

Big Data as a growth factor in Danish business – potential, barriers and business policy implications

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Bridging business needs
and innovation policy



Foreword

“More data was created in 2011 than in the whole of human history, or at least, since the invention of the alphabet”

OECD Observer, 2011¹

“Big data” is a concept arising from the explosive growth in data led on by the continued digitisation of society.

Today, the automation and digitisation of enterprises lead to the storage of vast amounts of data from manufacturing, transactions and customer behaviour. In the public sector digitisation has resulted in registration of more and more information derived from individuals, enterprises, properties, geographic characteristics etc. The emergence of social media, smart phones and other consumer goods such as PCs, tablets and digital cameras has resulted in significant growth in data volumes from individual consumers.

At the same time, technologies for handling, analysing and exploiting large volumes of data has improved significantly.

For the businesses this trend allows for transforming large volumes of data into, for example, new services, improved products and marketing efforts targeting different customer segments. Several international studies points to the huge potential offered by big data and suggest that enterprises that focus on big data outperform their peers.

Therefore, it is vital that business policies take into account this emerging trend and addresses initiatives that can be implemented to promote the proliferation of big data in Denmark.

This analysis serves two main purposes:

Firstly, to map tangible examples of how Danish enterprises address big data and what benefits may be achieved in doing so.

Secondly, to highlight key barriers that either delay or limit Danish enterprises (small and medium sized business in particular) in their ability to exploit big data potential and in continuation hereof to draft recommendations for various business policy initiatives.

The conclusions and recommendations presented below are based on a number of in-depth case studies and interview with companies that are regarded as Danish big data pioneers in the area. In other words, we have focused on companies that have taken initial steps in the area of big data, and

¹ See http://www.oecdobserver.org/news/fullstory.php/aid/3921/Can_big_data_deliver_on_its_promise_.html

which have gained insight into the challenges and opportunities related to big data and data-driven business development.

The report is structured as follows:

Chapter 1 summarises the results and presents the most important recommendations for business policy initiatives.

Chapter 2 investigates the concept of big data and highlights the methodology applied throughout the analysis.

Chapter 3 highlights big data trends across Danish businesses. Who are the pioneers? What are the driving forces? How is big data typically used? And what benefits have been realised until now?

Chapter 4 discusses the impact of big data and data-driven business development with regards to management, organisation and skills requirements.

Finally, in Chapter 5, we analyse the key challenges and barriers that exist in big data and data-driven business development. In continuation hereof, the report introduces a number of business policy initiatives.

The report has been compiled by partner Jens Nyholm and consultant Louise Conradsen (Both from IRIS Group). The report has been supervised by a sparring group, whose members include professors Børge Obel and Jacob Kjær Eskildsen and special advisor Pernille Dissing Sørensen (Interdisciplinary Centre for Organizational Architecture at Aarhus Universitet). Preliminary results and conclusions have been the subject of ongoing discussions with a Steering Group consisting of employees from the Danish Business Authority.

Enjoy the reading!

Chapter 1

Summary, perspectives and recommendations

1.1 BIG DATA AND DATA-DRIVEN BUSINESS DEVELOPMENT

In recent years, big data has been the topic of much discussion in the Danish business world, among researchers, across international forums and in media business sections. This discussion has in part been sparked by a number of international studies that point to the significant economic potential of big data. Examples include:

- An MIT study showing that enterprises that engage in big data outperform other enterprises by 5 to 6 percent in terms of profits.²
- A Zangerberg and Co. report pointing to a market potential of 20 billion DKK in the energy and construction sector.³
- In a 2011 report McKinsey Global Institute suggests that big data may lead to an increase in profit margins by as much as 60 percent in retail⁴.

There is no uniform definition of big data; however in an international context big data is often defined in accordance with the three Vs:

Volume: The massive and exponentially growing volumes of data generated and stored by enterprises, individuals and public authorities.

Velocity: The growing speed with which data can be stored and analysed, in part as the result of the growing calculating power of high-performance computers.

Variety: The growing number of data sources available to enterprises and which today are easily collected and communicated through, among other things, broadband and mobile technologies. Data may be derived from computers in production, sensors, social media, customers, website traffic, internet text files, digital cameras, public data sources etc.

If applying the international definition big data is a technology, which allows for collecting, analysing and exploiting large volumes of data from various data sources.

The present analysis will provide insight into how Danish enterprises work with data and big data, and what it will take to realise the full potential found in Danish business.

² McAfee og Brynjolfsson (2012); "Big Data: The Management Revolution", Harvard Business Review

³ Zangerberg & Co. (2012); "Quantifying public data"

⁴ McKinsey Global Institute (2011); "Big data: The next frontier for innovation, competition, and productivity"

From the onset our analysis shows that big data is by no means an unambiguous concept and that the interpretation, understanding and application of big data will vary across enterprises.

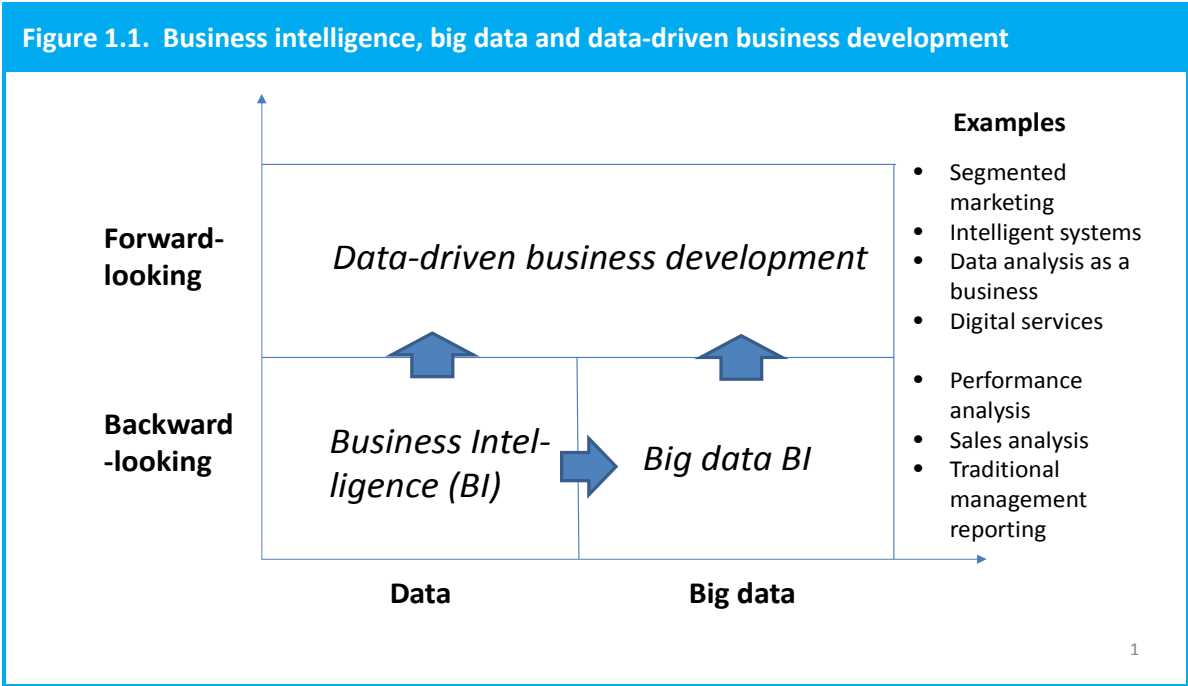
In order to interpret and discuss data trends in Danish business we find it relevant to distinguish between *data*, *big data* and *data-driven business development*.

Data in large volumes as well as extensive data analysis has for many years served as an important decision platform for Danish businesses. A large number of enterprises have built *Business Intelligence* units that have significant experience in analysing and structuring data from sales, financials, transactions, salaries, performance etc.

Big data is, first and foremost, a testament to the significant growth in the magnitude and breadth of data use. The transition from data to big data typically implies that enterprises venture into including data from among others customers and suppliers, production sensors, public data sources, social media etc. This data may be accumulated from the enterprise’s own systems and may through investments in improved computing power be used for better decision-making. Areas may include which customers yield the best returns, which suppliers are most effective, the customers’ perception of the enterprise and its products etc.

Data-driven business development evolves around using data and data analysis in business development. Rather than using data to investigate what has worked (or not worked) in the past, data now becomes a platform for *how* to market the enterprise, how to carry out product development or how to best service customers. One example is how marketing can be targeted to reflect data collected on individual customer profiles (gender, age, residence, previous purchases etc.). Another example is to use data from production sensors to provide continuous advice to customers on use or energy consumption or for further product development.

The three concepts are highlighted in the figure below.



Source: IRIS Group

There is a close link between big data and data-driven business development as new data sources and combinations of internal and external data are often the platform for data-driven business development. Yet, a company may be successful in data-driven business development and not be a big data enterprise in the international definition of the term (the three Vs). They may concentrate their efforts on singular data sources and limited amounts of data.

The initial phase of the analysis attempted to carve out – through desk research and interviews – big data pioneers in Denmark, in particular among small and medium sized business. During our research we did, however, reach the conclusion that big data – defined as large volumes of data, analysis based on combinations of many data sources, and high-performance computing power – is a relevant issue to only a limited number of Danish enterprises.

Today, only a handful of enterprises – even among some of the largest enterprises – collect and use social media data.

On the other hand, our research indicates that data-driven business development in many ways encompass the competitive nature of Danish enterprises, regardless of size.

Among a few large enterprises data-driven business development is based on data volumes, data sources and computing power that qualifies them to meet the international definition of big data (the three Vs). The same applies to certain highly specialised big data entrepreneurs that supply big data analysis to large enterprises and to the public sector.

Most of the interviewed data pioneers have taken gradual steps and have in recent years invested in, among other things:

- Improved registration and updating of own data.
- Use of new data sources (such as public data) in combination with own data.
- Improved data analysis software and tools.
- Skilled analysts.

In doing so, we have identified higher data volumes and the use of multiple data sources and stronger computing power in enterprises that have worked with data-driven business development. Still, only a handful of those enterprises will match the requirements for equipment and software investments that characterise big data pioneers such as Vestas (see Chapter 3), an enterprise that deals with massive data volumes.

When applying the term big data throughout the report we do not propose this to be a rigid definition tied to the number of stored bytes, a specified number of data sources, the use of super computers or similar characteristics.

In our definition big data is an overarching expression for the amount and composition of data that challenges the individual enterprise in its efforts to make decisions and business development increasingly data-driven.

While the precise mapping of the extent of big data or data-driven business development across Danish business has not been the focus of the analysis, our research has, however, given us insight as to why big data and data-driven business development remain a focus for only a handful of Danish pioneers.

This serves to confirm the conclusions from a recent international study, which shows that most IT-departments, even among some of the largest Danish enterprises, have not yet addressed the issue of big data. And that Danish business is lagging behind a number of European countries.⁵

Our research shows that the "pioneer group" in the Danish big data and data-driven business development area by and large encompasses two types of enterprises:

One group consists of young entrepreneurial enterprises which were born data-driven and which at an early stage have been successful in utilising access to various public core data. This group of enterprises are comprised of advisory and consulting firms that deliver big data analysis to other enterprises and public authorities. The group also covers innovative enterprises that have proved successful in using data to challenge more traditionally run enterprises in retail, catering, real estate etc.

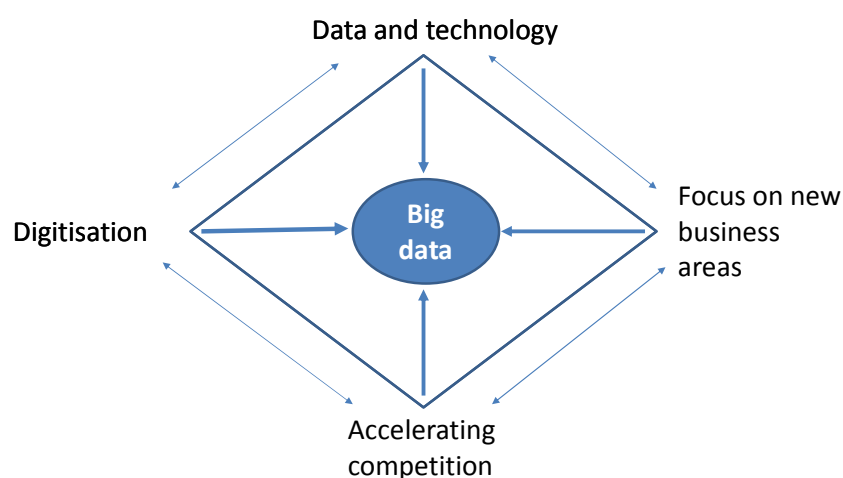
A second group consists of larger enterprises that have already built extensive Business Intelligence departments and which therefore have the skills needed to use data actively in their decision making processes.

On the other hand, our research points to a limited number of established SMVs among the front-runners in big data and data-driven business development. We have only identified a handful that are characterised by having a long tradition for data collection or by being engineer-focused by nature.

The reason behind this lies in what the report terms the four driving forces of data-driven business development; data/technology, digitisation, accelerating competition and emerging business models (Figure 1.2).

⁵ Interxion (2013); "Big data – Beyond the hype." Study carried out by Vanson Bourne.

Figure 1.2. The most important drivers in Big data and data-driven business development



Source: IRIS Group

The four headlines encompass the key driving forces and prerequisites for enterprises endeavouring into big data and data-driven business development.

First of all, the sophisticated use of data, of course, presupposes a high knowledge and skills level in the area of data, technology and data analysis. At the same time, data-driven business development requires an interest in data at the management level and a desire to allow strategic decisions to be governed by data rather than experience or “gut feeling”.

Secondly, big data and data-driven business development cannot be viewed independently from the enterprises’ general level of digitisation. A higher level of digitisation will lead to more extensive collection and storage of data, which in turn makes it easier to move, integrate and use data. In that respect the low level of digitisation for many SMEs remains a challenge according to a recent study⁶.

Thirdly, big data trends are driven by the competitive landscape in each individual business sector. Big data is one of several roads to pursue when attempting to distinguish your enterprise from international competitors that primarily compete on price.

Fourthly, big data and data-driven business development are closely linked to the development of new business models. Often, it will be the transition from one business model to another that drives big data. Industrial enterprises may distinguish themselves from international competition by developing concepts, where service and advice is tied to product itself. In that respect, data becomes an important theme, as the continuous collection of data related to the product may constitute an important part of the service.

⁶ IRIS Group (2013); “Digitisation of Danish Business”. Commissioned by the Danish Business Authority.

The initial steps when endeavouring into new business models within a specific business sector will often be driven by innovative entrepreneurs with novel ideas or from larger enterprises with large R&D departments.

The report highlights several examples of young enterprises that challenge existing value chains and business models through the innovative use and combination of various data sources.

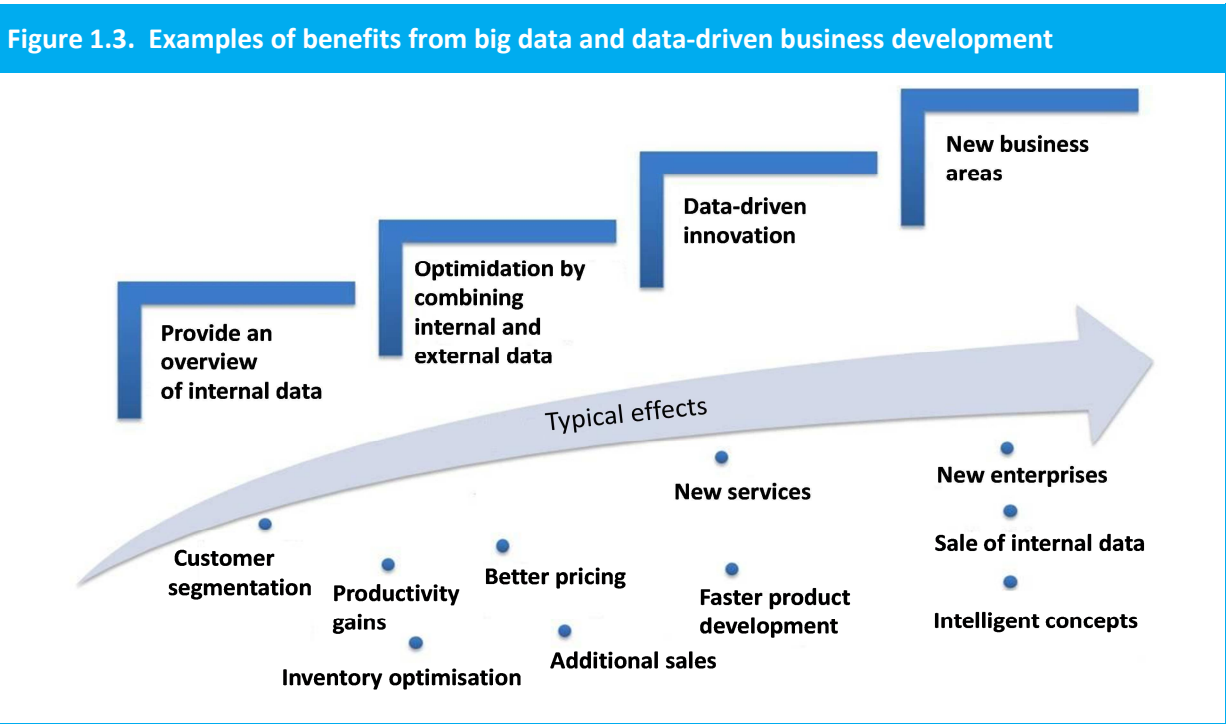
All four drivers are vital in terms of enterprises making investments in big data and data-driven business development. They make up the platform for rendering meaning to big data strategies and hold the potential for further development of the enterprise.

The characteristics of the driving forces logically imply that larger enterprises and data-driven entrepreneurs dominate the initial phase of big data adoption. For most SMEs the implementation of big data strategies will require substantial investments in digitisation, technologies, new employees and changes in the way the business is managed. In that respect it should come as no surprise that the majority of SMEs are somewhat reluctant and may have to be convinced by successful best-practice examples from competitors or other business sectors.

1.3 BENEFITS AND POTENTIAL

Many of the interviewed enterprises have only just begun to reap the benefits from big data and data-driven business development. However, the analysis points to a number of benefits and potential in the area.

Figure 1.3 provides an overview of various types of expected or realised benefits among the interviewed enterprises.



Source: IRIS Group

The figure shows that the gains from big data and data-driven business development can be summarised into four headlines related to how enterprises use data.

For most *established* enterprises the first steps involve gaining a better overview, structure and coherence of the enterprise's own data. At this level data is used to gain insights into the enterprise's customer base. Data may also be used to optimise internal processes and make them more effective, which in turn will strengthen productivity.

The following steps include using internal data in combination with external data to target marketing efforts, provide better pricing, predict sales and inventory levels etc. External data may include profile data on customers and consumers collected from public data sources or from private suppliers of statistical information on individuals.

A number of the interviewed enterprises actively use data to develop better products and services. Several enterprises use internet user "fingerprints" for continuous product enhancements. Other data sources may include social media feedback data related to new products or embedded product data used for offering specific services.

Finally, as illustrated in the right hand side of the figure big data holds the potential for building a range of entirely novel business areas. This may take place in both existing enterprises and in new enterprises. The pioneer group includes new enterprises that deliver data analysis and data advisory services to other enterprises and to public authorities.

To existing enterprises new business areas may include the sale of internal data to other enterprises. Big data technologies may also constitute the platform for building intelligent systems such as household units that may communicate with each other (intelligent concepts).

Box 1.1 presents examples of some of the benefits achieved across the four areas.

Box 1.1 Examples of benefits from big data and data-driven business development

Gaining insight into own data:

- *Grundfos* has implemented an extensive Enterprise Resource Planning (ERP) system, which stores internal transaction data, production data, logistics data etc. The system is used for various analyses, which have led to more effective production and working progress.

Optimisation by combining internal and external data:

- An insurance company uses big data analyses to select and segment potential customers in preparation for tele/marketing campaigns. This has led to a three doubling in success rates (the number of sold products as a share of the total number of households).
- *SAXO.com* (an internet bookstore) has combined internal sales data with external demographic data to devise a recommendation algorithm, which is used to provide recommendations for a new book once the buyer has placed his or her first purchase in the shopping cart at saxo.com. This led to an immediate increase in sales of 12 percent.

Data-driven innovation:

- *Migatronik* has developed an intelligent welding machine that supervises welding processes providing 50 000 reports every second to supervise welding processes. This provides key information on

the product performance as well as individual welder performance. Migatronik uses the data to provide information on better use of the product and for the rapid registration and follow-up on potential error messages.

- *Hapti.co* develops online gaming products. The company uses data fingerprints from costumers using their gaming products for product development purposes including defection patterns for specific age groups, which would indicate that certain game sequences may be too boring or too complicated.

New business areas:

- Established in 2012 *Dataprocess* already employs more than 20 people. The company is specialised in data pooling for Danish municipalities (using municipal data) used for error detection, identifying cost savings areas and detecting social fraud.

Hence, the analysis shows that big data and data-driven business development may yield substantial returns across the entire value chain; from development, over production and quality control, to sales marketing and services.

The limited number of pioneers and the fact that gains have only just been realised would imply that the societal effects of big data remains negligible. On the other hand, the interviews carried out do suggest that big data and data-driven business development could potentially be a key factor in boosting Danish productivity growth.

International studies point to a similar picture. In 2011 McKinsey Global Institute carried out the most comprehensive study on big data at that time, which among other things estimated the potential gains across five business sectors. The study concluded that big data *per se* has the potential for boosting productivity growth in the life science sector by 0.7 percent on an annual basis and that the use of big data in certain industry sectors could potentially reduce productivity costs by as much as 50 percent.

The impact of big data in an international context

The purpose of this analysis has not been to benchmark Danish business against our peers.

However, as mentioned above an international study points to a slower adoption of big data in Denmark compared to other countries. The Danish business structure, which is dominated by a large share of small and medium sized business, supports the notion that Denmark may not be progressing as rapidly as other countries. The fact that we have identified only a handful of pioneers (large enterprises and emerging, data-driven entrepreneurs) would further serve to underline this assessment.

On the surface it would appear the slow implementation of big data in Denmark would point to a loss in competitive power.

However, it is important to stress that big data is also becoming a differentiating factor for enterprises engaged in price competition. In that respect big data becomes another tool that enterprises may use in dealing with competition from enterprises across Asia and Eastern Europe that primarily compete on price and traditional quality parameters.

If the potential is to be utilised it is vital that initiatives be implemented to strengthen the SMEs' focus on digitisation and data-driven business development.

In addition, many of the interviewed enterprises highlight a unique Danish potential. Denmark is a highly regulated society and has one of the world's most digitised public sectors and thus has a unique starting point for big data adoption compared to most other countries.

The nature of Danish business structure, being dominated by a large proportion of SMEs with only a limited tradition for data handling, does make it somewhat unrealistic that the speed of datafication can match that of countries like the United States and Germany.

Due to the richness of its data sources Denmark could become a hotspot or experimental lab for developing new products and services based on the creative use – and combination of – various data sources, not the least public data. The fact that we have witnessed in recent years the emergence of a number of new enterprises that rely on easier access to public data underlines the opportunity and potential.

"Once the regulatory framework is in place there will be a significant market for data trade and data analysis. This offers a massive potential for Denmark. Denmark is a highly digitised country, which registers massive amounts of data. Denmark could become the hotbed for the next big data adventure."

Morten Lindblad, founder, Dataprocess

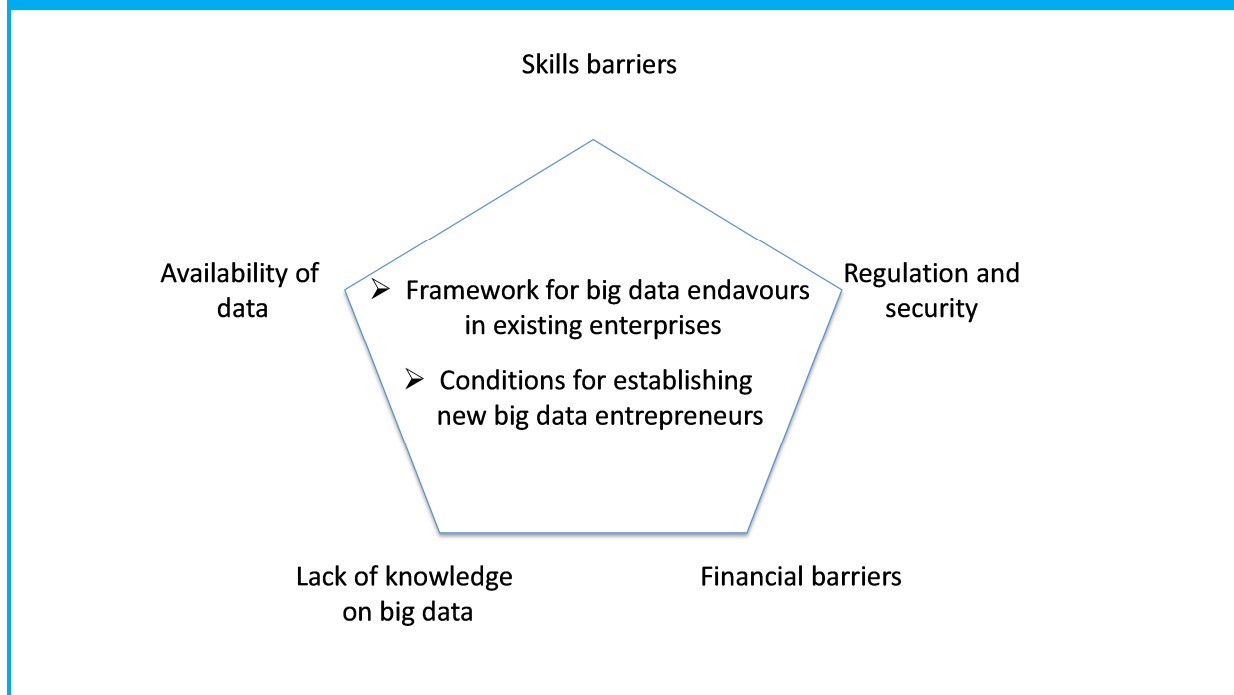
The present analysis attempts to provide a broad image of the competitive landscape of current big data pioneers. The next step would ideally be to map specific Danish opportunities in big data (health and energy, for instance) and how these opportunities may be realised through various research and innovation projects, intelligent public demand and easier access to data.

1.4 BARRIERS

During the interviews we have attempted to uncover the most important barriers for big data and data-driven business development. Barrier and challenges have also been a discussion point in a policy workshop, which was attended by enterprises, consulting firms, researchers and public authorities.

Overall, the five types of barriers will play an important role in the proliferation and utilisation of big data and data-driven business development in Danish business (Figure 1.4).

Figure 1.4. Overview of key barriers for the proliferation and use of big data and data-driven business development



Source: IRIS Group

As illustrated above the most important barriers are a combination of *internal barriers* related to skills, lack of knowledge and financial challenges and *external barriers* related to data access (in particular access to public data) as well as regulation and security.

The barriers sketched out will impact trends in existing enterprises and will also impact the creation of new data-driven entrepreneurial enterprises.

Below, we summarise the most important issues related to each of the five areas. The barriers are further detailed in Chapter 5.

Skills barriers

Issue #1. Shortage of analysts

Several companies voice concerns related to their future ability in recruiting highly specialised analysts. We are currently seeing signs of a shortage of mathematicians, data engineers, statisticians etc. This is also reflected in the increased market value of analysts. In the event that big data and data-driven business development takes off on a major scale the lack of available analysts may pose a serious problem.

Issue #2. Analysts lack business understanding

Most mathematicians, data engineers, economists, statisticians etc. are not equipped with technologies or issues related to big data or data-driven business development. Today, data handling and data analysis are closely tied to business development. Hence, it remains a natural element in data-driven business development for analysts to assume a larger responsibility for drafting new ideas for new services and for communicating data and results that may be used in the day-to-day business. This

will require that analysts possess a business-oriented approach and take on the role as sparring partners for the rest of the organisation.

There is a lack of educational programs focusing on building a bridge between data analysis and business development. At the same time one should stress the importance of existing education focusing more on issues, tools and data types that characterise big data and data-driven business development. Among other things, efforts should be made to empower future analysts to be able to work with large volumes of data, data of varying quality, unstructured data etc.

Issue #3. Shortage of skills at the executive level

Executives often lack the skills needed to interpret and use data actively for business development purposes. Many Danish enterprises are not accustomed to handling data and are thus not able to use data for decision making purposes, product development etc.

The proliferation of big data in Danish business will most likely require targeted training programs and best-practice cases that executives may draw inspiration from.

Availability of data

Issue #4. Improved access to public data.

Access to public data has improved significantly in recent years. The release of a series of public core data on January 1, 2013, has been one of the key reasons behind this. However, enterprises do see room for improvement:

- Public data that has not yet been made available (including energy tags, hydro maps, health-related data etc.).
- In an international context data costs (i.e. data from Statistics Denmark) are regarded as being very high.
- It remains difficult for many Danish enterprises to gain an overview of relevant public data that may be interesting from a business perspective.
- A significant level of uncertainty and lack of knowledge among many public authorities in terms of how to provide enterprises with access to public data.

In other words, we see a continued untapped potential in improving enterprise access to public data that may be used for business-related purposes.

Regulation and security

Issue #5. Ambiguous regulation of personal data

A large share of the pioneers in data-driven business development use – or would like to use – personal data for marketing or product development purposes. The collection, handling and storage of data are subject to EU regulation, which aims to balance considerations regarding consumer protection, consumer trust and the innovative use of data.

Current EU legislation has been overhauled by technological opportunities related to coordinating data records and the fact that citizens voluntarily submit personal data via the internet. This leads to a number of uncertainties regarding legality. At the same time enterprises are faced with divergent interpretational and sanctional practices across borders.

It remains vital that enterprises can act prudently with regard to handling personal data and that efforts be made to de-mystify the use of personal data, i.e. that consumers are provided with information on what data is used for and how the use of personal data can be beneficial to both consumers and enterprises.

Lack of knowledge on big data

Issue #6. Executives lack knowledge the potential of big data, especially among SMEs

One of the key reasons behind the reluctance in big data adoption is the general level of uncertainty and lack of knowledge of its potential. The area is quite new and there are limited illustrative cases available today. This poses a significant challenge in calculating additional sales opportunities, productivity gains, better service agreements etc.

A significant level of uncertainty coupled with a lack of analytical skills among SMEs constitutes a significant barrier to the rapid proliferation of big data and data-driven business development.

Issue #7. Limited access to sparring

The lack of adequate sparring and inspiration for the use of big data remains a barrier for the adoption of big data across Danish enterprises. The private sector development system has limited skills available in terms of uncovering the potential for big data use and the impact on management and organization in using big data for business development purposes. At the same time, there is a scarcity of networks and best-practice cases available to serve as inspiration.

Financial barriers

Issue #8. Big data is an expensive and difficult endeavour

The costs associated with building a big data organization are substantial and will challenge many small and medium sized businesses. This will require investments in employees with analytical expertise, hardware and software investments, management resources and resources for purchasing external data and external consulting services. Given the uncertainties of the magnitude of its potential most enterprises will be somewhat hesitant in addressing big data.

1.5 BUSINESS POLICY IMPLICATIONS

A key purpose of the analysis has been to come up with ideas for business policy initiatives that will strengthen the proliferation of big data and data-driven business development. In that respect we have embarked on finding the answers to three key questions:

- Which initiatives and framework conditions are vital for enterprises that have already endeavoured into big data to further utilise the potential?
- How can existing companies be persuaded to address big data and data-driven business development?
- Which initiatives will facilitate the creation of additional growth-enterprises in the area?

It should be stressed that most of the responsibility lies at the executive level. Danish enterprises must build the knowledge and insights and make the necessary investments. However, business policies may play a pivotal part in eliminating some of the key barriers that exist in terms of big data and adoption and to increase the potential for those enterprises that have already taken the first steps.

In box 1.2 below we have highlighted five key initiatives that would contribute significantly to providing a significant boost in the three areas highlighted above. The initiatives are further detailed in Chapter 5 along with a number of supplemental proposals.

Box 1.2. Five key initiatives that will strengthen the proliferation and benefits of big data and data-driven business development in Denmark

1. Launching a big data campaign:

- We recommend to launch a national campaign with the aim of 1) strengthening interest – and insight – in big data, in particular among small and medium sized businesses, 2) demystifying big data to convince more enterprises that big data is relevant and should be considered a natural step in the evolution of an enterprise and 3) focus on the economic aspects of big data among authorities and knowledge institutions.
- The campaign would evolve around regional conferences, information meetings and various information materials that focus on best-practice examples from various business sectors. A national web site on big data, cases, Q&A, conference and meeting information, networks, training etc. would be beneficial in that respect.
- As part of the campaign we propose the introduction of a temporary big data “voucher scheme” where SMEs may receive funding to cover as much as 50 percent of the costs (to a certain limit) associated with launching big data initiatives (funding for consultancy services in relation to feasibility studies and drafting of business cases).
- We propose to set up a team of experts (experienced analysts with a keen understanding of business) within the confines of the Growth Houses or the Danish Technological Institute to assist enterprises - free of charge - to pursue big data or data-driven business development.
- The campaign could be organized in collaboration among authorities at the state level, relevant organisations and the supplier chosen for the task.

2. Strengthening education in big data:

- A significant boost in education related to big data, including 1) new academic programs combining it/data analysis and business development, 2) a stronger focus on big data issues and business-related use of data within existing educational programs, 3) targeted, case-based executive training programs for using data in decision making processes and for general enterprise development.
- A first step would be to set up a big data education council consisting of researchers, relevant department heads and representatives from consultancy firms and big data pioneers. The Council will produce tangible recommendations for new academic programs and practices within the existing educational framework.

3. Improved access to public data

- We propose that the government drafts a strategy for data access including the opportunity for allowing access to non-sensitive personal data at attractive/reasonable conditions.
- The strategy should take into account several areas including 1) releasing volumes of public data, which is not available today, 2) addressing the cost of purchasing data, in particular data from Statistics Denmark, 3) access to information on relevant public data, 4) standard conditions and standard contracts for the purchase and use of public data, and 5) a state-level obligation to publicise data in

easily accessible formats.

- In continuation of the strategy it would be prudent to launch a one-stop web site for public data including access to relevant public data by relevant category. We further propose to establish a service entity that will function as a joint point of entry for enterprises seeking assistance and information for the use of public data.

4. Secure and legit use of personal data

- We propose setting up a national entity to provide guidance to enterprises to the proper interpretation of personal data legislation. The entity will publish manuals and other relevant information on best practice in data processing.
- The entity will offer advisory services and will counsel and educate enterprises and authorities on relevant techniques for avoiding personal identification when dealing with multiple data sources.

5. Big data entrepreneurship program

- Efforts should be made in the coming years to facilitate the start-up of data-driven entrepreneurial enterprises with new business ideas. The entrepreneurship program should focus on utilising the high quality of public data in Denmark and will become a cornerstone in making Denmark an exploratorium for the innovative use of public data.
- Supporting big data entrepreneurs may be achieved by allocating funds for interdisciplinary projects across Danish universities, where researchers, enterprises and authorities collaborate on the use of public data. The ultimate goal of the projects will be to identify business opportunities and build business cases that will lead to the creation of new enterprises.
- As part of an entrepreneurship program we propose the creation of 1 or 2 incubator “hotspots” for big data entrepreneurs. This will help facilitate knowledge sharing and provide access to relevant sparring and expertise.
- Finally, we propose the launch of an annual “Big Data Innovation Cup” which will award the best business ideas in the area of utilising public data. We suggest that 3 annual awards be launched targeting students, entrepreneurs and already established enterprises.

Based on the research carried out it is our assessment that the five focus areas collectively will boost big data adoption and data-driven business development in the foreseeable future.

The five focus areas supplement each other in that:

- Educational efforts, easier access to public data and improved framework for the use of public data will have an impact on enterprises that have already journeyed into big data and data-driven business development (as highlighted in Chapter 5 regarding the enterprises’ prioritisation of business policy focus areas).
- A big data campaign will first and foremost drive more enterprises to actively address big data and data-driven business development.
- A big data entrepreneurship program and easier access to public data will support the emergence of new enterprises including enterprises in the area of big data analysis and big data consultancy.

In the short term, priority should be given for launching a big data campaign and drafting a government strategy for public data access.

Priority should be given to strengthening big data in existing education and training. This will first and foremost a thorough discussion with universities and leading companies as to how the efforts are

organized including a discussion of initiatives that are already available across educational institutions.

Once again it should be stressed that the area of big data is not yet fully understood and will require further clarification. Future studies of big data will undoubtedly lead to new insights, uncover emerging potential and chart further barriers and possible adjustments in the existing framework conditions.