



A Review and Analysis on Data-Driven Decision Making the Key to Business Success

Pranay Mungara

ABSTRACT

Along the decision-making process we depend of assumptions, premises, the context and this is guided through the aim associated with the decision itself. The context and assumptions represent external aspects out of the control of any decision maker, but the premises and the knowledge of the company depends of our data. A common conceptual mistake is associated with the confusion related to data and information when indeed they are very different concepts. It is that to say, we can gather data from different heterogeneous data sources but nothing warrants us that the data are consistent, comparable and traceable. In this work we talk about the importance of the measurement and evaluation in relation with the data-driven decision making. Followed, we present the implications of an intuition-driven decision making and their possible social impact. Finally, an application case related with the monitoring of business process in the Autarchic Institute of Housing (La Pampa, Argentina) is shown for describing the application of the concepts related to data-driven decision making.

Keywords: Decision-making, Business, Data analysis.

INTRODUCTION

Along the decision-making process we depend of assumptions, premises, the context and this is guided through the aim associated with the decision itself [1]. The context and assumptions represents external aspects out of the control of any decision maker, but the premises and the knowledge of the company depends of our data because they are part of our organization as system [2]. A common conceptual mistake is associated with the confusion related to data and information when indeed they are very different concepts. It is that to say, we can gather data from different heterogeneous data sources but nothing warrants us that the data are consistent, comparable and traceable. In this sense, if we need make a decision, we need to know the entity under analysis and their associated information at the precise instant. It is important because from the point of view associated with the general system theory it is necessary identifies the system for identifying their boundaries, context, subsystems, feedback, input and outputs. Once the system was identified, we can go on the quantification related to each associated characteristic for knowing it in detail.

Thus, and for knowing the entity under analysis, we need to measure it for quantifying their associated characteristics and from there; we define the indicators for interpreting each metric's value. In this way, the Measurement and Evaluation (M&E) process can be supported by a conceptual framework with an underlying ontology. The M&E framework allows defining the necessary concepts for carry on a measurement process in consistent and repeatable way [3].

Even when is important that a measurement process give us consistent, comparable and traceable results, but also it is very important its automatization. In the now economy, the operations happen in real time and for that reason we need seriously consider the online monitoring for detecting and preventing different situations on the fly. In this sense, the role of the measurement and evaluation frameworks are a key asset, because they allow structure and automate the measurement process in consistent way [4].

Once than it is possible to warranty that the measures are comparable, consistent and traceable, the decision-making process will be naturally based on their history (the measures along the time). In this aspect, the Organizational Memory take a particular importance, because allows store the organizational experience and knowledge for future recommendations (i.e. as foundation of assumptions, premises, among others). The Organizational Memory is fed continuously by the measures and their associated experiences, and it constitutes the base for the feedback in the decision making process [5].

However, the Organizational Memory is a model and for that reason, it is possible that there not exist recommendations (or experiences) for a new situation (i.e. natural disaster). It is very important for remembering because in cases associated with measurement and evaluation processes on infrastructure in the context of smart cities, it is possibly get partial data because it is highly possible that there not exist previous records. The last is the case of the city of Santa Rosa (La Pampa, Argentina) where even with previous experience about the level of raining, nothing could be done when in a week the city received water in an equivalent volume to one year [6].

In this invited talk we talk about the influence of the data and information along the decision-making process. Also, we focus the measurement and evaluation process as key asset associated for knowing the entities under analysis (e.g. a business process, a person, a system, etc.), their contexts, and the way in which the process could be automatized. We highlight the role associated with the Organizational Memory as knowledge base for recommendations [7].

Digitalization is changing modern economic realities at an unparalleled [8]. A wide variety of digital trends and technologies are forcing companies to change their business models, organizational structures, and corporate processes [9]. The half-life of certain technologies and digital opportunities is becoming ever shorter, and companies must adapt to these dynamic conditions and transform themselves accordingly. The use of data, artificial intelligence, and analytics plays a key role in this process, and "exploiting vast new flows of information can radically improve company's performance". Companies of varying sizes and from various industries are pushing to become data-driven and apply a variety of digital tools [10]. However, some companies have been less successful than others in mastering this transformation.

LITERATURE REVIEW

In [11] "was described Assessing the quality of the information proposed by an information system has become one of the major research topics in the last two decades. A quick literature survey shows that a significant number of information quality frameworks are proposed in different domains of application: management information systems, web information systems, information fusion systems, and so forth. Unfortunately, they do not provide a feasible methodology that is both simple and intuitive to be implemented in practice. In order to address this need, we present in this article a new information quality methodology. Our methodology makes use of existing frameworks and proposes a three-step process capable of tracking the quality changes through the system. In the first step and as a novelty compared to existing studies, we propose decomposing the information system into its elementary modules. Having access to each module allows us to locally define the information quality. Then, in the second step, we model each processing module by a quality transfer function, capturing the module's influence over the information quality. In the third step, we make use of the previous two steps in order to estimate the quality of the entire information system. Thus, our methodology allows informing the end-user on both output quality and local quality. The proof of concept of our methodology has been carried out considering two applications: an automatic target recognition system and a diagnosis coding support system.

In [12] it was entities in a systematic way and further fostering robust data analysis among projects, measurement and evaluation (M&E) strategies are a valuable asset in any organization. However, the evaluation of the quality of the capabilities for an integrated M&E strategy –seen as a resource– has often been neglected. We regard a M&E strategy is integrated if three coexisting capabilities are supported, namely: i) a conceptual framework, ii) a well-established process specification, and iii) an explicit methodological support. Under this premise, we conducted a case study where GQM+ Strategies (Goal-Question-Metric), and GOCAME (Goal-Oriented Context-Aware Measurement and Evaluation) strategies were evaluated. The results allowed us to understand the strengths and weaknesses of both strategies. From this understanding we have planned improvement actions and implemented some changes in GOCAME as well. This paper ultimately analyses the achieved gains after recommended changes were performed.

We present an application case related to the Autarchic Institute of Housing of La Pampa, in where the business processes are considered as entity under analysis. In this aspect, the measurement and evaluation strategy using CINCAMI was defined for supporting the decision-making process.

In [13], Executives know that a company's measurement systems strongly affect employee behaviours. But the traditional financial performance measures that worked for the industrial era are out of sync with the skills organizations are trying to master. Frustrated by these inadequacies, some managers have abandoned financial measures like return on equity and earnings per share. "Make operational improvements, and the numbers will follow," the argument goes. But managers want a balanced presentation of measures that will allow them to view the company from several perspectives at once. In this classic article from 1992, authors Robert Kaplan and David Norton propose an innovative solution. During a yearlong research project with 12 companies at the leading edge of performance management, the authors developed a "balanced scorecard;" a new performance measurement system that gives top managers a fast but comprehensive view of their business. The balanced scorecard includes financial measures that tell the results of actions already taken. And it complements those financial measures with

three sets of operational measures related to customer satisfaction, internal processes, and the organization's ability to learn and improve—the activities that drive future financial performance.

In [14] Our artful design and robust facilitation means that your leaders emerge ready to take on existing and new challenges better than before, which can lead to improved corporate metrics. In addition, Insight Experience provides unparalleled end-to-end program support to ensure a seamless and rich experience for both you and your learners. After virtually every leadership development program we deliver, across all levels of leadership, we hear that it was the "best training" participants have ever experienced.

Research on the digital transformation of organizations must keep pace with this exponential development in practice, and current scholarship is focused on the use of data for improved decision-making processes [15]. Research has shown that the use of data has a positive influence on the decision-making process and associated outcomes—in other words, the quality of the decision [16]. Studies have determined that relevant management capabilities and leadership skills for actively managing this change are of high importance for an effective transformation [17]. This finding has prompted further research into which management characteristics and skills positively influence the shift toward data-driven decision making [18]. While current research shows that this shift requires a great number of resources [19], managers largely remain puzzled and uncertain about how they should manage the transition from intuitive to analytics-based decisions [20]. Hence, a profound understanding of the newly emerging managerial role, including expected key leadership characteristics and capabilities, has become critical to managing the transformation [21]. In order to develop an understanding of how to master the strategic challenge, the human dimension and psychological aspects must be understood in great detail; therefore, a scientific framework to guide practitioners on how the digital manager of the future should look is required [22]. Although the importance of data is constantly rising and companies push for the application of analytical solutions, studies show that through 2025 the majority of responsible executives will fail to foster the required data literacy among employees in order to become a data-driven company [23]. While at the same time, there is a great discourse regarding research in applied analytics and the operationalization of analytical methods in companies [24].

THE IMPORTANCE OF THE MEASUREMENT AND EVALUATION

We need to measure and what are the benefits. The common sense in the engineering, say us that we need to characterize a concept or an object for knowing their physical and abstract characteristics. Once we know each characteristic, it is useful to quantify each one for studying the behaviour in different situations. Thus, and from the study of each situation, we can basically identify a normal and an abnormal situation; which is useful for detecting and preventing not wanted results. In this sense, the avoidable situations and the optimization of resources give us an interesting social and economic point of view as positive argument of the measurement. In each case, the concerns associated with the quality of the information keep being an active branch of researching

The measurement allows quantifying the characteristics of an entity under analysis, such as a system, a component, etc. However, we need put special attention of the concepts related with the measurement process for warranting the homogeneity [25]. That is to say, the measurement is useful if and only if the measures are consistent and comparable and the measurement process is repeatable. For that reason, we need have the same interpretation in relation to the concepts of measures, metrics, indicators, among others. In this aspect, the measurement and evaluation frameworks take special sense, because allow us make an agreement about the concepts that we want use along the measurement process and speak in the same language avoiding misunderstandings.

For example, if we want to monitor an organization as a system, we could use the Balanced Scorecard perspective of Kaplan & Norton [26]; the Goal-Question Metric approach [27]; the C-INCAMI (acronym of Context-Information Need, Concept Model, Attribute, Metric and Indicator) framework [28]; among others. Each approach could have weakness and strengths, but it depends of the situation in which we want apply them [29]. Independently of chosen approach, we need keep consistency along the time in relation to the way in which we measure for warranting the consistency and comparability of concepts and measures.

In terms of Data Quality based on the ISO 25.012, there are characteristics related exclusively with the data itself, which implies that the characteristics depend exclusively of the data, such is the case of the accuracy, completeness, consistency, credibility and currentness. However, there are other characteristics which depend of the data and the system at the same time, such as the accessibility, compliance, confidentiality, efficiency, precision, among others. This is important to highlight because the data is a part of the system, and the data quality is affected by the data itself but also by the system which process them. The data-driven decision making could be defined as “the practice of basing decisions on the analysis of the data rather than purely on intuition” [30]. In this sense, we can quickly

note that if the decision-making is based on the data, a poor data quality will directly affect the decision-making process.

For this reason, the monitoring on each stage of the data lifecycle is critic. That is to say, we need to use practices in the organization for monitoring the data acquisition, data processing, data analysis, data preservation and data

reuse, user deletion. In this sense, there are interesting proposals related to different perspectives associated with the needed practices for keeping the data quality, such as the data maturity model from CMMI Institute, or CALDEA model based on maturity models.

In terms of data-driven decision making the organization makes different decisions based on their data. In this sense, the history associated with the data is a key asset for supporting the decision-making. For that reason then organizational memories could be addressed for modelling then organizational experiences from the historical measures and evaluations. Moreover, a case-based reasoning could be deployed from the organizational memory for supporting their recommendation in the decision-making process.

THE SOCIAL IMPACT OF THE DATA-DRIVEN DECISION MAKING

Smart city refers to cities which integrates and monitors their critical infrastructure using smart computing to deliver core services to public [31]. However, the idea behind of smart cities is not only related with a technological factor, but also is associated with aspects such as governance, economy, among others.

Each decision along the different services or infrastructure in a city should be sustained on their experiences. In this way, using the experiences and data from the city, we are able to typify different situations of normality and consequently, we can detect the situations out of normality. This is a key aspect for monitoring infrastructure and services in a city, and the final idea is related to prevent risk situations, and in the worst case, their detection in real time.

The measurement and evaluation process are critical for knowing the current state of each service or infrastructure in the city. That is to say, if we do not measure, we will not know the state of each element. This is critical for orienting the data decision making, because each decision should be based on the current situation of different elements along the city. What if we do not have the data? It is highly possible that the decisions are oriented by the intuition since we do not have facts or records for supporting the alternatives of decision.

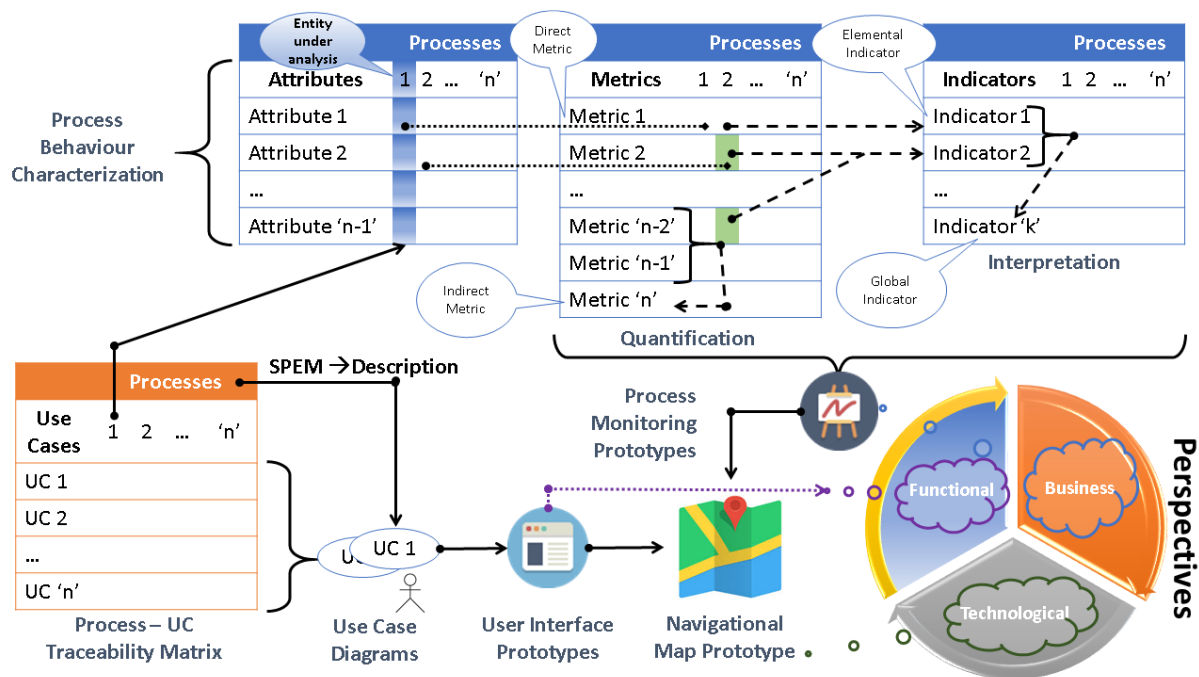


Fig. 1. Conceptual Perspective associated with the Business Process Monitoring. A Data-Driven Decision Making La Pampa keep suffering the consequences of the inundations. Even when the natural disasters are not easy to prevent, it is possible to monitor the infrastructure and services along the city for planning the works with the due anticipation.

In the other extreme, the monitoring of the infrastructures and the services could at least improve the quality of life; anticipate disasters or even save the lives of the citizens [32].

- [1]. An application case: the autarchic institute of housing of la pampa

The Autarchic Institute of Housing of La Pampa (AIHLP) is the public organism responsible for the building of houses along all the provincial territory. Even when the organism receives funds from the provincial and national government, it administrates the funds in autarchic way. The future owners of each house are associated with families without the enough resources for accessing to the formal system

carry on the banks. In this way, the associated demand is continuous and the offer is always lesser than the demand.

Given the high demand, the AIHLP has a specific normative for assigning the houses considering the particular situation of each family. In this way, the authorities wanted make decisions on the base of previous experience for learning from past situations, optimize the resources and to avoid the repetition of errors.

In 2014, we start a business process reengineering to be transparent the behaviour of each process, using SPEM (acronym of Software Process Engineering Meta-Model) as modelling language. We use IBPREME (Integrated Strategy based on Processes,[33] Requirements, Measurements and Evaluations), a process-oriented strategy, which the aim is related to monitoring the processes as entity under analysis using C-INCAMI as Measurement and Evaluation framework

Once we managed to validate each process with our stakeholders, we started the definition of the measurement and evaluation project using the GOCAME strategy. In this sense, our entity under analysis was each modelled process. From there, in coordination with the authorities, we define the mode in which they wanted characterize each business process and their associated point of view. The figure 1 synthesizes the idea from the identification of process attributes to the implementation of the three perspectives of monitoring (technological, functional and business).

As you can see in figure 1, each characteristic or attribute descriptive of a process was associated with a metric for its quantification. Followed, in collaboration with the authorities, an indicator was defined for interpreting each associated metric in each process. In this point, the business knowledge of the authorities was essential for incorporating the decision criteria inside the indicator definition.

From the metrics and indicators, we managed to prototype the visual scorecard for monitoring the processes. In this way, the business perspective concluded with the implementation of the web-enabled and multi-device command board.

In parallel, each task and activity in the process allow us to derive the model of use cases. From the uses cases the user interfaces were prototyped, and once they were validated by the final user, they were implemented. Both the user interface and the command board are naturally linked because the processes incorporate the logical.

[2]. Important of Data Driven Decision Making

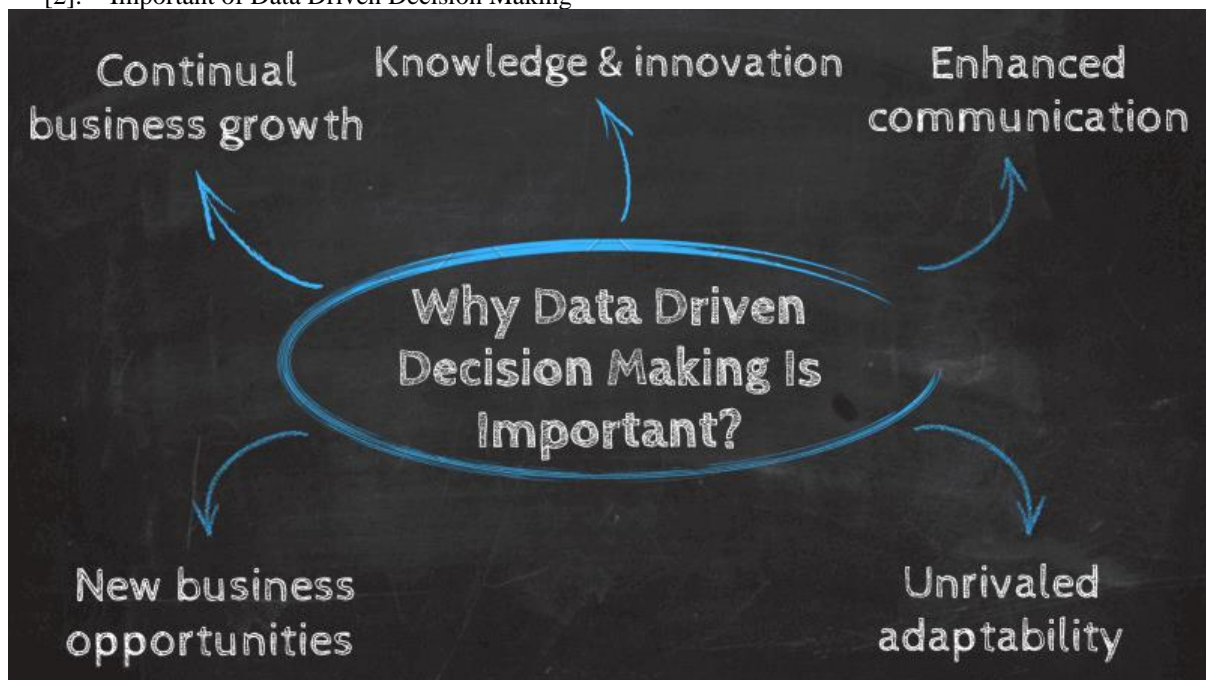


Figure 2: Importance of Data Driven Decision Making

Data based decision making provides businesses with the capabilities to generate real time insights and predictions to optimize their performance. Through this, they can test the success of different strategies and make informed business decisions for sustainable growth.

There are wealth reasons that using data to make decisions is a pursuit every modern business should place at the heart of their culture - and we're going to explore the main points of importance.

- A. Continual organizational growth
The core importance of data in decisions lies in consistency and continual growth. Data-driven decision making empowers companies to hone in on key insights based on a multitude of functions, operations, and departmental activities.
One decision after another actioned with consistency will empower you to set actionable benchmarks that result in continual progress and growth - the key ingredients to long-term success in today's cut-throat digital age.
- B. Knowledge & innovation
Data driven business decisions can determine the success of a company. This is a testament to the importance of online data visualization in decision making.
MIT Sloan School of Management professors Andrew McAfee and Erik Brynjolfsson once explained in a Wall Street Journal article that they performed a study in conjunction with the MIT Center for Digital Business. In this study, they discovered that among the companies surveyed, the ones that were primarily data driven benefited from 4% higher productivity as well as 6% higher profits.
Companies that approach decision making collaboratively tend to treat information as a real asset more than companies with other, more ambiguous approaches. Also, when you view digital insights as a genuine asset, you will foster a culture of data driven education - a commercial ecosystem where everyone leverages the power of information to learn more while working to the best of their abilities.
- C. New business opportunities
Decision making based on data leads to the discovery of new and exciting business opportunities. Drilling down into accessible visual information will give you a panoramic view of your business's core activities, which, in turn, will ensure you make a series of solid decisions that benefit the commercial evolution of your business.
Armed with the deep-dive insights that will improve your judgment, you will uncover opportunities to expand your growth, create new professional connections, and develop innovations that will give you an all-important edge over the competition.
- D. Better communication
Working with a data driven decision management mindset, you will become a better leader - and that will filter down throughout the entire organization.
Whether you're talking data driven finance, a data driven sales strategy, or any other kind of insight-driven initiative, working with powerful KPIs and visualizations will improve communication across the board.
Operating as one cohesive data driven unit, every one of your departments will gain the ability to share insights with ease and collaborate on key strategies that will ultimately turn you into a more intelligent and profitable business.
- E. Unrivalled adaptability
Last but certainly not least, one of the prime benefits of data driven decision making is that it will drive your business to be incredibly adaptable.
By embracing digital data, you stand to grow and evolve your empire over time, making your organization more adaptable as a result. The digital world is in a constant state of flux, and to move with the ever-changing landscape around you, you must leverage data to make more informed and powerful business decisions.
Data driven decision making tools will allow you to connect with emerging trends and patterns that concern not only your internal activities but the industry around you. If you can understand these trends or patterns on a deeper level, you can make informed decisions that will ensure you remain competitive, relevant, and profitable at all times [34].

CONCLUSION

In this invited talk we introduced our perspective on the importance of the measurement and evaluation in the data-driven decision making. In terms of data quality and based on the ISO 25.012, we can have aspects depending exclusively on the data, but also on the system or both. In this sense, the data-driven decision making is dependent of the data quality among other associated factors (e.g. governance, etc). A poor data quality, a poor measurement process, possibly implies a poor decision-making process. Thus, the Data Management Maturity Model from the CMMI Institute constitutes an interesting alternative at least for its consideration. We frequently can read papers about the benefits of the data-driven decision making, but in this talk we show the catastrophes associated with the use of the decision-making guided by intuition in a real case in the city of Santa Rosa (La Pampa, Argentina). It is interesting for sizing and making tangible the implications positive and negative related to the presence and absence of the data-driven decision making.

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