type F

The "Type F" companies have developed, between 2011-12 and 2013-14, the right conditions for DDG DC in a right way and that, recently, have also exploited them.

What should they do?

They should only focus on improving the efficiency of the system developed over the years.

Type G

The "type G" companies have lost their qualities in terms of antecedents, between 2011-12 and 2013-14. This reduction had a negative impact on their DDG capacity.

What should they do?

They should try do increase the quality of their antecedents before improving their DDG capacity.

Type H

The "type H" companies have strongly developed DDG DC antecedents and also a DDG DC but their level is still weak.

What should they do?

They could easily progress in their DDG DC in order to reach the possible advantages.

Type	Antecedents 2011-2	Antecedents 2013-4	DDG DC 2013-4	Percentage of companies	Comments
A	Low	Low	Without DDG	22%	These companies hadn't got and still haven't got antecedents to start a DDG project
B	Low	Low	Low	22%	These companies hadn't got and still haven't got antecedents to develop a high DDG DC
C	High	High	Without DDG	16%	These companies have got good conditions to develop their DDG DC but they didn't convert their potential by starting DDG projects
D	High	High	High	14%	These companies had got and still have got antecedents to develop and keep a high DDG DC
E	Low	Low	High	10%	These companies found other means, not identificated by the scientific research, to develop a high DDG DC
F	Low	High	High	8%	Between 2011-12 and 2013-14, these companies developed some antecedents and they quickly succeed to apply them to get a high DDG DC
G	High	Low	Low	6%	These companies decreased their efforts concerning the development of their antecedents. This didn't allow them to have a high DDG DC
H	High	High	Low	2%	These companies have got good conditions to develop a high DDG DC but they didn't convert their potential.

Table 3 Clustering companies

5. Conclusions

Due to its novelty, the development of Digital Data Genesis provides new challenges for organizations. Some of them have difficulties in developing a cohesive DDG strategy. But it is widely recognized that dynamic capabilities are amongst the key factors explaining the different degree of success of organizations.

The Digital Data Genesis capability - ability of choosing and integrating IT to generate and capture data in digital form and managing the digital data so produced - is emerging as a crucial resource for an organization's performance and competitive advantage.

The results of such study highlight that critical factors to success with the DDG are the high-performance organizational processes of sensing, learning, coordinating, and integrating. Moreover the company must strive to develop a pervasive and integrated IT infrastructure, large information repositories, and good information and IT management processes. Indeed, these are preliminary conditions for a successful development of the DDG DC and for the achievement of a competitive advantage.

6. Further research

Future studies could focus on "type E" companies. These companies developed the DDG DC through antecedents which have not been identified by academic research yet. For this reason, they could help in understanding the way of developing DC.

Appendix 1: Questionnaire

Digital Data, Survey 2013

Thank you for your participation







This investigation is supported by Grenoble Ecole de Management, the french region Rhône Alpes and Management academic department of Verona University. All data collected by the Grenoble Ecole de Management at the individual level remains strictly confidential. Data collection has been declared to the French national privacy authority (CNIL).
You can exercise your right to access and rectify information concerning you by writing directly to Claudio Vitari: claudio.vitari @ grenoble-em.com

This investigation is based on the following 2-page questionnaire

There are 23 questions in this survey

Introduction

In order to collect consistent data among the different respondents, we request that you answer the following questions keeping in mind that with the term "**enterprise"** we refer to the smallest organizational unit, you work in, that is an autonomous business unit in its investment decisions.

1 [1]

Your Contact

Please write your answer(s) here:

Name of the Entreprise	
Tax Code of the Entreprise	
Telephone	
Family Name	
First Name	
Your e-mail	

2 [001]

In your enterprise, what are your responsibilities?

*

Please choose **only one** of the following:

- ○ You are responsible for Sales of your enterprise, or a colleague (subordinate or superior)
- ○ You are responsible for the Information Systems of your enterprise, or a colleague (subordinate or superior)
- ○ You are responsible for the Information Systems and the Sales of your enterprise, or a colleague (subordinate or superior)

3 [2]

As responsible of Sales, which position do you fill?

Only answer this question if the following conditions are met:
° ((**001.NAOK** == "SITM" or **001.NAOK** == "SM"))

Please choose **only one** of the following:

- ○ Business unit manager
- ○ Manager of the sales department
- ○ Senior sales management
- ○ Mid-level sales management
- ○ Junior sales management
- ○ Other [ ]

4 [2B]

As responsable for the Information Systems, which position do you fill?

Only answer this question if the following conditions are met:
° ((**001.NAOK** == "ITM" or **001.NAOK** == "SITM"))

Please choose **only one** of the following:

- ○ CIO/Manager of the IT unit
- ○ Senior IT manager
- ○ Mid-level IT manager
- ○ Junior IT manager
- ○ Other

5 [101]

we would like to ask some supplementary questions to the head of sales of your entreprise (called sometimes Chief Sales Officer).

Could you please provide us his/her details?

Or, in alternative, a Sales manager of your entreprise.

Only answer this question if the following conditions are met:
° ((**001.NAOK** == "ITM"))

Please write your answer(s) here:

His/Her First Name	
His/Her Family Name	
His/Her Telephone	
Email	

6 [102]

We would like to ask some supplementary questions to the head of Information systems of your entreprise (called sometimes Chief Sales Officer).

Could you please provide us his/her details?

Only answer this question if the following conditions are met:
° ((**001.NAOK** == "SM"))

Please write your answer(s) here:

His/Her First Name	
His/Her Family Name	
His/Her Telephone	
Email	

7 [4]

How many employees, full-time equivalent, are there in your company?

Please choose **only one** of the following:

- ○ 1
- ○ 2 to 9
- ○ 10 to 49
- ○ 50 to 199
- ○ 200 to 499
- ○ 500 to 1999
- ○ 2 000 and more
- ○ Don't know

8 [5]

How many sales personnel, full-time equivalent, are there in your entreprise?

Only answer this question if the following conditions are met:
° ((**001.NAOK** == "SITM" or **001.NAOK** == "SM"))

Please choose **only one** of the following:

- ○ 0
- ○ 1
- ○ 2 to 9
- ○ 10 to 49
- ○ 50 to 199
- ○ 200 to 499
- ○ 500 to 1999
- ○ 2 000 and more
- ○ Don't know

9 [6]

How many external partners do market the offer of your entreprise (ex. seller agents)?

Only answer this question if the following conditions are met:
° ((**001.NAOK** == "SITM" or **001.NAOK** == "SM"))

Please choose **only one** of the following:

- ○ 0
- ○ 1
- ○ 2 to 9
- ○ 10 to 49
- ○ 50 to 199
- ○ 200 to 499
- ○ 500 to 1999
- ○ 2 000 and more
- ○ Don't know

10 [7]

How many employees, full-time equivalent, are there in you IS department?

Only answer this question if the following conditions are met:
° ((**001.NAOK** == "ITM" or **001.NAOK** == "SITM"))

Please choose **only one** of the following:

- ○ 0
- ○ 1
- ○ 2 to 9
- ○ 10 to 49
- ○ 50 to 199
- ○ 200 to 499
- ○ 500 to 1999
- ○ 2 000 and more
- ○ Don't know

11 [3]

How would you best describe your entreprise?

Please choose **only one** of the following:

- ○ Agriculture, food and beverage
- ○ Manufacturing and mining
- ○ Construction
- ○ Wholesale and retail trade
- ○ Transportation
- ○ Finance, Insurance
- ○ Real Estate
- ○ B2B Services
- ○ Communications, Electric, Gas, Sanitary Services, public administration and other services

12 [13]

What was you annual IT expenditure (operations and investment)?

Only answer this question if the following conditions are met:
° ((**001.NAOK** == "ITM" or **001.NAOK** == "SITM"))

Please write your answer(s) here:

currency?	
in 2012?	
in 2011?	
in 2010?	
in 2009?	
in 2008?	

13 [14]

What is your source of information on these expenditures?

Only answer this question if the following conditions are met:
° ((**001.NAOK** == "ITM" or **001.NAOK** == "SITM"))

Please choose **all** that apply:

- ☐ Dashboard
- ☐ Enterprise Resource Planning
- ☐ IT expenditure report
- ☐ Other:

14 [14B]

Eventual comments

Only answer this question if the following conditions are met:
° ((**001.NAOK** == "ITM" or **001.NAOK** == "SITM"))

Please write your answer here:

Digital Data Generation

In order to collect consistent data among the different respondents, we request that you answer the following questions keeping in mind that: with the term "**Sales process**" we refer to the organized set of actions and tasks aiming at developing and managing the relationships with the customers.

Then, with the term "**Digital Data Generation**" we refer to the production or capture of data, from its inception, in digital form. Example: the use of a Personal Digital Assistant (PDA) by the waiter of a restaurant to collect orders from the customers to the kitchen is Digital Data Generation, as opposed to the use of a note pad and a pen by the waiter to collect orders to the kitchen and only subsequently inputting the order in the digital cash register is not Digital Data Generation.

Hence "**Digital Data Generation Technology**" is the Information Technology that allows the production or capture of data, from its inception, in digital form. In the previous example, Personal Digital Assistant (PDA) technology is "Digital Data Generation Technology" indeed, in the previous example, the note pad and the pen are not "Digital Data Generation Technology".

Finally, in some sentences, we invite you to evaluate the **efficacy** of specific company's practicises. We request that you answer, keeping in mind that with the term "effective" we mean : "producing the desired effect".

15 [21]

Do you produce and/or capture data from their inception in digital form, in your Sales processes (i.e. "Digital Data Generation")?

*

Please choose **only one** of the following:

- ○ Yes
- ○ No

16 [E22A]

How do you practice Digital data generation?

Only answer this question if the following conditions are met:
° ((**21.NAOK** == "Y"))

Please write your answer here:

Please give a recent example on your production or capture of data, from its inception, in digital form, in your company

17 [S22DDG]

Please rate to which extent you agree with each sentence on 7 point-scale, where 1 means "no, not at all" and 7 means "yes, very much"

Only answer this question if the following conditions are met:
° ((**21.NAOK** == "Y") and (**001.NAOK** == "SM"))

Please choose the appropriate response for each item:

	1 - no, not at all	2	3	4	5	6	7 - Yes, to a large extent
When our Digital Data Generation must evolve, our Sales personnel successfully steer its evolution	○	○	○	○	○	○	○
The integration, into our Sales process, of Digital Data Generation is effective	○	○	○	○	○	○	○
Our Sales personnel effectively handle the digital data that they obtain	○	○	○	○	○	○	○
Our Sales personnel innovate thanks to the digital data that they obtain	○	○	○	○	○	○	○
Our Sales personnel have effective methods for managing the Digital Data that they obtain	○	○	○	○	○	○	○
Our Sales personnel have effective methods for the choices of Digital Data Generation	○	○	○	○	○	○	○
Digital Data Generation is successfully integrated into our Sales process	○	○	○	○	○	○	○
Our competitors have to assume less favourable competitive postures because of our Digital Data Generation	○	○	○	○	○	○	○
Our Sales personnel effectively process the data that they obtain in digital form	○	○	○	○	○	○	○
When our Digital Data Generation Technology must evolve, our IT personnel effectively lead its implementation	○	○	○	○	○	○	○
Our IT personnel appropriately chose Digital Data Generation Technology	○	○	○	○	○	○	○
Our Sales personnel utilize the digital data that they obtain to improve our commercial offer	○	○	○	○	○	○	○

18 [IS22DDG]

For the following sentences please rate on a scale of 1 to 7, where 1 means "no, not at all" and 7 means "Yes, to a large extent".

Only answer this question if the following conditions are met:
° ((**21.NAOK** == "Y") and (**001.NAOK** == "ITM"))

Please choose the appropriate response for each item:

	1 - no, not at all	2	3	4	5	6	7 - Yes, to a large extent
Our IT personnel appropriately chose Digital Data Generation Technology	○	○	○	○	○	○	○
Our IT personnel effectively handle the digital data that they obtain	○	○	○	○	○	○	○
When our Digital Data Generation Technology must evolve, our IT personnel successfully steer its evolution	○	○	○	○	○	○	○
Digital Data Generation Technology is seamlessly integrated into our Sales processes	○	○	○	○	○	○	○
Our IT personnel effectively select Digital Data Generation Technology	○	○	○	○	○	○	○
Our IT personnel effectively process the data that they obtain in digital form	○	○	○	○	○	○	○
When our Digital Data Generation Technology must evolve, our IT personnel effectively lead its implementation	○	○	○	○	○	○	○
The Digital Data Generation Technology is seamlessly integrated into our Sales processes	○	○	○	○	○	○	○
Our IT personnel have effective methods to choose Digital Data Generation Technology.	○	○	○	○	○	○	○
Our IT personnel have effective methods for managing the Digital Data that they obtain	○	○	○	○	○	○	○

19 [SIS22DDG]

Please rate to which extent you agree with each sentence on 7 point-scale, where 1 means "no, not at all" and 7 means "yes, very much"

Only answer this question if the following conditions are met:
° ((**21.NAOK** == "Y") and (**001.NAOK** == "SITM"))

Please choose the appropriate response for each item:

	1 - no, not at all	2	3	4	5	6	7 - Yes, to a large extent
When our Digital Data Generation must evolve, our Sales personnel successfully steer its evolution	○	○	○	○	○	○	○
Our IT personnel appropriately chose Digital Data Generation Technology	○	○	○	○	○	○	○
The integration, into our Sales process, of Digital Data Generation is effective	○	○	○	○	○	○	○
Our IT personnel effectively handle the digital data that they obtain	○	○	○	○	○	○	○
Our Sales personnel effectively handle the digital data that they obtain	○	○	○	○	○	○	○
When our Digital Data Generation Technology must evolve, our IT personnel successfully steer its evolution	○	○	○	○	○	○	○
Our Sales personnel innovate thanks to the digital data that they obtain	○	○	○	○	○	○	○
Our Sales personnel have effective methods for managing the Digital Data that they obtain	○	○	○	○	○	○	○
Digital Data Generation Technology is seamlessly integrated into our Sales processes	○	○	○	○	○	○	○
Our Sales personnel have effective methods for the choices of Digital Data Generation	○	○	○	○	○	○	○
Digital Data Generation is successfully integrated into our Sales process	○	○	○	○	○	○	○
Our IT personnel effectively select Digital Data Generation Technology	○	○	○	○	○	○	○
Our competitors have to assume less favourable competitive postures because of our Digital Data Generation	○	○	○	○	○	○	○
Our Sales personnel effectively process the data that they obtain in digital form	○	○	○	○	○	○	○
Our IT personnel effectively process the data that they obtain in digital form	○	○	○	○	○	○	○
When our Digital Data Generation Technology must evolve, our IT personnel effectively lead its implementation	○	○	○	○	○	○	○
Quand nos Technologies de Génération des données numériques doivent évoluer, le personnel en charge de notre Système d'Information conduit efficacement leur implementation	○	○	○	○	○	○	○
Our IT personnel appropriately chose Digital Data Generation Technology	○	○	○	○	○	○	○
The Digital Data Generation Technology is seamlessly integrated into our Sales processes	○	○	○	○	○	○	○
Our Sales personnel utilize the digital data that they obtain to improve our commercial offer	○	○	○	○	○	○	○
Our IT personnel have effective methods to choose Digital Data Generation Technology.	○	○	○	○	○	○	○
Our IT personnel have effective methods for managing the Digital Data that they obtain	○	○	○	○	○	○	○

20 [S23A]

Rate to which extent you agree with each sentence on a 7 point scale, where 1 means "no, not at all" and 7 means "yes, very much".

Only answer this question if the following conditions are met:
° ((**001.NAOK** == "SM"))

Please choose the appropriate response for each item:

	1 - no, not at all	2	3	4	5	6	7 - Yes, to a large extent
Each member of the Sales department effectively coordinates with the rest of the Sales department	○	○	○	○	○	○	○
Our digital data are recent	○	○	○	○	○	○	○
Our information repositories *(collections of logically related data e.g., daily sales, customers correspondences)* have been long-standing	○	○	○	○	○	○	○
Our digital data are too much	○	○	○	○	○	○	○
Our Sales personnel are effective in applying the new knowledge	○	○	○	○	○	○	○
In our industry, business environment changes unpredictably	○	○	○	○	○	○	○
Our digital data are rapidly available to our Sales personnel	○	○	○	○	○	○	○
Each member of the Sales department is proactive in contributing to the collective output of the Sales department	○	○	○	○	○	○	○
Our digital data are excessive	○	○	○	○	○	○	○
Our Sales personnel effectively coordinate their different work activities	○	○	○	○	○	○	○
The range of our information technologies (e.g. applications, software, servers) have widened over time	○	○	○	○	○	○	○
Our information repositories (collections of logically related data e.g. daily sales, customers correspondences) cover a long history of events	○	○	○	○	○	○	○
Each member of the Sales personnel promptly contributes in the collective solution of the Sales department's problems	○	○	○	○	○	○	○
Our digital data cover all our data needs	○	○	○	○	○	○	○
Our Sales personnel put effectively into practice their recently acquired knowledge	○	○	○	○	○	○	○
Our Sales personnel effectively observe customers' preferences	○	○	○	○	○	○	○
Our digital data are a burden to us	○	○	○	○	○	○	○
Our digital data are incomplete	○	○	○	○	○	○	○
Our digital data contain very few errors	○	○	○	○	○	○	○
Our Sales personnel effectively employ the new knowledge about our customers	○	○	○	○	○	○	○

21 [S23B]

Rate to which extent you agree with each sentence on a 7 point scale, where 1 means "no, not at all" and 7 means "yes, very much".

Only answer this question if the following conditions are met:
° ((**001.NAOK** == "SITM" or **001.NAOK** == "SM"))

Please choose the appropriate response for each item:

	1 - no, not at all	2	3	4	5	6	7 - Yes, to a large extent
The range of our communication technologies (e.g. Web sites, call centers, telephony) have widened over time	○	○	○	○	○	○	○
The range of our network technologies (e.g. broadband, Intranet, Extranet) have widened over time	○	○	○	○	○	○	○
Each member of the Sales department effectively integrates his job with the others towards a collective result	○	○	○	○	○	○	○
Our Sales personnel set up a well-coordinated team	○	○	○	○	○	○	○
Our digital data are accurate	○	○	○	○	○	○	○
Our Sales personnel effectively look for new business opportunities	○	○	○	○	○	○	○
Our digital data are obsolete	○	○	○	○	○	○	○
In the recent past, our IT personnel have proven effective in exploiting IT	○	○	○	○	○	○	○
In the recent past, our Sales personnel have proven effective in processing information	○	○	○	○	○	○	○
Our Sales personnel effectively gather feedback from our partners	○	○	○	○	○	○	○
Our digital data are comprehensive	○	○	○	○	○	○	○
Our digital data are inaccessible to our Sales personnel	○	○	○	○	○	○	○
In the recent past, our Sales personnel have proven effective in exploiting information concerning our Sales performance	○	○	○	○	○	○	○
Our digital data are easily obtainable for our Sales personnel	○	○	○	○	○	○	○
In the recent past, our Sales personnel have proven effective in leveraging the information concerning our failures	○	○	○	○	○	○	○
Our digital data are incorrect	○	○	○	○	○	○	○
Our digital data are up-to-date	○	○	○	○	○	○	○
Our information repositories (collections of logically related data e.g. daily sales, customers correspondences) span over a long period of time	○	○	○	○	○	○	○
In the recent past, our IT personnel have proven effective in developing IT applications	○	○	○	○	○	○	○
In our industry, customers' preferences change unexpectedly	○	○	○	○	○	○	○

22 [SIS23B]

Rate to which extent you agree with each sentence on a 7 point scale, where 1 means "no, not at all" and 7 means "yes, very much".

Only answer this question if the following conditions are met:
° ((**001.NAOK** == "SITM"))

Please choose the appropriate response for each item:

	1 - no, not at all	2	3	4	5	6	7 - Yes, to a large extent
Each member of the Sales department effectively coordinates with the rest of the Sales department	○	○	○	○	○	○	○
	○	○	○	○	○	○	○
Our digital data are recent	○	○	○	○	○	○	○
Our information repositories *(collections of logically related data e.g., daily sales, customers correspondences)* have been long-standing	○	○	○	○	○	○	○
In the recent past, our IT personnel have proven effective in leveraging IT	○	○	○	○	○	○	○
Our digital data are too much	○	○	○	○	○	○	○
Our Sales personnel are effective in applying the new knowledge	○	○	○	○	○	○	○
IT changes unpredictably	○	○	○	○	○	○	○
In our industry, business environment changes unpredictably	○	○	○	○	○	○	○
Our digital data are rapidly available to our Sales personnel	○	○	○	○	○	○	○
	○	○	○	○	○	○	○
Each member of the Sales department is proactive in contributing to the collective output of the Sales department	○	○	○	○	○	○	○
Our digital data are excessive	○	○	○	○	○	○	○
Our Sales personnel effectively coordinate their different work activities	○	○	○	○	○	○	○
In the recent past, our IT personnel have proven effective in carrying IT projects	○	○	○	○	○	○	○
The range of our information technologies (e.g. applications, software, servers) have widened over time	○	○	○	○	○	○	○
Our information repositories (collections of logically related data e.g. daily sales, customers correspondences) cover a long history of events	○	○	○	○	○	○	○
IT innovations are hardly foreseeable	○	○	○	○	○	○	○
	○	○	○	○	○	○	○
Each member of the Sales personnel promptly contributes in the collective solution of the Sales department's problems	○	○	○	○	○	○	○
Our digital data cover all our data needs	○	○	○	○	○	○	○
Our Sales personnel put effectively into practice their recently acquired knowledge	○	○	○	○	○	○	○
Our Sales personnel effectively observe customers' preferences	○	○	○	○	○	○	○
Our digital data are a burden to us	○	○	○	○	○	○	○
Our digital data are incomplete	○	○	○	○	○	○	○
Our digital data contain very few errors	○	○	○	○	○	○	○
Our Sales personnel effectively employ the new knowledge about our customers	○	○	○	○	○	○	○

23 [IS23]

For the following sentences please rate on a scale of 1 to 7, where 1 means "no, not at all" and 7 means "Yes, to a large extent".

Only answer this question if the following conditions are met:
° ((**001.NAOK** == "ITM"))

Please choose the appropriate response for each item:

	1 - no, not at all	2	3	4	5	6	7 - Yes, to a large extent
Our digital data are rapidly available to our Sales personnel	○	○	○	○	○	○	○
In the recent past, our IT personnel have proven effective in leveraging IT	○	○	○	○	○	○	○
IT changes unpredictably	○	○	○	○	○	○	○
Our digital data are inaccessible to our Sales personnel	○	○	○	○	○	○	○
In the recent past, our IT personnel have proven effective in carrying IT projects	○	○	○	○	○	○	○
IT innovations are hardly foreseeable	○	○	○	○	○	○	○
Our digital data are easily obtainable for our Sales personnel	○	○	○	○	○	○	○

Thank you for your participation

01-01-1970 – 01:00

Submit your survey.
Thank you for completing this survey.