Visualising Strategies: The impact of user interpretation of a strategic decision support system

Martin Kunc

Warwick Business School, UK

Martin.Kunc@wbs.ac.uk

Ross Kazakov

Strateggo Ltd, Bulgaria

Paper Presented at the 32nd International Conference of the System Dynamics Society, Delft, Netherlands

July 20 – July 24, 2014

ABSTRACT

On the one hand, simulation models have been employed to support managers to understand the complexity in their businesses. On the other hand, there are different simulation models and different user interfaces to support managers' decision making processes. The use of simulation models will have different impact on managerial effectiveness to understand the information provided by the performance measurement system and manage their businesses. In this paper, we explore the interpretation of users of a strategic decision support system based on the concepts of dynamic resource-based view/strategy maps and its impact on the strategic decision making process. Our aim is to identify what is the impact of the interpretation assigned to the decision support system on the decisions made. The research has been conducted with 30 product managers from the pharmaceutical industry exploring similar decision support system. The results indicate that sense making is a key factor affecting the usefulness of decision support systems and impacting the decision making process.

1. Introduction

Companies make significant investments in the development and implementation of performance measurement systems assuming the use of performance measurement systems has a positive impact on the performance of the organization due to an improvement in strategic learning and decision effectiveness. However, empirical research into the performance implications of performance measurement systems is still scarce and ambiguous (Capelo & Dias, 2009). Sometimes, inadequate definition and use of the performance indicators are highlighted as factors affecting the performance measurement system (Ittner & Larcker, 1998). Capelo & Dias (2009) also suggest the measures and perspectives are independent and do not follow a cause-and-effect logic. Moreover, Kunc (2008) found that delays are not usually considered in performance measurement systems. Additionally, Lipe and Salterio (2000) examined the judgmental effects of the balanced scorecard (Kaplan & Norton, 1996) in a business unit finding more emphasis on common measures and under-weight for unique measures. To summarize, the attention of managers to performance measurements is not similar or even aligned to the intended design of the performance measurement systems. This situation, in addition to the complexity of organizations, may require the use of simulation models to support managers making sense of how the performance measurement system operates in terms of cause-effect relationships (Kunc, 2008).

However, using simulation models may imply some problems. While simulation models have been employed to support managers to understand the complexity in their businesses (Kunc and Morecroft, 2007), there are different simulation models and different user interfaces, from 'back of the envelope' type of models to fully developed models (Kunc and Morecroft, 2007). Consequently, the use of simulation models may have different impact on managerial capabilities to read and understand the information provided by the performance measurement system. Our aim in this paper is to explore the impact of managers' interpretation of the decision support system on the decisions made.

We performed an observational study of a group of managers from the same industry using a strategic decision support system based on the concepts of dynamic resource-based view (Morecroft, 2002; Kunc and Morecroft, 2010) and systems thinking-based strategy maps (Kunc, 2008; Kaplan and Norton, 2000, 2001). The research has been conducted with 30 product managers from the pharmaceutical industry during a one day workshop.

2. Balanced Scorecard and Dynamic Resource-based View

Kaplan and Norton (1996) developed the balanced scorecard (BSC) with the aim of overcoming limitations of traditional performance measurement systems narrowly focused on financial measures. BSC systems feature a mix of leading (performance drivers) and lagging (outcome measures) indicators, financial and non-financial measures, and hard and soft measures. BSC systems aim is to help managers monitor actual financial and market performance, evaluate the results of short-term actions, and assess the progress of implementing corporate strategy (Kaplan and Norton, 2000). BSC systems provide top managers with a picture of a possible future (vision), a plan for getting there (strategy) and a map of the medium- and short-term quantifiable objectives and actions (Kaplan and Norton, 2001). Kaplan and Norton (1996) describe the process of strategic learning using BSC: organizations employ BSC to link strategy to the budgeting process; management teams review strategy using the BSC; and finally a process for learning and strategy adaptation evolve the organization based on the information obtained from BSC systems.

Later on, Kaplan and Norton (2000, 2001) developed, and emphasized, the strategy map as a complementary tool to BSC systems. The strategy map links the performance indicators in a causal chain representing the company's critical objectives and the crucial relationships among them that drive organizational performance (Kaplan and Norton, 2000). The strategy map identifies the interconnectedness within the business and the importance of understanding cause-and-effect relationships and their dynamics upon which to infer future performance and define objectives and action plans (Warren, 2002). While BSC systems may be consistent with a systemic and dynamic view of business management and performance measurement (Capelo & Dias, 2009). Kunc (2008) found that managers can identify 50% more concepts related to their business performance using simply causal loop diagrams than BSC. Kunc (2008) suggested that qualitative causal loop diagramming helps managers to identify key variables and their causal interrelations, and the use of system dynamics simulation modelling is necessary to develop a better comprehension of business dynamics, such as time delays and accumulations in the key business processes. The use of BSC systems and strategy maps fits well with the resource-based view of the firm and the dynamic management of resources (Kunc and Morecroft, 2009).

The 'resource-based view' (RBV) of the firm (Wernerfelt, 1984; Barney, 1991; Peteraf, 1993) emerged as an opposition to the Porterian view of strategy. Resource-based theory (RBT) focused its analyses on the opposite, internal or introvert perspective to posit that firms' performance differences are based on a certain set of internal capabilities or unique organizational assets (Henderson and Clark, 1990), or resources which should lead to sustainable competitive advantage only if they are 'valuable, rare, imperfectly imitable, and non-substitutable' (Barney, 1991, pp. 105–111). RBV also posits that firms can be conceptualized as bundles of resources, which are heterogeneously distributed across firms, (Amit and Schoemaker, 1993; Penrose, 1959; Wernerfelt, 1984; Pitelis, 2007), but its research initially failed to answer questions about resources dynamic nature and origin. Only in the recent years, RBT was expanded with research to partially account of its initial static stance, introducing concepts of resources and capabilities life cycle (Helfat and Peteraf, 2003), and the dynamic management of resources (Sirmon et al., 2007) by dynamic managerial capabilities which align, coordinate, reconfigure and renew the firms resource base (Teece, 2007). Dynamic capabilities also carry the capacity to respond to change by realignment and renewal of firms activities (Porter, 1996) thus supporting a constant state of "strategic fit" (internal and external) (Miller and Shamsie, 1996; Siggelkow, 2002; Eisenhardt and Brown, 1999) and "strategic surprise" (Volberda and Rutges, 1999).

Sirmon et al. (2007) suggested a dynamic resource management framework with the prime purpose to account for some deficits of the RBT like "oversight of dynamism, environmental contingencies and managerial role", by linking value creation in dynamic environmental contexts to the management of firm resources. Components of the suggested resource management model include "structuring the resource portfolio, bundling resources to build capabilities, and leveraging capabilities". Also the model incorporates causal flows and feedback loops suggesting the need of continuous adaptation to the external market dynamics. Acquiring, accumulating, and divesting are the structuring processes described to obtain the resources that the firm will use for bundling and leveraging purposes. Bundling refers to the processes (i.e., stabilizing, enriching, and pioneering) used to integrate resources to form capabilities, and leveraging involves a set of processes like mobilizing, coordinating, and deploying capabilities in order to take advantage of specific markets' opportunities. The System Dynamics Group at London Business School, e.g. Warren (2002), Morecroft (2002), Kunc and Morecroft (2010), established the linkages between RBT and System Dynamics developing a Dynamic Resource Based-View of the Firm (Dynamic RBV). Dynamic RBV posits that firms are systems of resources which are conceptualized and managed by bounded rational managers. While resource conceptualization is a cognitive process influenced by managers' mental models, resource management processes are goal seeking processes responsible for managing the set of resources (Kunc and Morecroft, 2010). Therefore, resource management processes are strongly linked to performance measurement systems in terms of goal and target setting and managerial attention to certain resources (as they are considered important through the performance indicators included in the BSC).

Organizations usually operationalize resource management processes and performance measurement systems through decision support systems (Kunc, 2008).

3. Decision Support Systems

In recent years, the availability and quality of model-based decision support systems have increased exponentially in different areas, e.g., customer relationship management systems, retail marketing, employee scheduling (Banker and Kauffman 2004). However, some researchers (e.g., Van Bruggen et al. 1996, Lilien et al. 2004) suggested a lack of user understanding of the logic underlying decision support systems output due to the dynamic complexity existing in organizations. Decision making in complex dynamic systems is a continuous process. We learn to make decisions by perceiving the changes in the system, storing examples of situations experienced, and predicting future situations based on past experience (Tabacaru et al, 2009) continuously refining decision making processes. Thus, experienced decision makers do not choose among alternatives, but rather assess the nature of the situation and, based on this assessment, select an action appropriate to it (Tabacaru et al, 2009).

Similarly, managers make decisions and learn in the context of feedback information systems (Morecroft, 2007). In single-loop learning, managers follow a simple goal seeking decision making process as they compare information about the state of a real system to pre-established goals, perceive deviations between desired and actual states, and make the decisions they believe will move the system towards the goal (Morecroft, 2007). In double-loop learning process, information about the business system is not only used to make decisions but also feeds back to modify the managers' mental models (Sterman, 2000). As their mental models change, managers define new strategies and policies. Cognitive limitations and quality of feedback information are factors that impact the effectiveness of double-loop learning since they affect managers' perception and understanding of the actual business system (Sterman, 2000). However, there is an additional factor that affects double-loop learning processes, which is the interpretation of the information received. Dynamic decision-making theory based on mental models (Morecroft, 2007) implies that managers make decisions which are the result of applying rules and policies governed by their mental models. Thus, an erroneous mental model implies significant differences between managers' perceptions and business reality.

Decision support systems contain variables representing the complexity of the real world to support managers to make decisions. BSC systems are decision support systems. However, accounting studies (e.g., Ittner et al., 2003) couldn't find evidence that the use of BSC as a performance measurement system enables managers to learn more effectively about the business system and improve its performance through better decision making. Perhaps managers may not appreciate the significance of non-financial and leading measures eluding the cause-and-effect logic chain (Lipe and Salterio, 2000). Even though the set of performance indicators includes the most important components of the business system, this information is not helpful if managers do not understand the crucial relationships among these indicators and how they drive organizational performance (Capelo & Dias 2009; Kunc, 2008).

Ritchie-Dunham et al. (2007) using simulation-based experiments tested the impact of a decision support system based on BSC principles. They found that similarity between the subjects' mental models and the structure of the simulation model impacted positively the BSC usage. Other results (Strohhecker, 2007) also showed that the use of simulation-based BSC systems led to mental models closer to reality and positive impact on performance. Kunc (2008) suggests the feedback process for modelling and reviewing manager assumptions about cause-and-effect relationships leads to a better understanding of the business context and can promote organization performance. Capelo & Dias (2009) proposes the development of strategy maps to improve learning capacity because the participants become 'system modellers' as they develop a systemic and dynamic understanding of the business context.

An important aspect related to Dynamic RBV is the key role of asset stock accumulation processes in the performance of the firm, e.g. human resources, customers, etc., since resources are the basis for past, present and future performance (Warren, 2002). However, people fail to grasp that the quantity of any stock, e.g. customers, only rises when the inflow, new customers, exceeds the outflow, customer losses (Sterman, 2010). People assume that the output of a system is positively correlated with its inputs, e.g. the output (the stock) behaves like the input (the flow or net flow) (Sterman, 2010). Cronin, Gonzalez and Sterman (2009) call such behavior the correlation heuristic. They show that stock-flow errors are robust to a wide range of information displays and other conditions. Therefore, it may be an important condition for decision support systems to display the information correctly in terms of asset stocks and flows to the stocks. Sterman (2010) and Kunc (2011) found that even relatively brief exposure to stock-flow concepts appear to improve people's abilities to recognize stock-flow structure and correctly apply the principles of accumulation. Therefore, strategic decision support systems may provide information not only on measurements systems, e.g. BSC, but also on the asset stock accumulation processes underlying the performance of the firm.

To summarise, there are positive developments in performance measurement systems with the use of strategy maps but there are still aspects to improve, such as understanding resource accumulation processes, to fully appreciate the dynamics of businesses through the use of performance measures in decision support systems.

4. Research methodology

The methodology employed involves an observational study of the behavior of managers when they face a decision support system based on the concepts of Dynamic RBV. In this case, the decision support system was embedded in a “management flight simulator” using System Dynamics (Sterman, 2000).

Two types of simulators can be identified in SD: simulators used for facilitated learning and to support individual learning. The simulators for facilitated learning, “management flight simulators”, are usually used in workshop settings, where the learning process is overseen by a facilitator. Management flight simulators do not reveal to the learners the causal structure of the underlying model so participants are supposed to discover the structure while engaging in a double-loop learning process that involves active and reflective experimentation (Morecroft and Sterman, 1994). The students should actively engage in exploring the virtual world to have a successful learning intervention. SD-based simulators that facilitate individual learning are known as Interactive Learning Environments or transparent box simulators. A key feature of this type of simulators is that along with the outcome feedback, provided by the management flight simulators, the learners receive also cognitive feedback based on the causal structure and how it determines the behaviour observed (Hämäläinen et al, 2013). Some scholars found a positive effect of providing subjects with information about the causal structure of the underlying model (Großler et al. 2000).

In this case, we trained a group of managers from the pharmaceutical industry in strategic analysis using Dynamic RBV before showing a strategy map. Then the participants had the opportunity to use a management flight simulator as a decision support system to manage a drug in a competitive pharmaceutical market.

5. Study

We have conducted a workshop on Pharmaceutical Product Performance Modelling and Management of Dynamic KPIs using a Pharma Balanced Scorecard. The workshop was delivered to more than 30 mid and senior product managers working at diverse group of multinational innovative and generic drugs companies present in an Eastern European country.

The workshop focused on challenging the widely spread perception of static product performance management and KPIs setting with a dynamic resource-based view perspective. A key question for consideration was the managerial ability to forecast accurately product performance, which is a critical but highly uncertain task related to the commercial evaluation of a new drug in the pipeline, the new drug launch strategy and the new drug performance measurement and control.

Limitations of the managerial ability to forecast accurately product performance were identified by the literature and practice (Paich et al, 2011) to be based on two widely used sets of aggregate assumptions: expected indication prescriptions over sales and expected share of prescriptions over sales. Hence, the low degree of accuracy of the forecasting process is connected with misapplication of similar products’ historical performance, failure to leverage information and knowledge from multiple sources (information and interpretation complexity), inconsistent assumptions to evaluate strategic options, disconnection between forecast and operationalization of product strategies, and generally static approaches.

With the aim to explain an approach for overcoming the above described limitations, a dynamic model of KPIs setting and performance forecasting was presented to the workshop participants, based on the BSC (Kaplan and Norton, 2001) and dynamic RBV (Morecroft, 2002). The model took into account four key dimensions, relevant to the pharmaceutcal market: Organizational structure and capabilites; Processes and systems to develop drugs and compete; Product differenting value proposition and treatment attractiveness; Doctors and their demands and expectations as key customers; and the Healthcare environment structural and regulatory changes, including new stakeholders. From a Dynamic RBV perspective, the key resources of a Pharma Market Resource System (Figure 1) are Doctors' Prescribing Behaviour (Doctors Adoption of a drug); Treatment Attractiveness in term of product performance and value for money; Sales Force and Marketing Budget; Patients Flow as access to new patients and to competitors' patients; and Government related resources such as access to pricing and reimbursement authorities. The dynamics of the resources were also simply explained using the flows to the resources (see Figure 1)

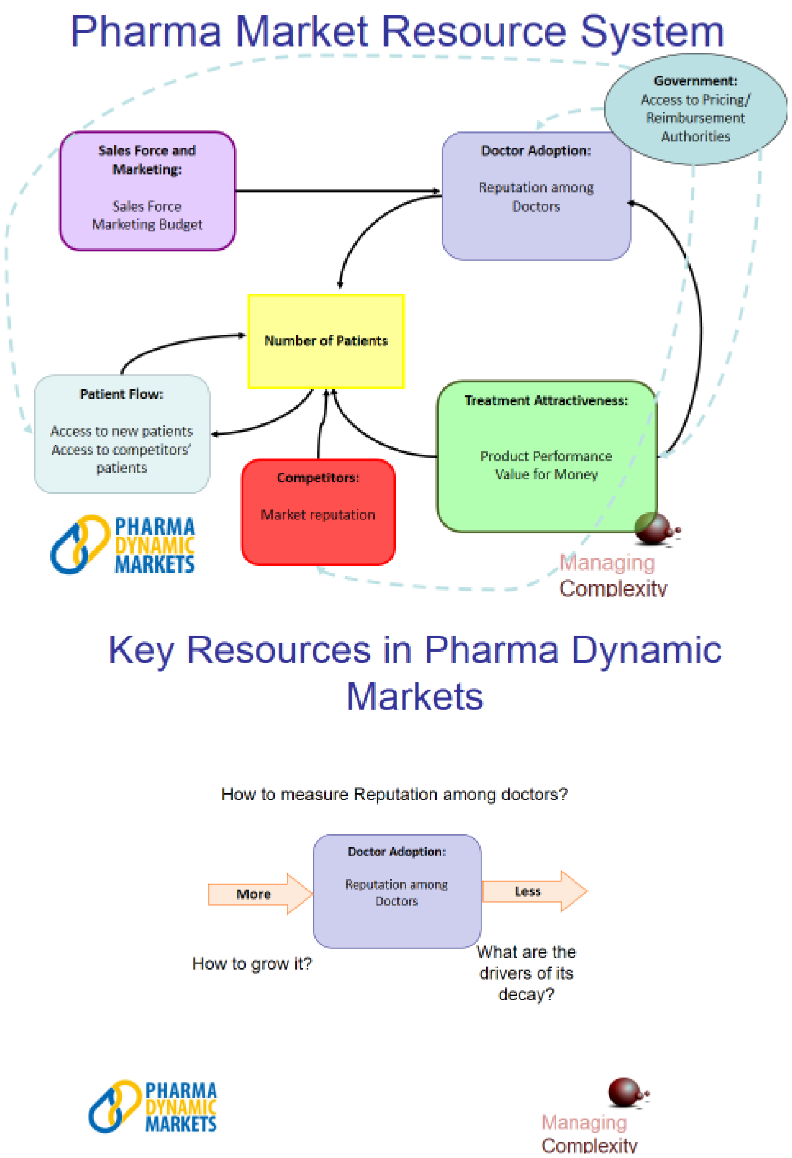

Figure 1. The Pharma Market Resource System and basic flow adjustment

After the introduction of the Pharma Market Resource System, described above, the workshop attendees were gathered in nine competing groups and given the task to set realistic product budget objectives in order to achieve highest profit, using the model interface by means of manipulating budget allocation to the following activities: Personal (doctor) promotion; Non-personal (doctor) promotion; CME (continuous medical eucation); and Patient education. The working with the model provided ground for the product managers to think how – by appropriate budget allocation across ativities - to positively influence the key resources' accumulation and growth and negatively influence the resources depletion processes. And most importantly, the managers tried to manage their strategies (set of budgeted activities) in a systemic fashion, accounting for causal loops and feedback effects. By virtually allocating alternative budget values to these activites, the participants were able to formulate and try the performance outcomes of different configuration sets, reflecting managers' understaning of the needed product market strategy mix within a constrained budget resources and with the goal to outcompete their virtual rivals from the other groups.

Another question was explored connected to the complexity of KPIs employed by pharma companies, that account to thousands in number, and the difficulty to meaningfully interpret the vast variety of the data observed by the practitioners and the dynamic interrelationships between all the performance indicators. In this respect, a new construct was introduced to the participants that we named The Pharma Balanced Scorecard (Figure 2).

The Pharma Balanced Scorecard builds on the Pharma Market Resource System (see figure 1) and links the key resources (doctors adoption, treatment attractiveness, sales force effectiveness, patients flow, access to reimbursement and response to competitors moves) and their dynamic to measures, targets and initiatives. The whole decision support tool is intended to help managers to forecast future and monitor actual product performance, to identify strategic gaps and take corrective actions.

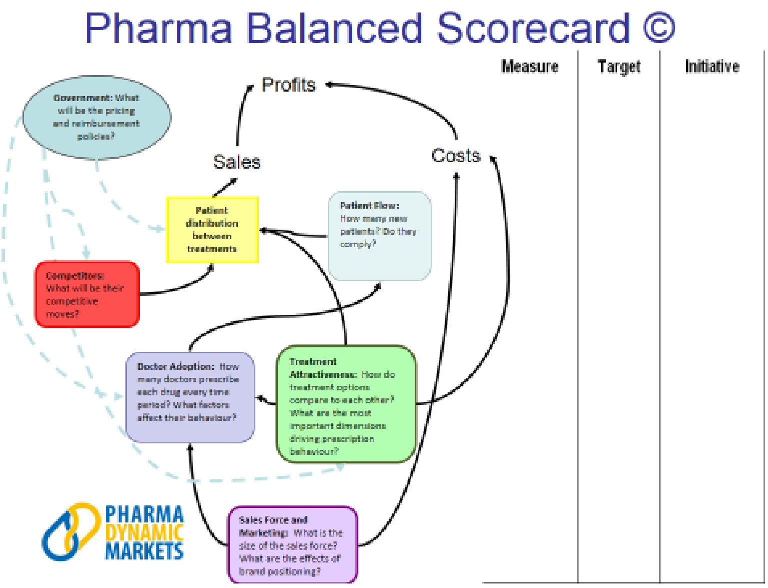

Figure 2. The Pharma Balanced Scorecard

In order to assist a more thorough understanding of the resource dynamics and their dependance on the budgeted marketing activities by the workshop participants, the model was presented to the group teams as a decision support system embedded in a "management-flight" simulator with two interfaces: in the form of SD interface developed with Vensim software (see figure 3), and in the form of a Java programmable interface (not included). Both interface types exhibited, on the one hand, key input (independent) variables which the group teams were able to manipulate and try different scenarios and resource configurations and, on the other hand, key output (dependent) resources and related indicators.

The decisions (see figure 3) were: Total Marketing Budget, Continuous Medical Education (CME) budget, Personal and Non-personal promotion budget, Patient Education budget (the last three concepts are percentage of the total marketing budget), Access to Reimbursement Budget, Product utility/Attractiveness, Product Price, and expected Competitor aggressiveness. The managers could observe the results in terms of product market share, profits, number of prescribing doctors, current, new and swithcing patients, relative product performance in respect to rival products, and reputation among doctors.

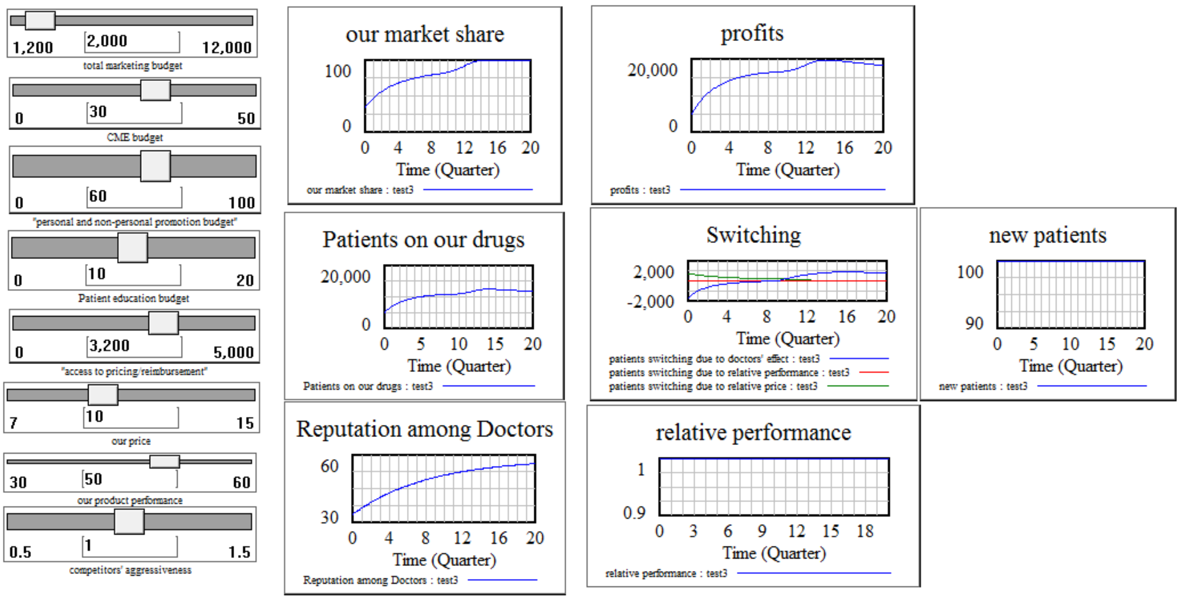

Figure 3. Management flight simulator for Pharma Resource Market System using Vensim

6. Results and Discussion

We present the results in two areas: final performance obtained and the market each group believed was managing. The results were surprising (see table 1) if we assume that they should obtain similar performance from a learning perspective (e.g. using the management flight simulator without consideration of their contextual knowledge). The nine groups differed in their results given the same decision support system (management flight simulator) and the intrinsic knowledge about the dynamics of the Pharma Market Resource system (they received the same training before the experimentation task). However, results were not surprising if we include the contextual knowledge about their market segments. In other words, their interpretation of the variables could have been influenced by their knowledge about the market segments.

For example, an important relation identified is between the investment in marketing and the conceptualization of the market, groups tended to allocate more marketing budget when they expected to be in a larger market. This clearly shows an indication of cause-effect thinking in their decision making process where their conceptualization of the market influenced in their budget. Another interesting example is that most groups agreed on the allocation of marketing budget to CME activities around 50% except the group that identified the product for the hospital market (25%) which switched the budget towards personal education (60% compared with 30% on average). Interestingly when the market was conceptualized as niche or specific, the groups assigned larger budgets to patient education (20%) than simpler markets. Therefore, they failed to visualise the feedback effect between investment and market size, as it was considered as given, since the profits obtained depended on the investment in marketing.

Simultaneously, price has been maintained within similar values (10) even though the characteristics of the markets differed. This result may be influenced by the price reimbursement scheme existing in the country where the firms operate. Interestingly, the groups with the highest prices (15 and 12) and the group with the lowest price (9) were concerned on investing in access to price reimbursement as a key resource to drive their businesses. This is consistent with the local price regulatory environment as products without access to reimbursement by the national health insurance fund will loose on price competition versus rival products which are partially or fully reimbursed by the state and hence with lower or zero retail price for the end users/patients.

Another interesting finding was that by experimenting with the flight simulator, the competing groups started to better comprehend the need to manage all the KPIs and given resources as dynamic configurations which are interrelated and subject to more complex and non-linear feedback effects. This was evident by the large number of iterations by each individual group to search for and find optional performance outcome by experimenting with setting different budgeted allocation schemes and KPIs.

Groups	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
CME	50%	50%	60%	50%	25%	48%	40%	50%	50%
Personal	30%	30%	30%	40%	60%	32%	45%	40%	30%
Patient	20%	20%	10%	10%	15%	20%	15%	10%	20%
Marketing budget	12000	2800	8000	12000	10000	10000	10000	6000	12000
Price	12	15	9	10	10	10	12	11	11
Utility	60	50	54	50	50	50	45	55	55
Access to reimburse	5000	5000	5000	3000	3500	3400	2500	4000	4000
Competitor aggressive	1	0.6	0.9	0.7	1	1	0.8	1	1
Profit	80000	17000	30000	20000	39000	90000	80000	35000	76000
Type of Market	Chronic disease	Niche	Not defined	Psych	Generic hospital	Generic	Prescription based original	Generic general application	Original non specialist

Table 1. Results from the Groups Participating

6.1 Discussion

The results obtained provide interesting implications for the design of decision support systems and the integration of Dynamics RBV and BSC. Firstly, the concept of dynamic RBV is applicable to understand different market resource systems. Conceptually, the use of resource systems (Morecroft, 2002; Kunc and Morecroft, 2009) provides a clear bridge between system dynamics modelling and strategic management. Groups have used a similar template, Pharma Market Resource System, to make sense of their markets that was reflected in their decision making processes. Secondly, there is evidence of the importance of strategy maps, as an elaboration of BSC, to generate linkages between diverse performance indicators and their linkages with decision making processes. The results show correlations between their conceptualization of the key factors in the markets and their changes in the allocation of resources to improve their performance, e.g. a small complex market implied low investment and specific budget to develop a knowledge resource in the market compared with a large simpler market. Thirdly, the design of decision support systems should consider the impact of managers' mental model and sense making since the interpretation of the interfaces will affect significantly their decision making processes, e.g. resource allocation processes differed even using the same decision support system and being trained in similar principles (Kunc and Morecroft, 2010).

In addition, the observed behaviour of the managers when working with the interfaces and presenting their performances suggests that interfaces support a more thorough understanding of the dynamic aspects of KPIs. KPIs are comprehended as dynamic configurations of activities and resources which are interrelated and subject to more complex and non-linear feedback effects, which in turn influence performance quite often in unexpected ways producing "counter-intuitive" results (Kunc, 2008; Sterman, 1989). Also, the use of management flight simulators proved to be a useful tool to explicitly show that equal sets of resources can produce different performances depending on the way they are managed, which is related with the concept of equifinality (Eisenhardt and Martin, 2000) on one hand, and, on the other hand, illustrates the existence of performance heterogeneity (Peteraf, 1993). It is known that managerial cognition is related to the concept of bounded rationality (Simon, 1982 and 2000; Morecroft, 1983) and our study shows clearly the impacts of the interfaces for the enhancement of managerial cognitive capabilities, in relation to their dynamic conceptualization of resource systems, resource dynamic management and their perception and cognitive absorption of feedback effects.

7 Conclusions

The System Dynamics community has been pioneering research on the impact of interfaces and management flight simulators on decision making. Most of the research has been performed with students on tasks designed specifically to demonstrate certain hypotheses (e.g. Capelo & Dias, 2008). However, there are few studies that employed real decision makers using management flight simulators close to their domain tasks, except Moxnes' work on fisheries (Moxnes, 1998). Our study provides evidence of the importance of mental models on interpreting the task domain and their impact on the usefulness of decision support systems/management flight simulators. To summarize, decision makers add an extra layer of interpretation to the decision making tools that has to be considered on analyzing the results from diverse experiments and the design of decision support systems

.

7 References

Amit, R., & Schoemaker, P. J. (1993). Strategic assets and organizational rent. *Strategic management journal*, *14*(1), 33-46.

Banker, R., & R.J. Kauffman. 2004. The evolution of research in information systems: A fiftieth-year survey of the literature in management science. *Management Sci*ence 50(3), 289-298.

Barney, J. 1991. Firm Resources and Sustained Competitive Advantage. *Journal of Management* Vo1.17, Na 1.99-120

Capelo C., & Dias, J. F. (2009). A system dynamics-based simulation experiment for testing mental model and performance effects of using the balanced scorecard. *System Dynamics Review*, *25*(1), 1-34.

Cronin, M., C. Gonzalez and J. D. Sterman (2009). Why Don't Well-Educated Adults Understand Accumulation? A Challenge to Researchers, Educators, and Citizens. *Organizational Behavior and Human Decision Processes*, 108(1): 116-130.

Eisenhardt, K. M. & S. L. Brown. 1999. Patching: Restitching business portfolios in dynamic markets. *Harvard Bus. Rev*. 77(May–June) 72–82

Eisenhardt, K. M., & Martin, J. A. (2000). Dynamic capabilities: what are they?. *Strategic management journal*, *21*(10-11), 1105-1121.

Großler, A., F. H. Maier, & Milling, P. M (2000). Enhancing learning capabilities by providing transparency in business simulators. *Simulation & Gaming* 31(2): 257-278.

Hämäläinen, R.P., Luoma, J., & Saarinen, E. (2013) On the importance of behavioral operational research: The case of understanding and communicating about dynamic systems. *European Journal of Operational Research* 228 623–634

Helfat, C. E. & Peteraf, M.A., 2003. The dynamic resource-based view: capability lifecycles. *Strategic Management Journal*, 1010, 997-1010.

Henderson, R. & Clark, K. (1990) Architectural innovation: The reconfiguration of existing product technologies and the failure of established firms. Administrative Science Quarterly, 35: 9–30

Ittner, C. D., & Larcker, D. F. (1998). Are nonfinancial measures leading indicators of financial performance? An analysis of customer satisfaction. *Journal of accounting research*, 36, 1-1.

Ittner, C. D., Larcker, D. F., & Meyer, M. W. (2003). Subjectivity and the weighting of performance measures: Evidence from a balanced scorecard. *The Accounting Review*, 78(3), 725-758.

Kaplan R, & Norton D. (1996). *The Balanced Scorecard*. Harvard Business School Press: Boston, MA.

Kaplan R, & Norton D. (2000). *Having trouble with your strategy? Then map it*. Harvard Business Review September–October: 167–176.

Kaplan R, & Norton D. (2001). *The Strategy-Focused Organization: How Balanced Scorecard Companies Thrive in the New Business Environment*. Harvard Business School Press: Boston, MA.

Kunc, M. (2008). Using Systems Thinking to Enhance the Value of Strategy Maps *Management Decision*, 46: 761-778

Kunc, M. 2011. Teaching Strategic Thinking using System Dynamics: Lessons from a Strategic Development Course. *System Dynamics Review* 28: 28-45

Kunc, M and J. Morecroft. (2007). System Dynamics Modelling for Strategic Development in Dyson, R and O'Brien, F. (eds.) *Supporting Strategy: Frameworks, Methods and Models,* Wiley & Sons.

Kunc, M. and Morecroft, J. (2009). Resource-based strategies and Problem Structuring: Using resource maps to manage resource systems. *Journal of the Operational Research Society*, 58: 191-199.

Kunc, M. and Morecroft, J. (2010). Managerial decision-making and firm performance under a resource-based paradigm. *Strategic Management Journal*, 31: 1164-1182

Lilien, G.L., Rangaswamy, A., Van Bruggen, G.H., & Starke, K. (2004). DSS effectiveness in marketing resource allocation decisions: reality vs perception. *Information Systems Research* 15(3) 216-235.

Lipe, M. G., & Salterio, S. E. (2000). The balanced scorecard: Judgmental effects of common and unique performance measures. *The Accounting Review*, 75(3), 283-298.

Miller, D., & Shamsie, J. (1996). The resource-based view of the firm in two environments: The Hollywood film studios from 1936 to 1965. *Academy of management journal*, *39*(3), 519-543.

Morecroft, J. D. (1983). System dynamics: Portraying bounded rationality. *Omega*, *11*(2), 131-142.

Morecroft, J. D. (2002). Resource management under dynamic complexity. Systems perspectives on resources, capabilities, and management processes, 19-39.

Morecroft, J.D.W. & Sterman, J.D. (1994) *Modeling for Learning Organizations*. Portland, OR, Productivity Press.

Moxnes, E. (1998). Not only the tragedy of the commons: misperceptions of bioeconomics. *Management Science*, 44(9), 1234-1248.

Paich, M., Peck, C. and Valant, J. (2011) Pharmaceutical market dynamics and strategic planning: a system dynamics perspective. *System Dynamics Review* vol 27, No 1 (January–March 2011): 47–63

Penrose, E. T. *(*1959*). The Theory of the Growth of the Firm. New York: John Wiley.*

Peteraf, M. A. (1993). The cornerstones of competitive advantage: A resource-based view. *Strategic management journal*, *14*(3), 179-191.

Pitelis, C. N. (2007). A behavioral resource-based view of the firm: the synergy of Cyert and March (1963) and Penrose (1959). *Organization Science*, *18*(3), 478-490.

Porter, M. E. (1996). What is strategy?. *Harvard Business Review*, November.

Ritchie-Dunham J, Morrice D, Anderson E, & Dyer J. (2007). A simulation exercise to illustrate the impact of an enterprise system on a service supply chain. *INFORMS Transactions on Education 7(3).*

Siggelkow N. 2002. Evolution toward fit. *Administration Science Quarterly* 47: 125–159

Simon, H. A. (1982). *Models of bounded rationality: Empirically grounded economic reason* (Vol. 3). MIT press.

Simon, H. A., 2000, Bounded Rationality in Social Science: Today and Tomorrow. *Mind & Society*, 1, 2000, Vol. 1, pp. 25-39

Sirmon, D.G., Hitt, M.A. & Ireland, R.D., 2007. Managing firm resources in dynamic environments to create value: looking inside the black box. *Academy of Management Review*, 32(1), 273-292.

Sirmon, D.G. & Hitt, M.A., 2009. Contingencies within dynamic managerial capabilities: interdependent effects of resource investment and deployment on firm performance. *Strategic Management Journal*

Sterman, J. D. (1989). Modeling managerial behavior: Misperceptions of feedback in a dynamic decision making experiment. Management Science, 35(3), 321-339.

Sterman, J. D. (2000). Business Dynamics: Systems Thinking and Modeling for a Complex World, Irwin/McGraw-Hill.

Sterman, J.D. (2010) Does Formal System Dynamics Training Improve People's Understanding of Accumulation? *System Dynamics Review* 26.4: 316–334.

Strohhecker J. 2007. Does a balanced scorecard management cockpit increase strategy implementation performance? In *Proceedings of the 25th International Conference of the System Dynamics Society, Boston, MA*

Tabacaru, M., Kopainsky, B., Sawicka, A., Krystyna A.S, & Skaza, H (2009). How can we assess whether our simulation models improve the system understanding for the ones interacting with Them? *Paper presented at the 27th International Conference of the System Dynamics Society*

Teece, 2007. Explicating dynamic capabilities: the natture and microfoundations of (sustainable) enterprise performance. Strategic Management Journal, 1350(August), 1319-1350.

Van Bruggen, G.H, A. Smidts, B.Wierenga. 1996. The impact of the quality of a marketing decision support system: An experimental study. *International Journal of. Research in Marketing* 13(4) 331-343.

Volberda, H.W. & Rutges, A., 1999. FARSYS: a knowledge-based system for managing strategic change. Decision Support Systems.

Warren K. 2002. *Competitive Strategy Dynamics*. Wiley: Chichester.

Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic management journal*, *5*(2), 171-180.