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# **The role of business analytics in supporting strategy processes: opportunities and limitations**

## **Abstract**

Many organizations consider business analytics to be a key organizational capability. To date there is little evidence on how organizations have included analytics at the heart of their strategy processes. This paper addresses this issue by exploring the activities within a strategy process and considering the potential role that business analytics might play in providing support to such processes. We perform a search in multidisciplinary databases for evidence of the use of business analytics within strategy processes and we reflect on its use in two case studies performing strategic analysis within the pharmaceutical industry. The findings indicate business analytics is still an emerging field without a structured approach. Business analytics can provide important data-driven insights into strategy processes; we therefore recommend its further integration with other traditional OR and strategy tools in order to support strategic decision makers.

**Keywords:** Strategic Planning; Business Analytics; Practice of OR

# 1. Introduction

Many businesses consider analytics as a key organizational capability based on the set of technologies and processes that use data to understand and analyse business performance (Davenport and Harris, 2007) but to date there is little evidence in the literature that organizations have included analytics at the heart of their strategy processes, another of the key capabilities in organizations, except in data-driven organisations. A strategy process includes those activities which inform, shape and support the strategic-level decisions and issues that an organization faces (Dyson et al. 2007). Scholars have focused their attention on the use of analytics to improve operational activities or as an emergent response to the existence of big data. The result has been that analytics appears to be beyond the scope of strategy processes, except for automating forecasting or analysing customer behaviour, such as in data-driven organisations. Business analytics can provide valuable insights in strategic decision making using its three functions: **descriptive**, e.g. who are the most profitable customers that we need to protect?, **predictive**, e.g. what will be the impact of a new pricing strategy on our most profitable customers?, and **prescriptive**, e.g. how can we reach the most profitable customers at the lowest cost? This paper addresses the potential role of business analytics in supporting strategy by exploring the activities within a strategy process and considering the role that it might play in providing support to such processes using two research methods: a literature survey of applications and a set of case studies.

The paper is organized as follows: the next section presents an overview of business analytics in relation to how the literature has classified analytics tools. The following section introduces strategy and the strategy process, and identifies a collection of key activities that constitute such processes. The next section relates the current use of business analytics to the activities in a strategy process and identifies gaps where historically tools from other fields

have provided support. A discussion section follows, and the paper concludes with some areas for further research.

## **2. What is business analytics?**

Within the literature, analytics is conceptualized both as a process and as a toolkit or collection of tools. Analytics as a process involves activities such as analysing data to support decisions and evaluate actions. For example Kiron et al (2014) describe ‘analytics’ as ‘the use of data and related business insights developed through applied analytical disciplines....to drive fact-based planning, decisions, execution, management, measurement and learning.’ Davenport et al (2010) detail their proposed **four-step analytics process** for developing offers to customers. **First**, the company needs to **define the objectives** for the analytical activity: what do you want to achieve: revenues, customer loyalty? The **second** step involves **collecting and integrating data about the problem**, in this case products and customers’ behaviours. The **third** step involves the **analysis of data using statistical analysis and predictive modelling** to find patterns between products and customers’ behaviours. Together with analysing data, Davenport et al (2010) suggest defining the rules or business processes to implement the findings from the analysis: design of offers, channel selection and timing. The **fourth** step is the process of **learning from your actions**, e.g. consider every activity as a trial or test of your models, and refining the execution through fine tuning the rules and business processes. For example, checking the customers’ responses to a certain offer or the behaviour in a new channel. Davenport et al (2010) considers the process to be continuous so the company may define new objectives after step four and start the process again. This description resonates with the steps within a traditional strategic planning process: defining strategic objectives, analysing the internal and external environment using data, formulating strategies and evaluating the implementation of strategies.

Before considering analytics as a toolset, it is important to discuss the disciplines related to analytics. Mortenson et al (2015) suggest disciplines belong to three categories. The **technological** category involves the disciplines, electrical engineering and computer science, that provide tools to **process the data**, such as hardware, software and networks (Mortenson et al, 2015). The **quantitative methods** category consists of the applied quantitative methods to **analyse data**, such as statistics, operational research (OR), econometrics and machine learning (Mortenson et al, 2015). Finally, the **decision making** category includes the tools, approaches and theories to **support the decision making process** such as psychology, behavioural science as well as information systems (visualization of data) and soft OR/problem structuring methods (understanding the complex problems) (Mortenson et al, 2015). Many of the tools, methods and approaches can be located in more than one category, e.g. operational research tools belong to both the decision making and the quantitative methods category (Mortenson et al, 2015). To summarize, analytics is an interdisciplinary set of tools with roots in disciplines that can be associated directly or indirectly to strategy processes.

Some of the literature refers to analytics as a toolset, where, for example tools can be classified according to three purposeful uses: descriptive, predictive, and prescriptive (Liberatore and Luo, 2011). **Descriptive analytics** are the most commonly used analytics tools consisting of the use of data to understand past and current business performance using techniques to categorize, characterize, and classify it into useful information. The main outputs are charts and reports which are employed to identify patterns and trends in data. Typical questions that descriptive analytics help answer are related to current and past performance: what, how much, which. **Predictive analytics** focuses on the prediction of future performance by examining historical data, detecting relationships in the data, and then extrapolating it. The outputs of predictive analytics are the detection of hidden patterns in

large quantities of data in order to predict behaviour and detect trends. Typical questions answered using predictive analytics are related to sensitivity analysis of the present situation such as what if. A particular case of a predictive analytics tool is simulation (Lustig, 2010) where the creation of a simulation model uses a mix of verbal data (describing the system) and historical data (calibrating the model) in order to either predict future performance of the system under what if conditions (sensitivity analysis) or identify better alternatives to improve the performance of the system (experimentation). In the latter case, simulation becomes a prescriptive tool. **Prescriptive analytics** employs tools such as optimisation and simulation to identify the best alternatives to achieve business objectives. Various mathematical and statistical techniques of predictive analytics can also be utilized with optimisation to take into account uncertainty in the data. Typical questions answered using prescriptive analytics relate to future performance linked to operational changes.

Davenport and Harris (2007) suggest that companies are fully involved in analytics when they combine data residing in information systems with rigorous analysis throughout all organizational functions and when this activity is supported by senior executives not only in decision making processes but also hiring people with analytical skills. Competing on analytics implies making business processes more innovative and efficient (Davenport, 2006). The literature reports a number of case studies exploring the use of analytics with important business performance gains (Kohavi et al. 2002). The common claim in all case studies is the use of analytics as a competitive advantage tool similar to the positioning of strategic operational research made by Bell (1998). Bordawekar et al (2012) classify analytical applications in terms of functional goals and types of problem and management issues solved as table 1 shows. This table also supports the previous positioning of analytics being used in a similar way to strategic operational research. Liberatore and Luo (2011) define 'business analytics' as a process of transforming data into actions through analysis and

insights for organizational decision making and problem solving. Similarly, Holsapple et al (2014) note that there is a stream within both academia and practice where analytics is associated with business, hence their coining the phrase ‘business analytics’; we have adopted this term in this paper.

<b>Analytical application</b>	<b>Analytics Tool Classification</b>	<b>Functional Goal</b>	<b>Problem types</b>	<b>Management Issue</b>
Supply chain management applications, i.e. product scheduling, routing	Prescriptive	Prescription	Optimisation	Achieving efficiency in supply chain by improving service and reducing costs
Revenue prediction	Predictive	Prediction	Learning / Descriptive and inferential statistics	Reducing inventory stock outs and improving cash flow management
Sales analysis, Financial reporting and budgeting	Descriptive	Reporting	Structured/ Unstructured data analysis	Quarterly financial analysis and budgeting
Insurance and credit risk modelling	Prescriptive	Simulation	Modelling and Simulation Inferential Statistics	Reduction on losses due to fraud and tailored pricing

**Table 1. Examples of business analytics applications, functional goals and analytical problem types (based on table 2 from (Bordawekar et al. 2012))**

One aspect in common in the applications of business analytics is the strong orientation towards supporting operational decisions. Bell (1998) and Bell et al (2003) argue that by virtue of their scale and impact on business performance, such operational decisions are indeed strategic in nature, hence his coining of the term ‘strategic operations research’ (SOR). They also argue that expertise in strategic operations research helps organizations to achieve sustainable competitive advantage. Thus, the concept of 'strategic operational research' can also be applied to ‘strategic analytics’ because business analytics tools have provided competitive advantage for organizations through operational efficiency studies

(descriptive and predictive analyses and occasionally prescriptive)<sup>1</sup>. Hence for these organizations business analytics based tools have become the cornerstone of their competitive advantage. Davenport and Harris (2007) support this suggestion since they say that analytics and big data have become a strategic capability and resource respectively (Chen et al, 2012), both key concepts to the theory of competitive advantage.

In summary, the case for business analytics providing managerial support for operational decisions is clear; business analytics is strongly rooted in data-driven analysis with its resulting focus on evidence-based management (Pfeffer and Sutton, 2006) and operational efficiency. The question remains: can business analytics offer support to strategy processes within organizations? The next section explores this issue by defining strategy and strategy processes and clarifying the nature of support that such processes require.

### **3. Strategy, strategy processes and the role of business analytics**

In contrast to operational decisions, strategic decisions, or strategies, are typically influenced by the following factors: multiple conflicting objectives, limited directly relevant data, diverse interested stakeholders, different decision alternatives, and long timescales and horizons. Thus when developing strategy it is difficult to determine whether the choice has been correct and whether such decisions are based on what managers foresee and believe rather than on what they know (McGee et al. 2010).

Mintzberg differentiates between strategies that are deliberate and emergent (Mintzberg, 1978) defining deliberate strategies as those intended or planned strategies that get realized. Such strategies exhibit the following characteristics: they are explicit; they are developed consciously and purposefully; and they are defined in advance. For example, a company intends to launch a new product in the market and using predictive analytics defines diverse

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<sup>1</sup> We are grateful to our reviewers for this suggestion.



scenarios for the sales of the new product to support the selection of strategic actions (Berry and Linoff, 1999). When strategies are designed, the role of predictive and prescriptive analytics is key to offer guidance on the decisions, as well as to validate their robustness using multiple sets of data. In contrast, emergent strategies are those which were not necessarily intended, but which nevertheless are realized. Changes in circumstance such as those due to unanticipated events or behaviours often drive the development of emergent strategies. For example, a business analytics project uncovers evidence of new customer behaviour that hadn't been considered previously by the management team and, as a result, they decide to change strategy based on this evidence. In this case, the role of descriptive analytics, as a tool for exploration, is fundamental to feed back the results of their strategies. In fact, Mintzberg suggests that classifying strategies into three neat types is not so straightforward and that reality is somewhat more complex as many strategies exhibit characteristics of being both deliberate and emergent. For example, he describes a pattern of strategy development as episodes of deliberate strategy development being interspersed with periods of emergent strategy development.

Strategy is not only something that an organization has but it is also an activity that it undertakes, hence the literature differentiates between strategy content and process (De Wit and Meyer 2004, Thomas and Ingo 2006). In the literature, strategy processes are described as multidimensional integrative frameworks (Bailey et al. 2000) that support decision analysis. Dyson and Foster (1980, 1983) argue that in order for a strategy process to be effective certain activities need to be in place. Table 2 shows the tasks and activities used by O'Brien and Dyson (2007) in a strategic development process along with the use of operational research tools to support the process. Such activities include: setting direction, goals and objectives; assessing both the internal and external environments; generating and assessing strategic ideas before implementing strategic change; learning from virtual

performance obtained from the use of one of more models of the organization; implementing strategy and measuring and monitoring current performance. . Given the nature of strategic development, during the strategy creation phase, the most relevant OR tools are drawn from within the soft OR spectrum, e.g. System Dynamics, Problem Structuring Methods, SWOT, in contrast to the use of more hard OR tools, e.g. Decision Risk Analysis, during the choice and evaluation phases.

To summarize, table 2 identifies five key stages in strategy processes: direction setting, analysing the environment; formulating strategic options, rehearsing and choosing options, and implementing strategy. One feature of such processes that a tabular display does not capture is that in reality they are inter-related activities rather than a linear progression (O'Brien and Dyson, 2007). The activities involved in setting direction for an organization are concerned with the desired future direction that key decision makers in the organization wish to follow. Analysing the environment consists of two activities, that of assessing the internal environment, for example in terms of current resources and capabilities, along with that of the external environment, changes in which can have a major impact on the organization. Formulating strategic options consists of generating ideas for future strategic initiatives, whilst rehearsing and choosing options involves assessing and evaluating ideas. Finally, implementing strategy involves activities including implementing the chosen strategies, optimising operational efficiency, developing detailed implementation plans and measuring and reviewing organizational performance.

We argue that business analytics tools, as they rely on quantitative disciplines, can support each of the steps of the strategy process since OR has been employed previously in this process (see table 2, third column). Therefore, we have added a fourth column to table 2 indicating the potential linkages between the strategy process and business analytics tools. However, we recognise that one of the key elements that business analytics brings to the

strategy process is the exploitation of big data, which is a strategic resource in many organizations (Chen et al, 2012).

Strategy Process		Supporting Strategy: Frameworks, Methods and Models O'Brien, Dyson (2007)	Operational Research and management tools supporting the strategy process O'Brien, Dyson (2007)	Business analytics categories of these tools and an explanation of how they can also support the strategic activity
<b>Setting direction</b>	Identification of strategic issues	Setting the strategic agenda	Problem Structuring Methods	Descriptive analytics uncovers patterns in the data not known (data-driven) or test hypotheses about issues (hypothesis-driven)
	Setting direction	Setting direction	Problem Structuring Methods	Prescriptive/Predictive analytics can help managers to foresee the impact of different options
	Setting strategic goals/objectives/priorities	Setting strategic goals/objectives/priorities	Problem Structuring Methods	Prescriptive/Predictive analytics assists managers to define the right goals and priorities
<b>Analysing the environment</b>	Internal	Analysis of internal environment	System Dynamics	Descriptive analytics can evaluate historical data of different business processes to uncover issues and their impact on customers
	External	Analysis of external environment	Scenarios	Descriptive analytics of macro data describes the behaviour of economic, social, technological and political factors
<b>Formulating strategic options</b>	Generating ideas for strategic initiatives	Generating ideas for strategic initiatives	SWOT	Prescriptive/Predictive analytics can help managers to foresee the impact of different options as well identify options not known previously
<b>Rehearsing &amp; choosing options</b>	Assessing/rehearsing initiatives/ selecting options	Assessing strategic ideas through use of models(s). Learning from virtual performance	System Dynamics Decision Risk Analysis	Prescriptive/Predictive analytics provides managers with the future impact of different options
<b>Implementing strategy</b>	Implementing strategic change	Implementing strategic change	Performance Measurement Systems	Descriptive analytics evaluates historical data of different business processes and their changes in the performance
	Review/measuring/monitoring feedback of strategic performance	Learning from virtual and current performance	Performance Measurement Systems	Descriptive analytic analyses historical data of different business processes to extract lessons for future strategies.

**Table 2. The use of strategic tools in strategic planning**

In the next sections, we explore whether evidence of the linkages proposed in table 2 exist within the literature.

## **4. Evidence of the use of business analytics supporting the Strategy Process**

### **4.1. Literature Survey**

The huge development of business analytics is perhaps best illustrated by the number of articles that can be found in the literature when searching with the term ‘analytics’ across a wide range of journals and disciplines. To capture the most recent contributions to the use of business analytics in Strategy, we conducted a review of literature from the beginning of 2012 up to and including April 2017. Our sources were two online databases: ABI Inform and Business Source Complete which cover a wide variety of academic journals principally related to the field of management. This decision reduced the chances of findings papers from computer science, information systems or mathematics that appear, for example, in conferences or trade magazines. We recognize this is an important limitation to our study but our initial searches suggested that it was appropriate to focus on these two databases given our application area of interest – supporting the strategy process. The searches were restricted to peer reviewed scholarly journals written in English, covering articles and case studies. In line with previous research, the search terms were applied to article titles and abstracts (Mortenson et al. 2015). Table 3 shows the number of articles that our searches uncovered. First we searched using the term ‘analytics’. As this returned a fairly large number of articles, we restricted the search to terms ‘analytics and strategy’, however this still returned a large number of articles. As an alternative we searched using the terms ‘business analytics’ followed by ‘business analytics and strategy’; this latter search, we felt, returned too few items. Thus we pooled the results from three searches resulting in over 400

articles once duplicates were removed. We read each of these abstracts, looking for case descriptions and specific applications of business analytics tools; this process reduced the number of relevant articles to 338. Of these, 89 articles covered the use of business analytics in support of strategy related activities; this constituted the final list.

Search Term	Source	Number of items found	Combined results excluding duplicates	Papers relevant to 'business analytics' after review of abstract	Papers relevant to business analytics & strategy
<b>Analytics</b>	ABI Inform	1,328		N/A	
	Business Source Complete	5,580			
<b>Analytics &amp; Strategy</b>	ABI Inform	157	414	338	89
	Business Source Complete	160			
<b>Business Analytics</b>	ABI Inform	101			
	Business Source Complete	126			
<b>Business Analytics &amp; Strategy</b>	ABI Inform	14			
	Business Source Complete	12			

**Table 3. Numbers of items found using different search terms**

Table 4 provides a two-way classification of the 89 papers according to the business analytics categories of the tools used within the research and the strategic activities that they supported; the activities are classified according to those identified in Table 2. What is immediately obvious from Table 4 is that none of the papers describe providing support for the activity of setting strategic direction. The activities most often supported by business analytics tools were those of implementing strategy and formulating strategic options. It is also interesting to note that some of the papers described the use of tools to support multiple activities, for example, formulation of strategic options and implementing strategy.

<b>Business analytics categories</b>	<b>Total papers</b>	<b>Analysing the environment</b>	<b>Formulating options</b>	<b>Rehearsing &amp; choosing options</b>	<b>Implementing strategy</b>
Descriptive	13	5	2		9
Descriptive/predictive	31	8	20	1	25
Descriptive/prescriptive	4		3		4
Predictive	31	5	15	1	21
Predictive/prescriptive	8		3	1	8
Prescriptive	2		2		1
Totals	89	18	45	3	68

**Table 4. Analysis of tool categories and strategic activities supported**

Table 5 illustrates a selection of items found describing the application of business analytics tools to strategy support within a single case setting. As can be seen most of the cases relate to the activity of implementing strategy, typically by focusing on implementing strategy through optimising operational efficiency.

<b>Case study</b>	<b>Source</b>	<b>Context</b>	<b>Business analytics tools used</b>	<b>Business analytics tool classification</b>	<b>Strategy activities supported</b>
Syngenta	Byrum et al (2016)	Development of plant-breeding strategy.	Simulation & optimisation	Predictive / Prescriptive	Formulating options/ implementing strategy
Virtual Radiologic	Körpeoglu et al (2014)	Matching more than 400 radiologists with time-varying seasonal demand	Forecasting, capacity planning	Predictive / Prescriptive	Implementing strategy
Large multistate gas utility	Angalakudati et al (2014)	Operational resource allocation challenge concerning maintenance crew scheduling	Heuristic & optimisation	Prescriptive	Implementing strategy
Speciality steel bar	Pajouh et al (2013)	Daily available-to-promise decisions which	Optimisation	Prescriptive	Implementing strategy

company		determine in real time the dates by which it can promise delivery of products that customers requested during the quotation stage			
Trane Inc	Jensen et al (2013)	Improve the manufacture of a problematic feeder component assigned to a dedicated manufacturing process	Value stream mapping, regression & simulation	Descriptive, predictive, prescriptive	Implementing strategy

**Table 5. Case studies describing the use of business analytics as an efficiency tool to implement strategy**

Table 6 illustrates a selection of the items describing the use of business analytics tools for strategy support within a particular contextual setting, e.g. the function of planning within healthcare sectors. These items typically presented research resulting in propositions about the way that business analytics should be used within their contextual settings with the implications being relevant to multiple organisations / sectors. In contrast to Table 5, there is a broader use of business analytics tools across the descriptive/predictive/prescriptive categories and a broader range of activities from the strategy process supported.

<b>Context</b>	<b>Source</b>	<b>Business analytics tools used</b>	<b>Business analytics tool classification</b>	<b>Strategy activities supported</b>
Healthcare planning & Scheduling	Harris et al (2016)	Regression & functional approximation	Predictive	Analysing the environment / Formulating strategic options
Supply chain management	Wang et al (2016)	Statistical analysis, simulation, optimisation	Descriptive, predictive, prescriptive	Analysing the environment / Formulating strategic options / Rehearsing & choosing options / Implementing strategy
Direct marketing campaign	Asllani and Halstead (2015)	Goal Programming	Prescriptive	Rehearsing & choosing options
Customer churn prediction	Verbraken et al (2014)	Bayesian network algorithms	Predictive	Analysing the environment
Impact of employee health on business operations	Barron (2013)	Classification tool	Descriptive	Analysing the environment / Formulating strategic options
Interpreting data from statistical	Heer and Shneiderman	Visual analysis	Descriptive	Analysing the environment / implementing strategy



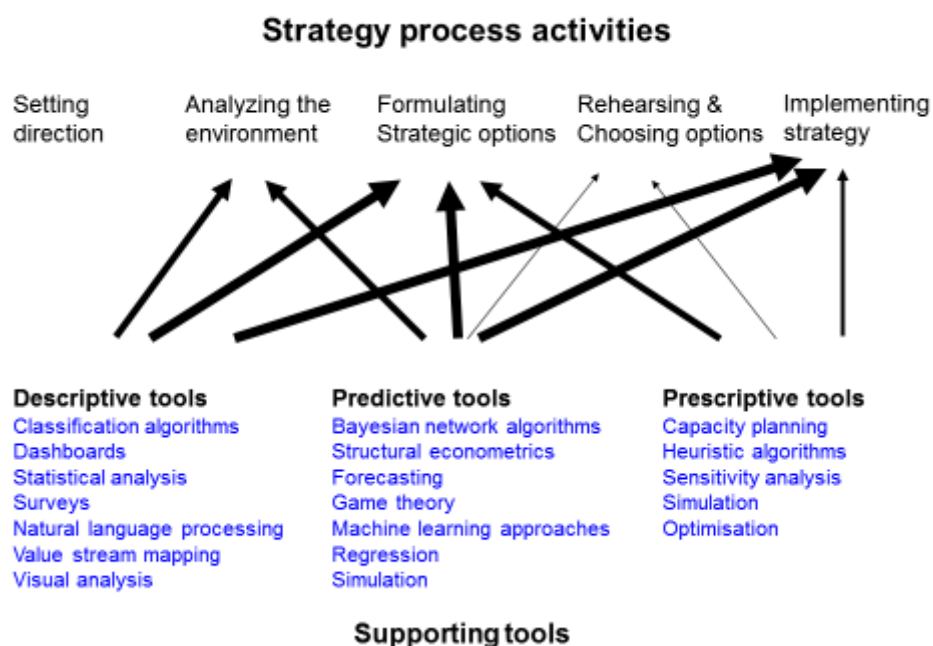
algorithms & data management systems	(2012)			
Development of a planning system	Kapoor et al (2012)	Dashboard, statistical analysis, simulation, sensitivity analysis	Descriptive, Predictive	Analysing the environment / Formulating strategic options / Rehearsing & choosing options / Implementing strategy

**Table 6: Examples of the use of or research into business analytics within different contextual settings**

## 4.2. Mapping the results to strategy process activities

After our review of the literature, we suggest, as figure 1 illustrates, that different tools classified under the banner of business analytics can support activities within the strategy process; the figure maps the tools captured in Tables 4, 5 and 6 to the key activities within a strategy process. We note that some tools may appear under more than one category depending on how they are used. For example, the UK OR Society classifies simulation as a prescriptive tool (The OR Society, 2017), whereas Lustig (2010) classifies it as predictive. It is clear from the diagram that there is evidence of all bar one activity (setting strategic direction) being supported by business analytics tools. **The thickness of the arrow indicates the frequency of link between tool type and activity considering the sample of articles considered in this research.** It is not surprising that our research found no evidence of business analytics providing support to the activity of setting strategic direction since goal-setting is usually performed by managers using discursive approaches, except perhaps where the goals are simply extrapolations of current performance as shown in dashboards. In contrast, most support is provided to analysing the environment, formulating strategic options and implementation through the use of descriptive and/or prescriptive analytics tools. The analysis of the environment, internally or externally, can be performed using classification algorithms and natural language processing to uncover trends. More importantly, predictive

tools, e.g. machine learning, Bayesian networks, simulation and forecasting, can help managers to foresee threats and opportunities during the analysis of the environment. When managers want to formulate strategic options (e.g. a marketing strategy), they start with an understanding of the current situation of the business using descriptive analytics (e.g. web analytics to evaluate customer sentiment) before extrapolating the trends of the current situation into the future (e.g. deterioration of customer sentiment) in order to formulate strategic options to change the future trends (e.g. marketing strategy to improve customer sentiment). The detection of the threats and opportunities can lead to formulating strategic options by considering optimisation algorithms. It is clear that choosing options is also the realm of optimisation and heuristics as the search can be daunting given the multiple options. Finally, implementing strategy can have a reactive approach using descriptive tools, e.g. dashboards, visual analytics and statistical analysis, to analyse the results obtained or a proactive approach using predictive tools, e.g. forecasting, game theory, and prescriptive tools, sensitivity analysis and optimisation.



**Figure 1 Mapping business analytics tools onto activities within a strategy process**

## 4.2. Case Studies

One of the authors was engaged with a colleague in two diverse business analytics projects in the Pharmaceutical Industry; for a review in detail of the projects see Kunc and Kazakov (2013) and Kazakov and Kunc (2016). The case studies related to performing business analytics to develop strategies either to reduce costs for government or to facilitate the successful launch of new drugs. Table 7 presents a summary of the case studies in terms of supporting strategy and business analytics.

Market data is clearly a strategic resource that can be exploited using descriptive analytics, e.g. dashboards and visual analytics, and predictive analytics, e.g. forecasting and machine learning, tools. However, strategic questions may also require data that does not exist, so it cannot be extrapolated from past behaviour. In this situation, simulation methods, e.g. system dynamics (SD) modelling, can be a useful analytic tool. Among the variety of simulation modelling tools, SD modelling (Sterman, 2000) is one of the most widely used tools to model and simulate business problems (Jahangirian et al, 2010) and support strategic development processes (Kunc and Morecroft, 2007; Torres, Kunc and O'Brien, 2017). SD can be categorised as predictive modelling tool since it aims to answer questions such what will happen next? (Lustig et al, 2010). Some SD scholars argue that SD can also provide synthetic data for posterior analysis using traditional business analytics methods such as clustering (Pruyt, 2017).

Case study	Source	Context	Business analytics tools used	Business analytics tool classification	Strategy activities supported
Competitive	Kunc and	An initiative run by the	Statistical	Descriptive	Identification of

dynamics in pharma markets	Kazakov (2013)	government health institute responsible for reimbursing medicine expenses to reduce future costs of medicine for cardiac diseases	Analysis  System Dynamics	Predictive	strategic issues Analysing environment Formulating strategic options Assessing initiatives
Development and re-assessment of a product market strategy for a new drug launch	Kazakov and Kunc (2016)	A generic pharmaceutical company intended to launch a new generic drug but it was delayed by registration issues. The firm's initially planned first-to-market strategy transformed into last-to-market entry. The company needed to design a new strategy.	Statistical Analysis  System Dynamics	Descriptive  Predictive	Identification of strategic issues Analysing environment Formulating strategic options Assessing initiatives

**Table 7: Summary of the cases using business analytics to support strategy within the pharmaceutical industry**

There are interesting similarities between the two case studies that highlight the importance of business analytics for sense making (e.g. identification of strategic issues and analysing the environment) and its subsequent use to complement and enrich data insights. First, the existence of data at the industry level can provide powerful insights for understanding the past and current dynamic of markets: volumes, frequency, and trends of prescriptions. The pharmaceutical industry has one of the first examples of big data when a database containing prescription activity at industry level was created: the National Prescription Audit (NPA) run by IMS Health (IMS Website). IMS Health, which was founded in 1954, is a global information and technology services company providing clients in the healthcare industry with 10+ petabytes of complex healthcare data across 100 countries (IMS Website). NPA is a widely accepted and employed source of prescription activity for pharmaceutical products collected from retail channels, e.g. pharmacies, and it contains information about patient age, patient gender, methods of payment, drug utilization, Rx size, average consumption on a weekly and monthly basis (IMS Website).

The positions held by the different actors within the industry strongly affects the interpretation of such big data and the purpose of the analysis. For example, the government saw increasing the prescription volume for expensive drugs as presenting both current and future problems with regard to funding while the pharmaceutical industry perceived growing trends as an opportunity to launch new variations of a successful medicine. Additionally, it should be noted that big data has the potential to bias strategic decision making. Big data reflects both past and current behaviours and it only accounts for what has been measured; therefore, strategies that require seeing the problem with an innovative lens may be misled. For example, the pharmaceutical company found themselves in a disadvantageous position since the successful medicine was already in the market. Consequently, the initial strategic assessment was to define strategies trying to entice current patients to switch to its medicine. The existing data didn't account for future patients, people with the disease who had not yet been diagnosed, and people who had abandoned their treatment using the existing medicine. In this case, the use of system dynamics, as a tool to conceptualise the business case, was important to detect sources of data not being accounted for within the strategic planning process. Thus, descriptive analytics can only work in the presence of adequate data and adequate data only exists if there is a purposive attempt to collect it, e.g. multiple behaviours and transactions are not collected automatically by the current technologies. Finally, predictive/prescriptive tools can be useful in creating supplementary synthetic data to help evaluate the robustness of strategies. Since synthetic data sets were able to reflect the properties of the original data sets (Eno and Thompson, 2008; Pruyt, 2017), system dynamics simulation was very useful in creating synthetic time series of volumes, frequency and trends of prescription patterns considering patients that had not been registered in the original NPA data.

## 5. Discussion

From table 4, we can draw some interesting insights about the use of business analytics tools to support the strategy process. Firstly, the two most common categories of tools employed are descriptive and predictive, indicating the use of business analytics to make sense of strategic problems, especially during the implementation of strategies, rather than using the tools to find solutions to strategic problems. While there seems to be a large number of papers suggesting the use of business analytics for formulating strategic options, their use is mostly associated with the generation of future trends to validate the options to be explored.

Our research has found evidence within the literature that business analytics tools are being used to support activities within a strategy process; however there some gaps. Our research found no evidence of the use of business analytics being used to support what might be considered the first stage of the strategy process, ie developing vision, mission and strategic objectives; such a finding is consistent with earlier research into the use of operational research approaches to support strategy development (Pidd, 2004). Much of the evidence that we found documented the use of business analytics to provide support to the logical back end of the process, focusing on strategy implementation and in particular, the optimisation of operational efficiency. There was also evidence that descriptive analytics has been used to support some activities towards the logical front of the process by providing real time information to help decision makers to make sense of their environment in the form of current issues facing their organization, for example emerging customer behaviours and trends. The evidence around the use of predictive analytics suggested it can be employed for formulating strategies in two stages. Firstly, extrapolating current trends offers a view of the future under a ‘business as usual’ situation. Secondly, strategies can be tested through observing their impact on the future trends and comparing them with ‘business as usual’.

However, there is a potential danger of narrowly focusing on real time data as strategies may become overly emergent. Ackoff (1983) long ago warned managers of the dangers of predict and prepare attitudes and practices; in the context of strategy processes concerned with the longer term future development of the organization, typically within contexts of increasing environmental uncertainty, such warnings warrant consideration. That is not to say that real time data analytics should not be used to support the strategy process. Rather, strategic decision makers need to appreciate the business analytics offering and recognise when it is appropriate to integrate business analytics into the strategy process, as a scientific process of transforming data into insight.

Having considered the evidence from our research, it is our view that strategy processes require more than the business analytics tools as captured by the current definitions of the analytics field because some activities require the integrated use of soft and hard information/data or even data that hasn't yet been collected because of the future oriented and visionary component of strategy development. Therefore, those using business analytics to support a strategy process need to adopt an integrative approach considering existing and supplementary synthetic data.

Another observation from our review of the literature is that there is evidence of the combination of more than one business analytics category of tool (table 4, 5 and 6). It is clear that strategic development processes are complex and require more than one tool to understand and define how to tackle the issues. The field of business analytics would therefore benefit from the consideration of the multi-methodology literature (Mingers and Gill, 1997). Tools from diverse fields have a long history of supporting activities within the strategy process. In our research we have found evidence that business analytics has been used to support activities within the strategy process; this can be used to supplement the existing research into how tools from different fields have been combined with strategy tools

(Kunc and Morecroft 2007, Kunc 2008, O'Brien 2011). There is some evidence (Jensen et al. 2013) of business analytics tools being combined with tools from other fields to support strategy. Notably though, we have not found evidence of the explicit combining of business analytics with well know strategy tools. Therefore, we suggest that those using business analytics tools to support a strategy process should consider a methodological approach that can accommodate diverse data sets and sources, including managerial assumptions and experience. Given the paucity of advances in business analytics, we cannot foresee how the next wave of tools will affect operational and strategic development processes. However, the developments in areas such as text analytics, web analytics, network analytics, and mobile analytics (Chen et al, 2012) may have important impact. Additionally, visual analytics, which are based on analytical reasoning, may be central to applying managerial judgment to reach conclusions from a combination of evidence and assumptions for understanding historical and current situations, as well as trends and events leading to current conditions (Thomas and Cook, 2006).

It is clear from the two cases studies that both business analytics and big data play an important role in supporting strategy since they help to uncover possible blind spots in strategy through analysing historical data and evaluating the robustness of strategic options using available business data. Cooperative big data sets, such as in the case of NPA in the pharmaceutical industry, can be important tools to help foster efficiency at an industry level through the use of business analytics to identify strategies that can benefit the whole industry. However big data may curtail innovative thinking and lead to strategies that affect industries negatively, as illustrated in the case study of the company only focusing on the behaviour of customers captured by the existing big data. Cooperative big data sets may thus form part of an e-government strategy (Irani et al 2007). Consequently, it is necessary to have an



important balance between data as a resource shared by the industry and a resource owned privately by one firm.

## **6. Conclusions**

Our paper evaluates the potential that business analytics can provide to support strategy processes. We have discussed the emerging field of business analytics and illustrated how business analytics has been applied in practice. There is some evidence that business analytics has been used to support evidence-based decision making. However, there is a danger that business analytics may be perceived as mainly providing operational support to decision makers through its strong focus on solving complex operational problems mining only historic data sets (an emergent strategy focus). Therefore, whilst business analytics may generate strategic change in organizations it may only be perceived as supporting emergent strategies.

We strongly believe that business analytics has a role to play in supporting a broader range of strategy making beyond the emergent realm. Business analytics can transform data into a more valuable strategic resource which is more difficult to imitate when data is combined with insights and intelligence, which is the realm of OR. In order to do this, we suggest that business analytics needs to engage with additional tools dealing with inputs in addition to data such as soft or qualitative data, including managerial knowledge and assumptions. Thus, we can visualize the integration between business analytics and other tools, such as traditional strategy tools, within the needs of each strategy activity.

Additionally, the actors participating in strategic development processes will change when IT departments, which manage data as a resource, become more active participants in the process. There will also be more active roles for OR consultants, who specialize in business analytical tools, within the teams supporting the strategic development process.

Finally, our research from both the literature and case study analyses indicate that the application of business analytics tools for strategy support should adopt a multi-methodological approach where some tools can be used to help make sense of and uncover problems/issues using existing big data while other tools can support the design and assessment of strategies.

Our proposition is not without limitations. The incredible number of papers published in journals from diverse disciplines in the area of business analytics implies the need for a more detailed review of the literature to extract patterns; we did not perform this task as our research focused on the issue of supporting the strategy process. Thus, further research may need to develop additional taxonomies to identify true business analytics practice from other practices which may be named similarly but which are intrinsically different. The existence of multiple perspectives on strategy may prevent the definition of a unique taxonomy of strategy process so our findings may be influenced by the complexity existing within the strategy field with respect to such processes. Finally, we propose integrating business analytics tools with other tools during the strategy process, but it is beyond the scope of this paper to explore how such integration may work. Thus, additional research is needed to explore how business analytics may be used in combination with other approaches suitable for the interactive nature of strategic making within a multi-methodological approach to support strategy, such as soft OR, and strategy tools.

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