# GAINING COMPETITIVE ADVANTAGE USING INNOVATIVE WEB 2.0-BASED SIMULATION TOOLS AND SERVICES

Hristoski Ilija[1]
Stojanov Željko[2]
Dobrilović Dalibor[3]
Dimovski Tome[4]
Kotevski Zoran[5]

**Abstract**

*Gaining competitive advantage over business opponents has always been a highest-priority task for each single enterprise. This is an especially important issue with SMEs, which have to exhibit maximum agility and flexibility to quickly reorganize and adjust their production capacities, as well as to maximize their operational efficiency in order to cope successfully with ever increasing demands being posed by the globalized business environment. The appliance of innovative information technologies through scientifically-based modeling and evaluation of business processes can significantly help SMEs in achieving their strategic business goals: reduction of costs, preservation of resources, and growth of effectiveness. All these effects contribute to improvement of overall SMEs' performances, thus directly affecting SMEs' competitiveness. The paper aims are twofold: to elaborate the recent increasing involvement of computer simulations within SMEs as a long-term strategy for achieving and retaining higher levels of competitiveness, as well as to point out the potentials offered by the innovative, Web 2.0-based simulation-oriented technologies, as being an alternative approach to traditional computer-based modeling and simulation assessment of business processes. In particular, the potential benefits of such approach have been practically shown using the Insight Maker®, a general-purpose online modeling and simulation environment, and the systems thinking methodology.*

**Keywords**: competitive advantage, SMEs, Web 2.0 paradigm, Web-based simulation (WBS), Insight Maker®

[1] "St. Clement of Ohrid" University – Bitola, Faculty of Economics, Prilep, Macedonia; e-Mail: ilija.hristoski@uklo.edu.mk
[2] University of Novi Sad, Technical Faculty "Mihajlo Pupin", Zrenjanin, Serbia; e-Mail: zeljko.stojanov@tfzr.rs
[3] University of Novi Sad, Technical Faculty "Mihajlo Pupin", Zrenjanin, Serbia; e-Mail: ddobrilo@tfzr.rs
[4] "St. Clement of Ohrid" University – Bitola, Faculty of Technical Sciences, Bitola, Macedonia; e-Mail: tome.dimovski@uklo.edu.mk
[5] "St. Clement of Ohrid" University – Bitola, Faculty of Technical Sciences, Bitola, Macedonia; e-Mail: zoran.kotevski@uklo.edu.mk

*"When you change the way you look at things, the things you look at – change!"*
Max Planck (1858-1947), a German theoretical physicist

## INTRODUCTION

How to rapidly respond to changes and how to gain sustainable advantage over business competitors are the two most important questions that remain 'a holy grail' of the contemporary economy. In today's dynamic and globalized marketplace, there is no room neither for the old-fashioned style of managing, nor for the traditional planning methods any more. Managers are facing multiple challenges related to building up adaptive and flexible organizations which are able to evaluate the ever-changing business environment in order to rapidly translate insights into winning strategies, over and over again, since "competition is at the core of the success or failure of firms" (Porter, 1985, p. 1). In this context, the notion of 'competitive advantage' has emerged, as being a fundamental premise to business success. Lately, the concept of competitive advantage has been thoroughly exploited in discussions about business strategies. However, whilst statements about it abound, there is no a single precise definition. For instance, Ehmke (2008) defines the term as "an advantage gained over competitors by offering customers greater value, either through lower prices or by providing additional benefits and service that justify similar or higher price". According to Pietersen (2010, p. 17), the term 'competitive advantage' means achieving a bigger Value/Cost gap than the competitors' one, i.e. a bigger gap between a product's value seen by customers and the total costs incurred in providing that product. This definition is in unison with Porter's views stating that "competitive advantage grows fundamentally out of value a firm is able to create for its buyers that exceeds the firm's cost of creating it" (Porter, 1985, p. 3).

According to Porter (1985), there are two basic types of so called 'positional' competitive advantages, including: (1) the cost advantage (when the enterprise is able to deliver the same benefits as competitors, but at a lower cost), and (2) the differentiation advantage (when the enterprise is able to deliver benefits that exceed those of competing products, i.e. providing a variety of products, services, or features to consumers that competitors are not yet offering or are unable to offer). Thus, a competitive advantage enables the enterprise to create a superior value for its customers and superior profits for itself. Besides these, two other types of strategies have been increasingly been adopted by enterprises recently, including (3) innovation (introduction of completely innovative, new or notably better products or services), and (4) operational effectiveness (performing internal business activities better than competitors' ones, which improves the characteristics of the company while lowering the time it takes to get the products on the market).

How can competitive advantage be achieved? Obviously, business flexibility is a key premise in assuring competitive advantage and consequently, a sustainable growth. There is now a direct, yet provable link between organizations' flexibility and business performance. To maximize flexibility, SMEs have to highly integrate and automate key business processes and their infrastructure, both internally and externally. At the same time, they must learn how to manage their business processes far more dynamically and responsively. Today SMEs face a severe business environment, fraught with capable competitors, high levels of uncertainty and complexity, numerous regulations, various modalities of consolidation, increasing number of ever-demanding customers, and adoption of contemporary business models that must change quickly and precisely. In order to navigate successfully throughout this landscape, SMEs have to become highly flexible or 'flex-pon-sive*', which is a "description of a company that responds with lightning speed and agility to rapidly changing business needs, having put a focus on processes that are enabled for change through IT" (Carter, 2007).

The rising importance of competitive advantage has recently attracted a profound research interest and has intensified the studies of this concept due to contemporary issues regarding superior performance levels of enterprises in a context of the existing, highly competitive market conditions.

## THE IMPACT OF ICT ON COMPETITIVE ADVANTAGE

SMEs dominate the national economies worldwide. Based on recently investigated literature resources, Liotta (2012) provided the evidence that 99% of enterprises throughout Europe are SMEs, 92% of which are micro-enterprises (European Commission, 2013). Those figures are quite similar to the corresponding percentages for China and India. In addition, Mendo & Fitzgerald (2005) reported that small businesses are more risky and with the higher firm failure rate in comparison with large companies. This finding fosters the SMEs' needs for finding out sources of innovation and gaining competitive advantage, as being fundamental factors that guarantee both their survival and prosperity.

In today's globally connected marketplace, a sustainable growth requires business flexibility and continuous innovation, both of which are increasingly proving to be impossible to achieve without aligning IT technology with business goals. Information and communication technology (ICT) has continually been proclaimed to be significant driver that fosters innovation and the sustainable competitive advantage. Recent studies have already confirmed the anecdotal evidence that successful use of ICT can significantly improve a company's performance potentials and competitive position, as well as future overall growth (King, 1989; Bharadwaj *et al.*, 1999; Stratopoulos & Dehning, 2000; Bharadwaj, 2000). In addition, enterprises can sustain strategic innovation by ICT management and use (Sambamurthy, 2000). Still, the competitive advantage gained by ICT adoption is impermanent, since information and communication technologies (both hardware and software) are nowadays relatively low-priced and user-friendly, thus being both highly accessible and easy to implement. As a result, once an organization starts to enjoy the benefits of its ICT-based competitive advantage, an abundant number of followers will try to neutralize it through replicating, or even enhancing the ICT solutions already been used, as soon as possible (Mata *et al.*, 1995). Despite these findings, Feeney & Ives (1990) point out that ICT-enabled sustainable competitive advantage is always desirable for any organization, and can be reached through achieving three different, yet closely related concepts including generic lead-time, competitive asymmetry, and pre-emption potential.

Much of the recent research has been focused on investigating the issues related to recognizing the direct effects emerging from the ICT adoption on increasing competitive advantage in enterprises (Davis *et al.*, 2003), as well as the issues regarding the identification of determinants of the sustainable competitive advantage due to ICT adoption (Dehning & Stratopoulos, 2003). A number of research endeavors have been focused on exploring the role of information systems (IS) in the process of gaining competitive advantage (Clemons, 1986; Zhang & Lado, 2001), whilst others are dealing with the factors facilitating the use of information technologies for gaining a competitive advantage (Neo, 1988).

In practice, plethora of innovative ICT tools and techniques has been increasingly used for gaining sustainable competitive advantage of SMEs. For instance, many organizations are taking advantage of business analytics and business intelligence IT-based solutions to help them find new insights, perceptions and understanding in their business processes and performance. Yet another IT-based activity is data mining, which can reveal significant, hardly detectable facts out from their databases and data repositories. In addition, computer simulations have been also used as a powerful approach to gaining excellence in decision making processes on all levels within SMEs. Lately, the notion of 'Big Data' has been also mentioned as one of the most promising, cutting-edge approaches to gaining a competitive advantage. Such data encompasses customers, suppliers, competitors, processes, operations, routines and procedures, as well as huge amounts of communication data originating from mobile devices, instruments, tools, machines and transmissions. However, extracting valuable knowledge and producing substantial economic benefits in this manner require a completely new business philosophy, an entirely novel, innovative and creative mindset, new people, extensive usage of ICT tools and technologies, and unique data storage and management strategies, which cannot be practically met by vast majority of SMEs.

## COMPUTER SIMULATION AND SMEs

Exploring different ways of doing things, as a result of the intrinsic human curiosity and longing for discoveries is the essence of the ever-lasting quest for the ultimate truth and knowledge. The phrases 'what if' and 'if we did it that way', being the seeds of improvements, inventions, and innovations, have always been the drivers of the overall progress. The previous statement is, in fact, the core concept of simulation: the ability to analyze the behavior of a given system and estimate the outcomes of its operation under various real-time scenarios and for a wide gamut of working parameters and various process variables, during its design phase, i.e. before it is really built up and exploited.

Simulation models are being created as simplifications of real systems to help their designers understand and overcome the inherent complexity and complicated nature of reality. Computer simulations, supported by modern software tools, are based on development of a computer model using simulation language, package, tool or integrated environment (O'Kane, 2003). They are useful in helping understand the core relations between interacting elements of the system and, to a certain extent, the implications of those interactions, thus providing a solid basis for learning and predicting system's behavior, as well as helping the decision making processes regarding the observed real system on all levels. Consequently, simulation is a technique for modeling and analysis, widely used for evaluating and improving real dynamic systems, which results in significant savings in time, money, and even lives (Harrell *et al.*, 2004).

In that context, simulations are crucial for companies in minimizing time, costs, and resource usage needed for accomplishing their business activities, which can lead towards achieving their strategic business goals and gaining substantial competitive advantage.

Therefore, the ability to analyze and test their activities in advance, before large investments are being done, becomes more and more important (Klingstam & Gullander, 1999). Utilization of simulation techniques and tools can improve the ability to make right decisions in complex and uncertain environments (Liotta, 2012). Therefore, simulation has become of the utmost importance in solving problems for engineers, designers and managers in an increasingly competitive world (Shannon, 1998). In addition, Košturiak & Gregor (1999) argued that simulation can be combined with other systems engineering methodologies for optimization of decision making regarding organizational structure, production program, manufacturing facilities, as well as the whole chain of logistics. At last, many researchers have argued that simulation techniques can assist in improving business effectiveness and performances, as well as in gaining higher level of understanding required for overcoming inherent complexities in the practice (Kettinger *et al.*, 1997; Klingstam & Gullander, 1999; Irani *et al.*, 2000; Johansson & Jörgensen, 2001; Williams *et al.*, 2001; O'Kane *et al.*, 2007).

It should be also pointed out that, compared to analytical (mathematical) models for analyzing systems, simulations are more comprehensible and more credible, because they require fewer simplifying assumptions and captures more real characteristics of the observed system (Shannon, 1998).

However, despite all of these facts and numerous benefits stated in literature (Klingstam & Gullander, 1999; O'Kane *et al.*, 2007), as well as positive experiences that show that simulation models are more accessible than SMEs expect (Hvolby *et al.*, 2012), the number of studies that reported the usage of simulation techniques in SMEs is very small, compared to the number of studies related to large companies, meaning that computer simulation techniques have not been widely adopted and implemented within SME sector. This is not an encouraging finding, since simulations are particularly useful for solving problems in manufacturing and service systems – the two common types of systems today in SMEs. These types of systems have much in common related to their structure (resources, activities, inputs, outputs) and objectives (requirements related to quality, efficiency, cost reduction, time savings, and customer satisfaction).

Until now, SMEs have been used computer simulations in variety of fields, such as: logistics and production networks (Liotta, 2012), reorganization and automation of manufacturing (O'Kane, 2003), supply chain networks (Byrne & Heavey, 2004; Terzi & Cavalieri, 2004; Jain & Leong, 2005), knowledge management (Soto *et al.*, 2011), product returns in retail SMEs (Ahmed & Latif, 2010), decision-making regarding future production strategies (Hvolby *et al.*, 2012), continuous process improvement (Adams *et al.*, 1999), lean assessment (Mahfouz *et al.*, 2011), or investigation of how costs of integrating existing and new ICTs affect SMEs' positioning at the market (Beneki *et al.*, 2009).

## WEB-BASED SIMULATION

Until recently, technology stood on the way of achieving high levels of flexibility and business performance. Thanks to the emergence of the Web 2.0 paradigm and open standards, technology now gives an opportunity to all companies, including SMEs, to become more innovative and to gain substantial competitive advantage. More and more, the Web is being considered as an online environment suitable for providing both modeling and simulation tasks. The emerging new innovative approach to computer simulation, which strives to become de facto an adequate replacement of the traditional workstation-based computer simulation, has been named as a 'Web-based simulation' (WBS). WBS is an integration of the Web with the field of simulation. It assumes an invocation of computer simulation services over the World Wide Web, specifically through a user's Web browser (Page *et al.*, 1998; Page & Opper, 2000; Byrne *et al.*, 2006; Byrne *et al.*, 2010). WBS is currently becoming a quickly evolving area in computer science, which is of significant interest for both simulation researchers and simulation practitioners. Such great interest is a direct consequence of the successfulness of the Web 2.0 paradigm, and its associated technologies, e.g. HTML, HTTP, CGI, etc., as well as the great popularity of, and reliance upon, computer simulation as being a problem solving and decision support systems (DSS) approach. This novel discipline is owing much to the appearance of the Internet-friendly programming languages, like Java or JavaScript, and of distributed object technologies, like the Common Object Request Broker Architecture (CORBA) and the Object Linking and Embedding / Component Object Model (OLE/COM), which have had particularly important effects on the state of this innovative simulation practice. Therefore, WBS, as being an emerging area of exploration and application within the simulation community, has been already considered a state-of-the-art discipline, which is expected to proliferate and even prevail in the forthcoming years (Harrell & Hicks, 1998; Guru *et al.*, 2000; Byrne *et al.*, 2006). Currently, the researchers in the field of Web-based simulation are interested in dealing with topics such as methodologies for Web-based model development, collaborative model development over the Internet, Java-based modeling and simulation, distributed modeling and simulation using Web technologies, and new applications (Miller *et al.*, 2000; Kuljis & Paul, 2001; Miller *et al.*, 2001; Zu Eissen & Stein, 2006; Byrne *et al.*, 2010).

## A CASE STUDY: USING INSIGHT MAKER® FOR MODELING AND SIMULATION

Insight Maker® is an innovative, free-of-charge, Web 2.0-based, multi-user, general-purpose, online modeling and simulation environment, completely implemented in JavaScript, which promotes online sharing and collaborative working. It integrates three general modeling approaches, including system dynamics, agent-based modeling, and imperative programming in a unified modeling framework. The environment provides a GUI aimed at model construction, offering advanced features, such as model scripting and an optimization tool. Insight Maker® has been developed for several years, and has gained significant adoption with currently almost 26,000 registered users (Fortmann-Roe, 2014).

To the best of our knowledge, it is the first, yet the one and only free-of-charge Web 2.0-based Internet service so far, that delivers a plethora of advanced features to its online users, including Causal Loop Diagrams, Rich Pictures Diagrams, Dialogue Mapping, Mind Mapping, as well as Stock & Flow simulation, thus offering a thorough insight into various aspects of a system's dynamics. By supporting agent based scenarios, storytelling and sensitivity analysis, Insight Maker® exhibits a wide gamut of features that not only rival, but, in many cases, outperform the traditional, commercially available simulation software packages.

To demonstrate the usefulness of Web-based simulations being applied in SMEs, we revert to stock-and-flow simulations, which are constituent part of System Dynamics (SD), a methodology and a mathematical modeling and simulation technique for framing, understanding, and discussing complex issues and problems. As an approach to understanding the dynamic behavior of complex systems over time and an important aspect of the systems thinking theory, SD uses internal feedback loops, time delays, as well as stocks and flows to model the entire system.

If compared to Discrete-Event Simulation (DES), System Dynamics uses a quite different approach. Contrary to DES, SD is essentially deterministic by nature. It models a system as a series of stocks and flows, whilst state changes are continuous, resembling a motion of a fluid, flowing through a system of reservoirs or tanks, connected by pipes. Because of its great flexibility, along with its ability to combine together both qualitative and quantitative aspects of the modeled system, as well as its tendency to model and simulate the dynamics of a system at a higher, yet more strategic level in order to gain a holistic insight into the dynamic interrelations among the different parts of a complex system, SD has been applied in many different fields of study so far, including project management, system analysis, health care, etc.

Using Insight Maker®, we have modeled one of the water tanks, named "R2", being an integral part of the complex water distribution system of "Studenchica", which supplies with clean, drinkable water the city of Prilep, Republic of Macedonia.

Without delving into the technicalities of implementation, it should be stated that the water tank "R2", which is responsible for delivering fresh water to the lower zone of Prilep, has a total capacity of 8,028 $m^3$ and is box shaped. There are one input and two output water flows going into/from the tank; the input flow conveys water into the tank with a variable intensity rate, which depends primarily on the magnitude of the freshwater spring, as well as the intensity of water consumption in the other segments of the distribution system, whilst the main output flow delivers water to end consumers with variable intensity rate, which depends on their consumption needs, fluctuating both in various time periods of the year and of the day. The other, minor outflow takes away the superfluous water (if any) towards the near-by artificial lake, thus preventing overflowing. There are three safety levels defined with the water tank: the minimum level (at 2.10 m during winter; at 3.10 m during summer), the maximum level (at 4.55 m), and the overflow level (at 4.80 m). The input flow is being automatically controlled by a valve, which assures stable water levels in the tank, interchanging between the maximum and the minimum safety levels.

The Insight Maker® model[6] of the previously described water tank is depicted on Fig. 1.

[6] The simulation model, named "Model of the Water Tank", can be seen and run at http://insightmaker.com/insight/18153#

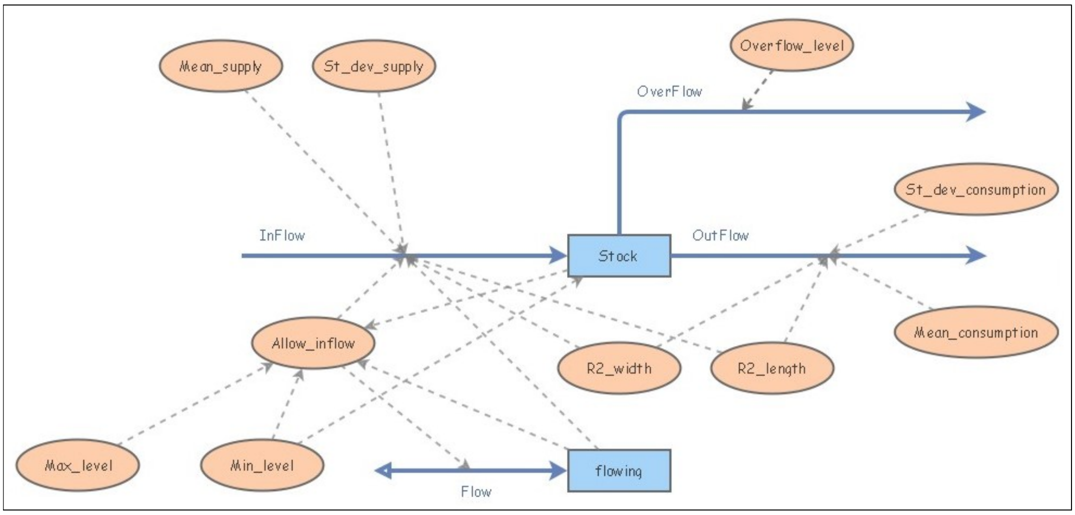


**Figure 1**. Water tank "R2", as modeled in Insight Maker®

The simulation model allows testing the behavior of the system by performing various simulations runs, each with a different combination of the key working parameters, defined by the user, using the sliders next to the right of the model.

Moreover, it is also possible to assess various scenarios for fixed, pre-defined sets of working parameters, encompassing various season-related patterns of input and output water flows (Fig. 2).

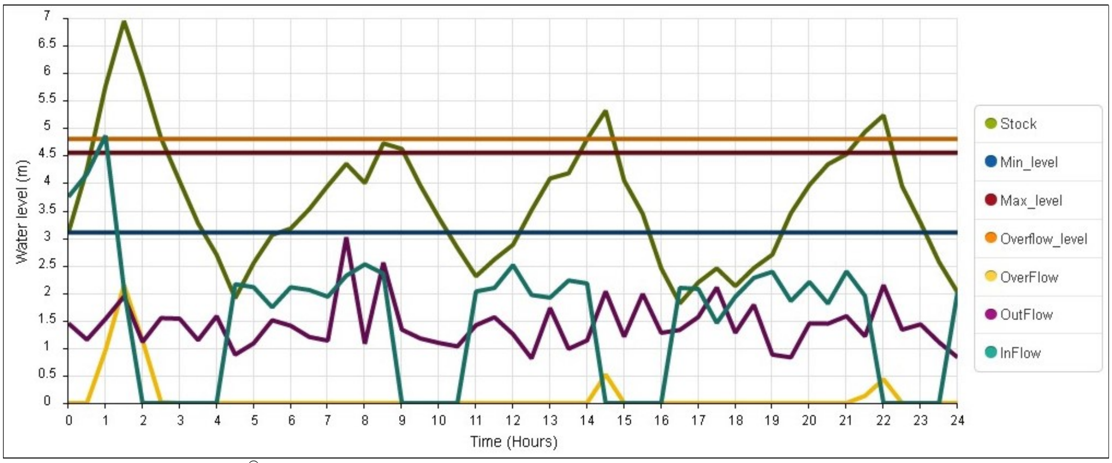


**Figure 2**. Insight Maker® graphical output from a specific simulation scenario run

## CONCLUSIONS

All types of computer simulations, including Web 2.0-based ones, can be successfully used for assessing and improving different business processes within SMEs, as well as for facilitating decision making in complex and uncertain situations. This is important, since it is very difficult, if even impossible, to experiment in real settings. Simulations can reveal new insights into business processes that will increase their effectiveness, performances and flexibility, thus creating an unprecedented competitive advantage on a long term.

Insight Maker® has proven to be a great innovative tool for mapping ideas by graphically visualizing them, and then, by converting maps into computational simulation models, to display specific behaviors and dynamics of a modeled system over time, as well as to carry out multiple scenario runs.

The intrinsic logic implemented within the actual simulation model of the water tank can be also successfully utilized by all types of Min/Max inventory systems, which, besides the ABC system, the Two-Bin system, and the Order-Cycle system, represent the simplest method of inventory control often found with SMEs, regardless of their nature.

## ACKNOWLEDGEMENTS

The authors would like to thank cordially Mr. Gjoko Jochkoski, Dipl. -Ing., Chief of Technical Department in the Public Communal Enterprise "Vodovod i Kanalizacija" from Prilep, Republic of Macedonia, for his great contribution and expertise given during the preparation of the paper. Nonetheless, a great appreciation also goes to Mr. Gene Bellinger, a passionate systems thinker and researcher from Kill Devil Hills, NC, USA, currently hosting Systems Thinking World on LinkedIn and facilitating the development of SystemsWiki.org, for sharing his knowledge and experience during the development of the Insight Maker® simulation model.

## REFERENCES

1. Adams, M., Componation, P., Czrnecki, H., Schroer, B.J. (1999). Simulation as a Tool for Continuous Improvement. *Proceedings of The 1999 Winter Simulation Conference (WSC '99)*, Phoenix, AZ, USA, pp. 766–773.
2. Ahmed, M. E., Latif, M. (2010). Exploiting Simulation for Product Returns in SMEs. *Proceedings of The World Congress on Engineering 2010 (WCE 2010)*, London, UK, Vol. III, pp. 2363–2368.
3. Beneki, C., Papastathopoulos, A., Tsagris, M. (2009). Simulation in the Expansion of SMEs Through the Adoption of ICTs: an Empirical Study of SMEs in Greece. *Proceedings of The 9th WSEAS International Conference on Simulation, Modelling and Optimization (SMO '09)*, Stevens Point, WI, USA, pp. 207–2011.
4. Bharadwaj, A. (2000). A Resource-based Perspective on Information Technology Capability and Firm Performance: an Empirical Investigation. *MIS Quarterly*, 24(1), pp. 169–196.
5. Bharadwaj, A. S., Bharadwaj, S. G., Konsynski, B. R. (1999). Information Technology Effects on Firm Performance as measured by Tobin's *q*. *Management Science*, 45(7), pp. 1008–1024.
6. Byrne, J., Heavey, C., Byrne, P. J. (2006). SIMCT: An Application of Web Based Simulation. In: Robinson, S., Taylor, S., Brailsford, S., Garnett, J. (Eds.) *Proceedings of The 2006 Operational Research Society (UK) 3rd Simulation Workshop (SW06)*, Royal Leamington Spa, UK.

7. Byrne, J., Heavey, C., Byrne, P. J. (2010). A review of Web-based simulation and supporting tools. *Simulation Modelling Practice and Theory*, 18(3), pp. 253–276.
8. Byrne, P. J., Heavey, C. (2004). Simulation, a Framework for Analysing SME Supply Chains. *Proceedings of The 36th Winter Simulation Conference (WSC 2004)*, Washington, DC, USA, pp. 1167–1175.
9. Carter, S. (2007). *The New Language of Business: SOA & Web 2.0*. IBM Press/ Pearson Education, Inc., Upper Saddle River, NJ, USA, pp. 13–22.
10. Clemons, E. K. (1986). Information Systems for Sustainable Competitive Advantage. *Information & Management*, 11(3), pp. 131–136.
11. Davis, L., Dehning, B., Stratopoulos, T. (2003). Does the Market Recognize IT-enabled Competitive Advantage?. *Information & Management*, 40(7), pp. 705–716.
12. Dehning, B., Stratopoulos, T. (2003). Determinants of a Sustainable Competitive Advantage due to an IT-enabled Strategy. *The Journal of Strategic Information Systems*, 12(1), pp. 7–28.
13. Ehmke, C. (2008). *Strategies for Competitive Advantage*. Department of Agricultural and Applied Economics, University of Wyoming, Laramie, WY, USA. http://ag.arizona.edu/arec/wemc/nichemarkets/ 05competitiveadvantage.pdf (accessed May 14th, 2014)
14. European Commission (2013). *A Recovery on the Horizon? Annual Report on European SMEs 2012/2013 (Final Report)*. http://ec.europa.eu/enterprise/policies/sme/facts-figures-analysis/performance-review/files/supporting-documents/2013/annual-report-smes-2013_en.pdf (accessed August 4th, 2014)
15. Feeney, D., Ives, B. (1990). In Search of Sustainability: Reaping Long-term Advantage from Investment in Information Technology. *Journal of Management Information Systems*, 7(1), pp. 27–46.
16. Fortmann-Roe, S. (2014). Insight Maker: A General-Purpose Tool for Web-based Modeling & Simulation. *Simulation Modelling Practice and Theory*, Vol. 47, pp. 28–45.
17. Guru, A., Savory, P., Williams, R. (2000). A Web-based Interface for Storing and Executing Simulation Models. *Proceedings of The 2000 Winter Simulation Conference (WSC '00)*, Orlando, FL, USA. Vol. 2, pp. 1810–1814.
18. Harrell, C. R., Hicks, D. A. (1998). Simulation Software Component Architecture for Simulation-based Enterprise Applications. *Proceedings of The 1998 Winter Simulation Conference (WSC '98)*, Washington, DC, USA. Vol. 2, pp. 1717–1721.
19. Harrell, C., Ghosh, B., Bowden, R. (2004). *Simulation Using ProModel*, 2nd Edition. The McGraw-Hill Companies, Inc., New York, NY, USA.
20. Hvolby, H-H., Svensson, C., Steger-Jensen, K. (2012). Simulation of Production Setup Changes in an SME. *Procedia Technology*, Vol. 5, pp. 643–648.
21. Irani, Z., Hlupić, V., Baldwin, L. P., Love, P. E. D. (2000). Re-engineering Manufacturing Processes through Simulation Modelling. *Logistics Information Management*, 13(1), pp. 7–13.

22. Jain, S., Leong, S. (2005). Stress Testing a Supply Chain Using Simulation. *Proceedings of The 37th Winter Simulation Conference (WSC 2005)*, Orlando, FL, USA, pp. 1650–1657.
23. Johansson, B., Jörgensen, T. (2001). An Enhanced Methodology for Reducing Time Consumption in Discrete Event Simulation Projects. *Proceedings of The 13th European Simulation Symposium*, Marseilles, France, pp. 61–64.
24. Kettinger, W. J., Teng, J. T. C., Guha, S. (1997). Business Process Change: A Study of Methodologies, Techniques, and Tools. *MIS Quarterly*, 21(1), pp. 55–80.
25. King, W. R. (1989). Using Information and Information Technology for Sustainable Competitive Advantage: Some Empirical Evidence. *Information & Management*, 17(2), pp. 87–93.
26. Klingstam, P., Gullander, P. (1999). Overview of Simulation Tools for Computer-Aided Production Engineering. *Computers in Industry*, 38(2), pp. 173–186.
27. Košturiak, J. Gregor, M. (1999). Simulation in Production System Life Cycle. *Computers in Industry*, 38(2), pp. 159–172.
28. Kuljis, J., Paul, R. J. (2001). An Appraisal of Web-based Simulation: Whither We Wander?. *Simulation* Practice *and Theory*, 9(1–2), pp. 37–54.
29. Liotta, G. (2012). Simulation of Supply-Chain Networks: A Source of Innovation and Competitive Advantage for Small and Medium-Sized Enterprises. *Technology Innovation Management Review*, November 2012, pp. 13–20.
30. Mahfouz, A., Shea, J., Arisha, A. (2011). Simulation Based Optimisation Model for the Lean Assessment in SME: a Case Study. *Proceedings of The 2011 Winter Simulation Conference (WSC '11)*, Phoenix, AZ, USA, pp. 2408–2418.
31. Mata, F., Fuerst, W., Barney, J. (1995). Information Technology and Sustainable Competitive Advantage: a Resource-based Analysis. *MIS Quarterly*, 19(4), pp. 487–505.
32. Mendo, F. A., Fitzgerald, G. (2005). Theoretical Approaches to Study SMEs eBusiness Progression. *Journal of Computing and Information Technology (CIT)*, 13(2), pp. 123–136.
33. Miller, J. A., Fishwick, P. A., Taylor, S. J. E., Benjamin, P., Szymanski, B. (2001). Research and Commercial Opportunities in Web-Based Simulation, *Simulation Practice and Theory*, 9 (1–2), pp. 55–72.
34. Miller, J. A., Seila, A. F., Xiang, X. (2000). The JSIM Web-based Simulation Environment. *Future Generation Computer Systems*, 17(2), pp. 119–133.
35. Neo, B. S. (1988). Factors Facilitating the Use of Information Technology for Competitive Advantage: An Exploratory Study. *Information & Management*, 15(4), pp. 191–201.
36. O'Kane, J. F. (2003). Simulation as an Enabler for Organizational Excellence. *Measuring Business Excellence*, 7(4), pp. 12–19.
37. O'Kane, J., Papadoukakis, A., Hunter, D. (2007). Simulation Usage in SMEs. *Journal of Small Business and Enterprise Development*, 14(3), pp. 514–527.
38. Page, E. H., Griffin, S. P., Lynn Rother, S. (1998). Providing Conceptual Framework Support for Distributed Web-based Simulation within the Higher

Level Architecture. *Proceedings of The SPIE Conference on Enabling Technologies* for *Simulation Science II*, Orlando, FL, USA, pp. 287–292.
39. Page, E., Opper, J. M. (2000). Investigating the Application of Web-Based Simulation Principles within the Architecture for a Next-Generation Computer Generated Forces Model. *Future Generation Computer Systems*, Vol. 19, pp. 159–169.
40. Pietersen, W. G. (2010). *Strategic Learning: How to be Smarter than Your* Competition *and Turn Key Insights into Competitive Advantage*, John Wiley & Sons, Inc., Hoboken, NJ, USA
41. Porter, M. E. (1985). *Competitive Advantage: Creating and Sustaining Superior Performance*. The Free Press, New York, NY, USA.
42. Sambamurthy, V. (2000). Business Strategy in Hypercompetitive Environments: Rethinking the Logic of IT Differentiation. In: Zmud, R. W. (Ed.), *Framing the Domains of IT Management*, Pinnaflex Educational Resources, Cincinnati, OH, USA, pp. 245–261.
43. Shannon, R. E. (1998). Introduction to the Art and Science of Simulation. *Proceedings of The 1998 Winter Simulation Conference (WSC '98)*, Washington, DC, USA, pp. 7–14.
44. Soto, M. M., Monroy, C. R., Fuentes-Pila, J., Diaz, A. M., Araujo, M. G. (2011). A Computer Simulation Model of Knowledge Management in Small and Medium Agri-Food Enterprise. *Proceedings of The 5th International European Forum on System Dynamics and Innovation in Food Networks*, Innsbruck-Igls, Austria, pp. 419–434.
45. Stratopoulos, T., Dehning, B. (2000). Does Successful Investment in Information Technology Solve the Productivity Paradox?, *Information & Management*, 38(2), pp. 103–117.
46. Terzi, S., Cavalieri, S. (2004). Simulation in the Supply Chain Context: a Survey. *Computers in Industry*, 53(1), pp. 3–16.
47. Williams, E., Derwactor, D., Shorkey, L. (2001). Evaluation of Machine Shop Logistics Alternatives Using Simulation. *Proceedings of The 12th European Simulation Symposium*, Hamburg, Germany, pp. 255–259.
48. Zhang, M. J., Lado, A. A. (2001). Information Systems and Competitive Advantage: a Competency-based View. *Technovation*, 21(3), pp. 147–156.
49. Zu Eissen, S. M., Stein, B. (2006). Realization of Web-based Simulation Services. *Computers* in *Industry*, 57(3), pp. 261–271.