CHAPTER 14

From analytic to predictive digital performance measurement - A new challenge for controlling

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ABSTRACT

Recently, digital technology enables companies to use a large amount of variety information with high velocity which could be used in decision – making. The focus is on «Big Data» which enables that vast amounts of transactions are quickly created from a wide variety of sources. Due to data and information explosion we need more than ever to develop analytical methods and models that will satisfy efficient business decision making. Controlling as one of the important functions in any company that provides analytical processing and creation of information for decision-making purposes is now deeply affected by the challenges of digital technologies. Analytic or retrospective view of performance measurement is changing to predictive or proactive. Big Data enables controller's to use more accurate data and develop forward-looking measures. The emphasis is on the prediction of future problems or identification of potential opportunities which will lead to the growth of added value. As a result, the role of controllers as a business partner needs to be further strengthened through its holistic analytical prospective thinking that will contribute to more efficient decision making.

The aim of this research is to present possibilities for controlling on regard of digitally oriented performance measurement and proactive role in decision making. The goal is to develop a conceptual model of "digital proactive/prospective controlling" useful for predictive analysis in any company using a range of "information literacy". The research is based on case study method followed by interviews with controllers and responsible management in key positions of selected companies.

Key words: digitization, performance measurement, controlling, prediction,

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1. Introduction

Today in the global world the number of information is enormously increasing and therefore selection need to be made for decision making purposes. Decisions are made on the basis of analytically processed data and the decision-making itself is a process of making choices from a number of alternatives for the purpose of achieving desired results (Eisenfuhr, 2011). Respectively, it is 'the process of making choices by identifying a decision, gathering information, and assessing alternative resolutions' (Atstaja et al, 2017: 26). One of the most important steps, on which the final decision depends mostly, is the information gathering and analysis through adequate methods and models. In today's era of Big Data and more than ever digitalized technology companies are enabled to use a large amount of variety information with high velocity. Therefore, we need more than ever to develop analytical methods and models that will enable efficient business decision making suitable for todays and future fast-growing environment. Like in all other corporate functions (Vasarhelyi et al., 2015) the Big Data effect has also deeply affected controlling, as one of the most important functions for providing analytical processing and creation of information for decision-making in any company. Hence, the performance management shifts from reactive analytic to proactive and predictive analysis (Kieninger et al., 2016). Together with that the role of the controller as a register, navigator, innovator and business partner (Weber and Schäffer, 2014, Möller et al., 2017) needs to be further strengthened through its holistic analytical prospective thinking that will contribute to more efficient decision making. Only companies that will consistently adapt to further trends and be able to predict their outcomes will be capable of surviving and developing. Therefore, it is of great importance that controllers have the ability of developing forward-looking measures and make performance measurement adjustable to the digital area. Big Data is the concept that enables them to do that more precisely than ever before. Who is the person who will be in charge i.e. have the knowledge to collect the required data and information from an unstructured pile of data, is the question that arises due to the information role of controllers. Will that be the task of the controller or the data scientist i.e. will the controller be forced to become a data scientist to survive in an era of digital data and will the role of controller in general be changed? How will that impact the performance measurement system? All this questions arises from the growing need for prediction of future problems and identification of potential opportunities which lead to the growth of added value.

Therefore, the aim of this research is to present the possibilities for controlling on regard of digitally oriented performance measurement and his proactive role in decision making. More accurate, the goal was to develop a conceptual model of "digital proactive/prospective controlling" useful for predictive analysis in any company using a range of "information literacy". In order to develop the model a literature review of current Big Data impact on controlling was carried out, followed by interviews with controllers and responsible management in key

positions of selected Croatian companies. The primary findings are that the controllers role will be party change due to the new digital era through constant skills and knowledge improvements.

2. Digitalized controlling - a review of literature

During past few years the term 'Big Data' has been defined from many authors. Boyd and Crowford (2012 :663) define it as a cultural, technological, and scholarly phenomenon that rests on the interplay of technology, analysis and mythology. Moffitt and Vasarhelyi (2013: 2) called it - the "pervasive phenomenon of Big Data, while Gray and Alles (2015: 26) called it the "black data". According to Giri and Lone (2015) it is used as a term for a collection of data sets so large and complex that it becomes almost impossible to process them due to the multiplicity, heterogeneity and autonomy of the sources of information characterizes with complex and evolving relationships, with constantly growth. Zakir et al. (2015: 81) are defining it as 'an important concept, which is applied to data, which does not conform to the normal structure of the traditional database'. Even there are many other definitions no one of them is a universally accepted definition of Big Data. But according to most literature Big Data is usually described as datasets that contain volumes of differently structured, semi structured and unstructured data (Giri and Lone, 2015) mostly characterized using 4 or 5 Vs: large volume of data, high velocity- analysis of streaming data, high variety- analysis of different types of data structures, information assets that demand cost- effective, innovative forms of information processing that enable enhanced insight, decision making, and process automation (Gartner, 2016), veracity- data from different sources, data accuracy and reliability, and value-examines the cost-benefit of collecting data (Zhang et al., 2015, Merrit-Holmes, 2016). Within these characteristics what is important for accountants, auditors and controllers are veracity and value, i.e. cost benefit of collecting data.

The goal of accounting has always been to provide information to decision makers (Capriotti, 2014), while the task of controlling was to use them i.e. analyze and present them to upper-level decision makers. Due to the new era of technology controllers, who strive to the strategic, more future-facing role, must go beyond traditional accounting data (Gray and Alles, 2015), or even beyond current early stage of modern controlling data use. The sources of today's data are numerous. Whether they are internal, like archives and data storage, external eg. public web, or both internal and external, like media, documents, business apps, social media, sensor or machine log data (Kapow Software, 2013), controllers must be capable to quickly identify which of them their company should collect, how to analyze them, and what action plan the analysis demands (Gray and Alles, 2015). Hence, the role of accounting as one of the internal data collectors will significantly decrease considering the total number of external data that controlling will use in purpose of their analysis i.e. predictions. Therefore, controlling will be forced to improve his skills and knowledge in order

to be able to help reach the efficiency and effectiveness of set goals. Although there is not much research regarding Big Data and controlling jet, the question on which most authors base their research is the future of controlling with regard to his survival and future tasks and corporate role.

Kieninger et al. (2016:2) point out that 'it is hardly surprising that the current wave of digitalization, and Big Data in particular, will have a considerable influence on controlling of the future'. They see the changes as a huge impact on methods, instruments, skills and organizations that will consequently redefine the entire world of controlling, and therefore suggest an overall concept for analyzing, forecasting and optimizing all business activities using Big Data. Weichel and Herrmann (2016) highlight that controllers can benefit of Big Data, especially the area of planning/forecasting, analysis, reporting and also the business partner role, through the construction of analytical models. Mehanna (2014) on the other hand highlights three main prerequisites that controllers need to fulfil beside technical requirements to successfully implement monitoring, prediction and prescriptive into their process: 1) strong governance through controlling, 2) quantified and dynamic entrepreneurial models and 3) personal development and change. Although so far controllers weren't taught modern data analysis technique, in order to fulfil their prediction role, authors referred to the essential role of various techniques, like 'Data Fracking Strategy', 'Data Mining' i.e. business intelligence (BI), data analytics, predictive analytics, and prescriptive analytics, as a condition for execution of the future role of controlling (Gentsch, 2003, Gray and Alles, 2015, Wang and Wang, 2015, Wang and Wang, 2016, Appelbaum et al., 2017). Additionally, in 2013 The Chartered Global Management Accountants (CGMA) has already reported that 51% of corporate leaders consider Big Data and data mining as one of the top ten corporate priorities fundamental for the data-driven era of business (CGMA, 2013). According to that they point out that controllers have four potential roles: Data scientist, Data manager, Data champion and Business partner (CGMA, 2014). There is no doubt that the mentioned techniques are already needed in all companies to make quick and accurate decisions. But the question that arises is if the use of them should be in the department of the controller or the data scientist, and will that mean that the data scientist as a more digitalized profession will reduce the controller's role in the future?

Al-Htaybat and von Alberti-Alhtaybat, (2017) through their interview based research, came to the conclusion that controllers continue to play an important role in their respective field by incorporating Big Data and its analytics. But what is more important, regarding the role, skills and influence of data scientists, is the conclusions that the years of training, acquired and tacit knowledge of an controller aren't replaceable, unless there is a data scientists with years of education and practice in controlling (Al-Htaybat and von Alberti-Alhtaybat, 2017). The best data scientist are comfortable speaking the business language, but people with all this skills are hardly to find, especially in a great demand that we are facing together with the future digitalization (McAfee and Brynjolfsson, 2012). Therefore, even though data scientists are seen as new breed of mana-

gerial decision supporters, controllers are expected to break with their traditions and collaborate with data scientists for mutual benefits (Osimitz Wieder et al., 2018). Of course, controllers will have to improve their skills according to the new techniques (Seufert and Treitz, 2017), but they will not have to become a programmer and statistician i.e. date scientist and vice versa. Therefore, the controlling that we knew and whose task was to support the decision making on base of already existing data, is rapidly changing and becoming more dependent to other corporate functions. Hence, todays controlling needs to start from the problems or appearance that need to be solved i.e. predicted, and accordingly to that find information that will give the answer for solving them and keeping under control. Here comes the role of the data scientist – mining and fracking of needed data, that controlling will finally transfer into information and knowledge for decision making.

3. Research

For the purposes of creating conceptual model we first conducted an exstensive desk research which involved the current situation relating to the knowledge of Big Data and its use in controlling. Following the secondary and initial data collection, structured interviews were then conducted with chairmen of controlling departments in 20 middle and large companies from different branches. We chose interview method because of more accurate and reliable received data. A self-administered questionnaire (17 questions in total) was used to analyze the controller's:

- knowledge of Big Data concept
- recent usage of operative system
- the future role of controller
- advantage and disadvantage of Big Data implementation

Most of the interviewed companies had little knowledge of the Big Data concept in generally. Only 25 per cent of the companies confirmed that they are fully acquainted with the term 'Big Data', and only 12 per cent had no contact with the therm. For example, some of the definitions they gave as their perception of Big Data are:

"Big Data is a technology that allows the collection and processing of large quantities of structured and unprocessed data in real time."

"Processing large amounts of data."

"The use of public networks and media data."

"A large quantity of unrelated data that are raw material for the production of information."

"Relational databases."

"Data processing software."

The first definition is from one of the companies that were fully acquainted with the term, while the other ones are from those who implied that they have little knowledge of it. That is especially evident from the last definition, which in no way corresponds to the definition Big Data. Hence, in generally they knew the meaning of the concept. The half of the companies use Big Data and they do it through web pages, internal archive, mobile sales application and other web sources.

Most of the companies (75%) make forecasting and projections. The forecasting is approximately on 3 years period and projection over 5 years with the use of experience methods in most cases. A few of them (38%) use additionally statistical methods, like regression and time-series, and just 25 per cent of them use more complex mathematical-statistical methods, like scenario methods and Delphi method. Used operative systems are different (SAP, ORACEL, BW, USALI,…) and partly satisfy their current needs in the controlling department.

According to the results, the controller's role is definitively changed and their knowledge should be more comprehensive including not only accounting and finance knowledge but also skills of business analyst, econometric knowledge as well as informatics. The professional profiles that will be required more than ever due to the on-going orientation to prediction are controllers, business analysts and data scientists. Accordingly, forecasting and projections will be the future orientation of controller's, but in the correspondence with the data scientists, what confirmed all respondents.

Controller's consider introducing Big Data into everyday's job as an advantage for their profession. Big Data will give them possibility to get new sources which enable them to get the overall picture of analysed phenomena. Considering possibility of volume, velocity and variety of data, interviewers expressed a kind of risks in recognizing the "right things"! There is a fear of being irrational in general because of rationality in detail. The comprehensive holistic approach required wider knowledge and skills which goes beyond what is known today.

4. Digital Prospective Controlling – DPC model

The main role of controlling is to convert data into useful business decision–making information. Thus the current wave of digitization, particularly Big Data will have important influence on controlling in the future. In the 4th industrial revolution, which characterized robotization and digitalization, information collected by Big Data sources will definitively have impacts on various aspects of controlling. Knowing relationship between manager and controller, which today is very often described as "business partners", leads to the first question: Whether the relations between manager and controller will change due to the digital environment? Probably requirements from the manger will be more oriented to the risk avoidance and its prediction.
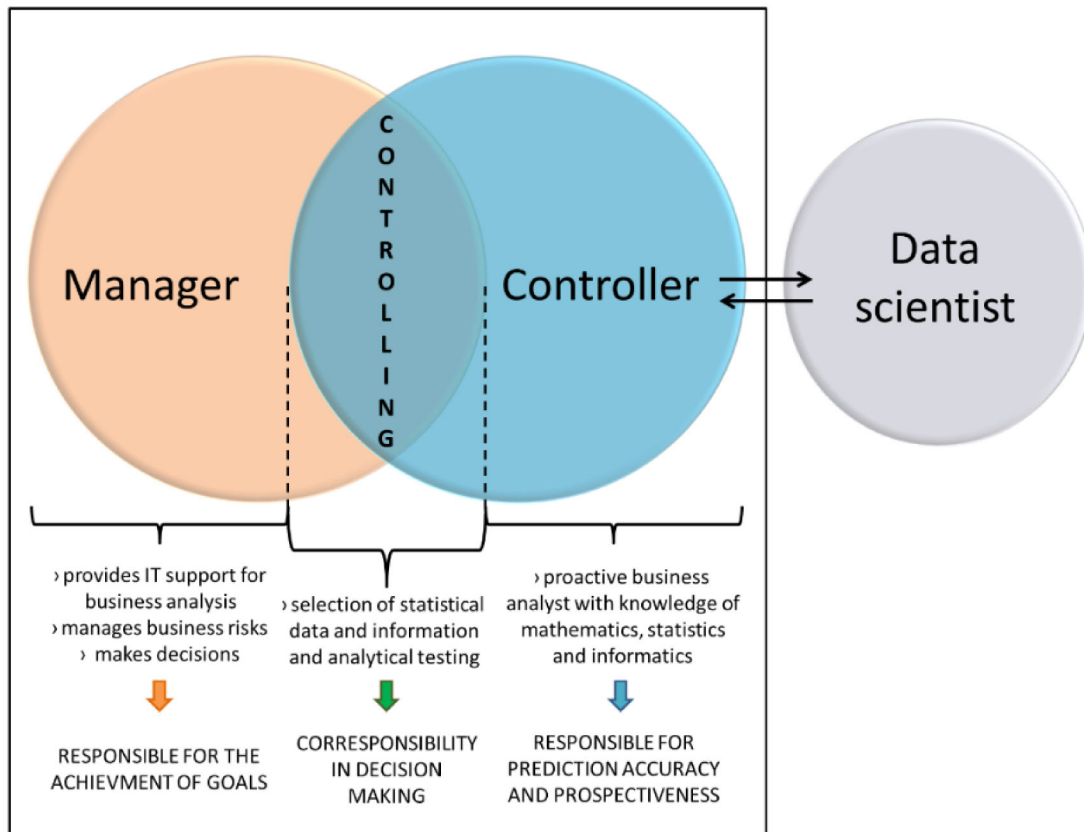
Figure 1. Future relationship between manager and controller

Source: Authors

For the purpose of achieving the stated objective controlling has always been a process that has emerged as a result of common efforts of management (individual or team) and controllers (Luković and Lebefromm, 2009). There-fore, in today's digital era i.e. the Era of Big Data, it is the manager's job to provide adequate digital support that will enable the largest use of Big Data sources for the achievement of set goals. The controller as the business part-ner on the other hand, needs to be capable to accurately predict and prospect future phenomena. Controlling as process and needs to clarify, asses, evalu-ate and make conclusions and suggestion due to selected statistical data and other information.

The second question which arises is whether the controller's orientation in in-vestigation will be changed? The proactivity is already a characteristic of con-troller, but with Big Data and risky environment predictive and prospective view will be more pointed. Today's analytic assessment of current situation based on historical accounting data will be changed with predictive and prospective planning system. Therefore, business analytics will be the critical area of their professional work, which mean the use of big volume of data, selection of key one's, make proper interpretation and conclusions and give reasonable propositions.
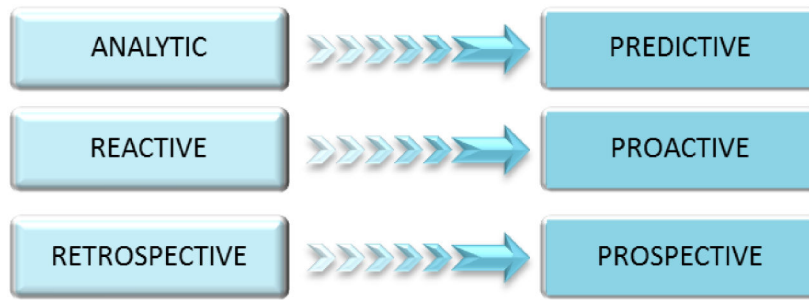
Figure 2. Shift in controllers' orientation

Source: Authors

The third question is put on controller's methods. Whether they should be more comprehensively oriented to statistics and mathematics? The interviews confirmed that the role of controller's will be more oriented to forecasting and projections. Precisely, the skill method is still the most used but with shift to simple statistical methods like regression, times-series and descriptive statistics.
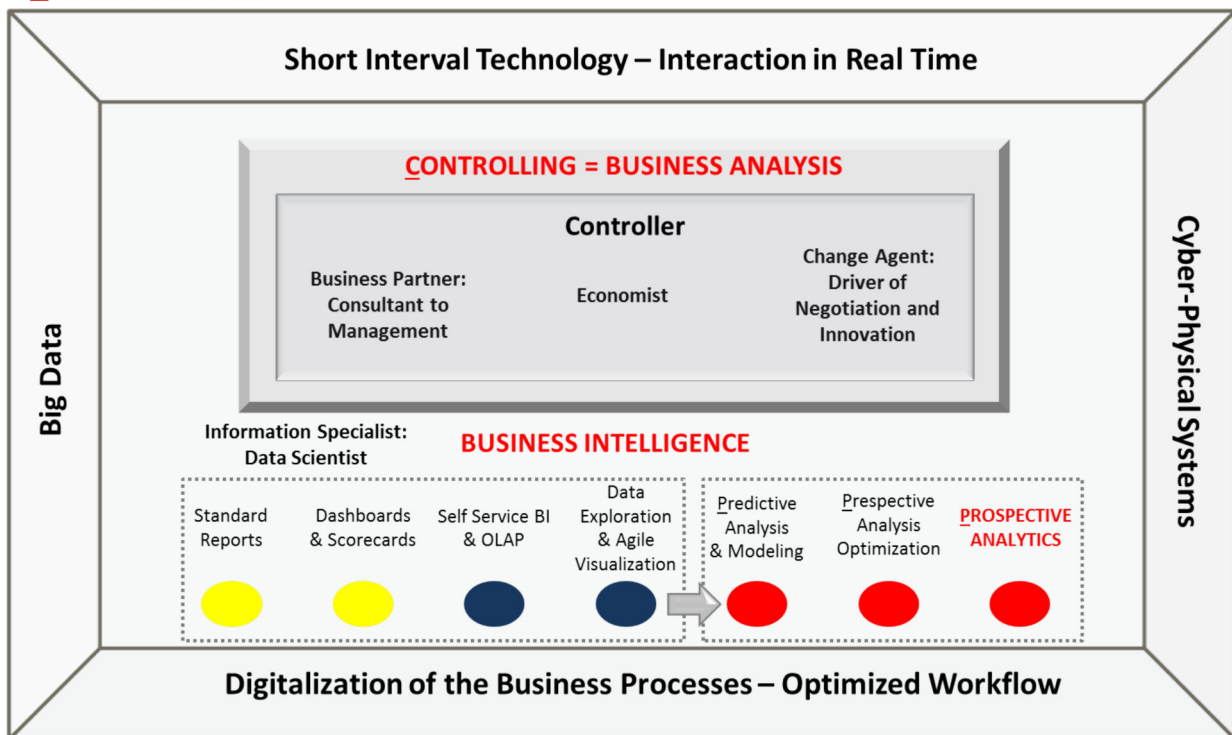

Figure 3. Digital prospective controlling – DPC conceptual model

Source: Authors

The Manufacturig Execution Systems (MES), which is used for Optimized Workflow in the production area, is not only the extended machine controller or the extension of an Enterprise Resource Planning (ERP) system. In recent years, the MES was widely seen as key figures generator for production. MES is an element of planning and quality assurance, with the short-term by optimizing production efficiency and control can be increased considerably. A modern production must be reactive in order to respond quickly to an ERP System. ERP

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provides an integrated view of core business processes, often in real-time, using common databases maintained by a database management system. They also track business resources - cash, raw materials, production capacity - and the status of business commitments: orders, purchase orders and payroll. The applications that make up the system share data across various departments (manufacturing, purchasing, sales, accounting, etc.) that provide the data.

Further, Short Interval Technology (SIT) is the concept, to monitor the business processes in general and the production processes in detail, to be able for fast reaction. On the technical side, the Information Technology (IT) system enables for predictive maintenance. The system detects a technical problem in future which enables the production control to plan the process for Enterprise Asset Management. The technical components of SIT are sensors, actuators and communication technologies like Radio Frequency Identification (RFID).

Cyber-physical systems are distributed networked production units - intelligent objects that are linked in a web of data and services with each other and be controlled autonomously. This involves the virtual image of the real world of production and supplemented by information. This virtual image can be found in the application system of the IT, making visible all possibilities of the manufacturing participants – human being and machines.

The use of Big Data, which can be characterized through different feature descriptors, is associated with the role of Data Scientist. Big Data can lead to a management revolution, if it is possible to generate the economic benefits of Big Data. For this purpose, however further qualified personnel is necessary that is specialized in terms of methodology in the analysis of data (Horváth et al., 2015). A recent study by the Institute for Business Intelligence shows the fundamental importance of Data Scientists. The role of the Data Scientist is required for the conversion of data from Big Data in information. Only with the obtained information the benefits of Big Data can be obtained at all. Therefore, the development of appropriate skills and a sensible organizational integration of the role of the Data Scientist is the critical point for a value-added contribution of Big Data. The role profile is described in the paper by Horvath, which relies on the contribution of Davenport (Horváth et al., 2015).

Therefore, in the digital environment supported by innovative forms of information processing, and according to the strategic and operative level of controlling, the controllers role of selecting and processing data into key business decision-making information can be classified in following business analytic use:

- Descriptive analytics - What happened? i.e. PAST orientation
- (use of financial data and other quantitative data - Ratio analysis, Clustering, Process mining…)
- Predictive analytics - What could happen? i.e. FUTURE orientation
- (use of forecast, probability models, statistical analysis and scoring models)

- Prescriptive analytics - What should be done? i.e. FUTURE orientation

- (based on the descriptive and predictive analytics leads to optimization)

Hence, for the last two analytics the overall name that comes is prospective analytics. Obviously the controller profile goes to the direction of combination with data scientist although fundamentally remains business analyst. For sure the controller need to have knowledge of informatics beside wider knowledge of economy and econometrics, but because of mentioned characteristic and more holistic approach to the concept of controlling in the future, term controlling is not adequate- business analysis goes beyond controlling.

5. Conclusions

Controlling as one of the important functions in any company is now deeply affected by the challenges of digital technologies. Big Data certainly enables controller's to use more accurate data and develop forward-looking measures. Beside this advantage, there is also a need to define controller's extended knowledge of other interrelated disciplines- mathematics, econometrics and informatics. Due to his future role in the business and requested skill the opens the question of the controller/controlling terminology. Collaboration with data scientist depends of the knowledge of both sides but the level of each others knowledge is questionable. Hence, the good communication and future mutual benefits depend on that level. Interviews confirmed that Big Data will have a notably share in the future role of controlling i.e. for the projection and forecasting in one word- prospective analytics. Theoretical research and practical view of controlling gained by interviews enabled developing a new model named the "Digital prospective controlling – DPC" which will be useful for predictive analysis in any company using a range of "information literacy".

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