Simulation as Efficient Support to Learning Business Dynamics

Alexander Karapidis[1], Lucia Pannese[2], Dimitra Pappa[3], Mauro Santalmasi[2], and Wolfgang Volz[4]

[1] Fraunhofer Institute for Industrial Engineering (IAO), Nobelstrasse 12, 70569 Stuttgart, Germany
Alexander.Karapidis@iao.fraunhofer.de
[2] imaginary s.rl. c/o Acceleratore d'Impresa del Politecnico di Milano, via Garofalo, 39, 20133 Milano, Italy
info@i-maginary.it
[3] Division of Applied Technologies, National Centre for Scientific Research (NCSR) "Demokritos", 15310 Agia Paraskevi, Greece
dimitra@dat.demokritos.gr
[4] Klett Lernen und Wissen GmbH, Educational Concepts, Rotebühlstr. 77, 70178 Stuttgart, Germany
w.volz@klett.de

Abstract. The aim of this paper is to provide insight in the important role simulation technologies can play in the context of effective business process-oriented learning. The gap between business processes and HR carrying out concrete tasks could be bridged by integrating knowledge management and learning needs with respect to business processes. First, the importance between business processes, learning and simulations is illustrated. Second, simulations and their impact for company efficiency is outlined. Third, the benefits of the PROLIX e-simulation are described according to specific requirements out of a business process perspective. A company case study is also presented. The conclusion is that decision support for management under specific performance conditions and the learning environment itself are key elements that contemporary e-simulations bring together for the benefit of work performance and effectiveness as well as efficiency of companies.

1 Business Process-Oriented Learning with e-Simulations

Nothing is constant but change, especially in a turbulent, complex and globalized world. To survive, an organisation should develop the capacity to learn continuously (Watkins & Marsick, 1993). Change and complexity also mean that people in organisations must constantly learn and adapt.

Enterprises are faced with a number of vital business issues to improve operational efficiency in terms of product time-to-market, cost retention, quality improvement, regulatory compliance etc. New approaches are needed for companies to effectively plan, structure and manage their activities so as to gain or maintain their competitive advantage. Creating strategic advantage and improving organisational competitiveness requires changes in business organisation (a shift towards performance driven

W. Nejdl and K. Tochtermann (Eds.): EC-TEL 2006, LNCS 4227, pp. 357 – 365, 2006.
© Springer-Verlag Berlin Heidelberg 2006

processes) and continuous investment in human capital growth, as the success of modern corporations increasingly depends on its intellectual assets.

Out of this perspective, learning emerges as a key enabler for organisations to support and enhance performance. This process entails linking individual training needs to the key business priorities by building links between business and learning processes. Since business processes define organisational roles and associate functions, each with its own specific requirements in terms of competencies, learning processes can be defined based on the lacking competencies of individual employees assigned to specific organisational roles: whenever there is a gap between the competencies profile of an individual assigned to a specific role and the competencies profile of the role (i.e. the competencies required for this particular role), the most suitable training plan must be designed and the most suitable learning resources must be mobilised, in order to fill it.

In response to the need of organisations and enterprises to improve their response to business change and reduce the time needed to fill competency gaps (Time2Competency) that result from business needs (e.g. business process changes, reorganisations), the European project **PROLIX** ("Process-oriented Learning and Information exchange"[12]) aims to couple business processes with learning processes in corporate environments, so as to facilitate business process oriented learning. This will support:

1. **Continuous tactical improvement (small scale):** This concerns tactical operations (short term decisions and small scale changes) aimed at the continuous improvement of organisational operations (day to day business, incremental performance improvements based on existing resources).
2. **Goal oriented change (large scale):** This relates to large scale changes in corporate strategy and/or goals (e.g. wide range business process reengineering activities, implementation of a new strategic plan).

For example, aligning organisational change and learning will enable organisations to:

- adapt to changes in business processes (business process reengineering)
- effectively introduce new employees to a project and /or role
- overcome performance problems caused by heterogeneous company culture among different company's departments, branches or within project teams (e.g. due to mergers and acquisitions)
- adapt to changes in organisational and/or management structure
- optimize the alignment between business process and competency management

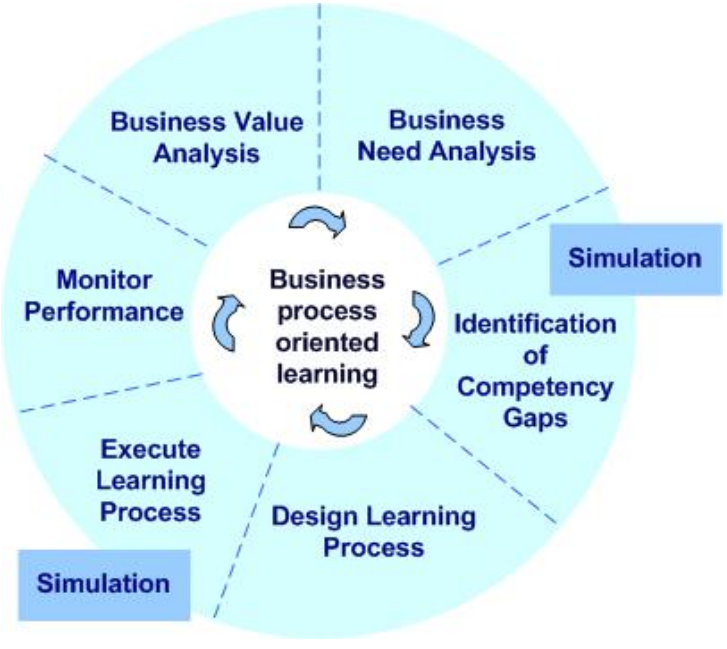
The optimisation of business processes by means of learning entails the combination of business process intelligence tools with knowledge management and learning services provision applications. In this context e-Simulations are expected to play an important role, for both business process optimisation and learning delivery. The aim of this paper is to investigate the double role of simulation technologies in the framework of business process-oriented learning. In this light the application of e-simulations in the framework of the PROLIX project in the publishing sector (Klett AG) will be discussed.

2 The Power of an e-Simulation

2.1 Management Perspective

Business process simulation (BPS) is a tool used to assist in the management of change in a variety of manufacturing and service settings. BPS can "assist decision making by providing a tool that allows the current behaviour of a system to be analysed and understood. It is also able to help predict the performance of that system under a number of scenarios determined by the decision maker"(Greasley, 2003).

From this perspective, simulation technologies can have a double role. They can either be a **vehicle for learning along processes** or a **decision support instrument** to help decide how to improve processes and the overall effectiveness of staff. Also, simulation techniques can be used to **validate decisions associated with the learning solution.**



Simulation has been available as an **operations management** technique in industry for approximately 50 years (compare Kelten & Sadowski 1998). BPS can facilitate the successful implementation of redesigned processes, within the context of business-process-reengineering activities. When faced with the need to adapt to business change, simulation can provide the answer to a critical from an operational point of view question, namely:

"Under which conditions can we have the correct resources to meet the performance requirements of a specific business process, in terms of execution time, cost, quality etc?"

Viewed as a **learning instrument**, simulations have the potential to add enormous value to corporate training environments. Simulation exercises are fun and engaging

and allow learners to internalize knowledge by applying new skills in a risk-free environment. This can dramatically increase motivation and retention rates—and provide a high return on training investments.

The main benefit of a simulation is that it allows users to be as close as possible to reality; therefore if learning happens through simulation, new acquired competences can immediately be applied to ongoing business, raising the return on investments. Also, if the simulation system is based on machine learning technologies, it has the capability to learn together with the user, resulting in an auto-adaptable tool. This means that the real and the virtual environment of the user change at the same time, making simulation even more efficient and learner-oriented.

2.2 User's Perspective

Simulations, which are virtual representations of their real counterparts, have a long list of strengths and advantages, especially if they are presented as non-entertaining games (or "serious games", as the "Serious Game Initiative" www.seriousgames.org funded by the Woodrow Wilson Center for International Scholars in Washington, D.C. in 2002 calls them). They:

- trigger profound insights for long-term thinking
- enable to think deeply about complex systems, because they allow to understand the dynamics of the elements that constitute the whole environment [1]
- make users feel responsible for success according to their actions
- show how actions affect context
- match high-quality content and high engagement [4]
- turn mistakes into learning elements avoiding to give the message that an error is something that cannot be recovered [3]
- shorten the time factor: adding foresight to a simulation allows to connect actions in the present with implications in the future
- allow situated learning and are therefore close to the working context
- make users feel more comfortable with the exercise [2] and raise the time he or she is willing to spend with it [1]

These benefits are due to the peculiar nature of game-based simulations, which profit from the match of simulation aspects, game aspects and pedagogical elements at the same time. [1]

Some studies carried out in the educational sector [2] as well as their follow-up carried out in the business environment substantially show a high degree of enjoyment in this new means of learning:

Simulation tools are generally perceived as pleasant, about usability surveys in general show that they are considered easy to use and in particular that they are considered effective tools for:

- change
- reflection
- assumption of new behaviours
- transferability of the information treated in daily situations

The simulators are considered as non-invasive tools. In fact, the subjects declare to feel free during the deployment of the assignment and in the choice of the answers. As far as the degree of involvement is concerned, users seem

- to be prepared to repeat the experience
- to have succeeded in identifying themselves in the situation
- that they would prefer this particular training means if they were free to choose
- to have succeeded in maintaining a high degree of interest and attention towards the treated topic

The simulations are not considered as being boring and they are perceived as less tiresome than frontal lessons in a classroom.

2.3 Application of Simulations in Business

Despite their potential online simulations are still under-used by corporate training departments. While many HR-managers in companies support the idea in principle, most have not integrated simulations into their corporate training offerings, Furthermore, the use of simulation as a decision-support tool for the optimisation of corporate training is still in its early steps.

One of the limitations of simulations until now, which possibly explains why they are not yet largely used in business, is that either these tools simulate processes but they do not have anything to do with training, or they represent very nice and effective training tools, that unfortunately are not linked to business processes.

The authors try to close this gap with a new type of simulation that can be a decision support system, simulating complex business processes and a training tool at the same time.

3 Competency-Based Simulation – The PROLIX Example

e-Simulations are part of the toolset of the PROLIX system [12] that will couple business processes with learning processes in corporate environments, in order to achieve optimal performance and reduce the time needed to fill competency gaps. Their role in the context of the PROLIX system is illustrated in figure 1.

The quest for organisational excellence calls for innovations and a continuous improvement of organisational operations. Business processes are generally identified in terms of beginning and end points, interfaces, and organisation units involved, particularly the customer unit. Davenport & Short (1990) define business process as "a set of logically related tasks performed to achieve a defined business outcome." A process is "a structured, measured set of activities designed to produce a specified output for a particular customer or market. It implies a strong emphasis on how work is done within an organisation" (Davenport 1993). In their view processes have two important characteristics: (i) They have customers (internal or external), (ii) They cross organisational boundaries, i.e., they occur across or between organisational subunits.

Nowadays, amidst constantly changing organisational operations, training is one of the most frequently applied solutions for dealing with business change. In this context learning and business process management need to be more strongly connected and coordinated in order to exploit learning as a key enabler for change.

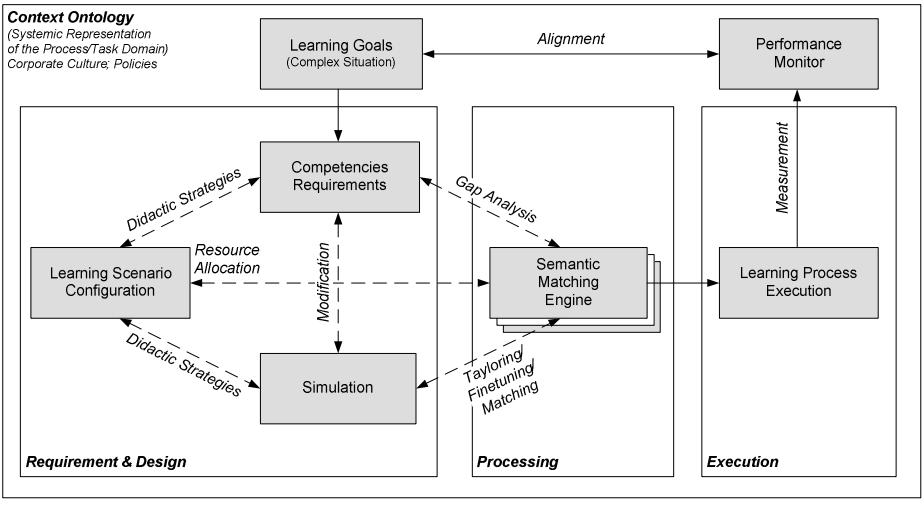


Fig. 1. PROLIX Process-oriented Learning Architecture

Based on this understanding, the aims for simulation-enabled learning developed in the PROLIX project are:

the reflection of workplace conditions, the involvement of realistic and authentic activities, the support of holistic judgement and undergoing quality assurance to guarantee the effectiveness of the simulation.

The **effectiveness** of the simulation is meant on one hand in terms of "interactivity" and of "performed actions" [11], because it is always much easier to remember and to understand the consequences of what one did than of what one heard or read; on the other hand it is to be understood in terms of "closeness" to the business situation. (The effectiveness of the simulation in terms of "simulation results" will be cross-checked by another module of the PROLIX architecture).

In fact, in the PROLIX project, the competency oriented process simulator will be a highly interactive web-based tool based on the concept of experiential learning that will be customizable for each customer's processes and sets of competencies, thus resulting always extremely close to business reality.

So, based on these pre-assumptions the competency-based simulator consists of a resource-based approach (person power and competencies necessary to cope with the requirements of a process step) interlinked with business process performance relevant criteria, namely time, cost and quality. This means, based on an evaluation matrix for each process step, the status of specific performance conditions can be seen and re-adjusted in a way, that it fits most optimal for overall business objectives (e.g. like very high quality criteria for the products/ services etc.).

The outcome can be described as a real-time learning simulation based on different blueprints of the defined business process and requirements raised by organisational issues brought up out of "real" work-situations to run these processes. So the PROLIX simulation tool that tries to bring together learning and process management aspects has three main characteristics:

- **User support tool based on a single business process as a good practice.** The result of the simulation is used as learning content in an instructional way. The employee on the shop floor can use the information as factum.

- **Business process configuration tool / simulation of possible scenarios by the business process engineer.** This simulation considers the "surroundings" of the process, in order to be able to identify its impact of different variables on the related processes. The aim is to try to reduce the risk of redundancies and of delays in the information transfer across different processes, trying to optimize the "whole" business environment.

- **User learning tool / "Edugaming" for staff training (shop floor level).** The idea is to simulate the different logical links of the tasks which build up the process in order to let the user understand how the process works and what the consequences of wrong logical links could be. The employee should understand what the relevance of his work is and what kind of impact a failure in his work task could have for the complete business process.

4 Application Example for the Competency-Based Simulator: The Educational Publishing Sector at Klett AG, Germany

The German publishing house Klett AG is one of the pilot users of the PROLIX system for business-process oriented learning,

The editorial environment
The core competence of an educational publishing house is to publish – develop, produce and market – teaching and learning materials for institutional education. Therefore, in the PROLIX project and especially in the competency-based simulator, a main process of education publishing should be modelled for the benefit of closing the gap between business process needs and an optimal condition to cope with all process steps. The traditional business process in the field of educational publishing consists of six main phases:

1. Product sketch
2. Product planning
3. Realisation
4. Production
5. Archiving
6. Sales / Distribution.

According to the outlined major process steps and its underlying sub-processes, different issues emerged that are critical for success to cope with a modified process:

Issues in developing business processes more adequately
Nonetheless, the need for structural changes in the business processes may emerge, even in this environment, which appears to be stable from an organisational point of view. A couple of such cases have been identified:

- Achieving greater efficiency in the planning and realisation phase, e.g. decreasing the time to market
- Introduction of a new editing environment, e.g. introducing a content management system
- Changing the business process at the conceptual level, e.g. addressing a new customer group
- Tailoring business processes according to specific customer's needs e.g. high-level quality for specific target groups

In shorter product/service life-cycles, a well-prepared and defined process with low barriers between human-machine-interaction and employees with adequate competencies are the key factors to resist in turbulent markets.

So, gaps between competency profiles needed to carry out a business process and work process related lacks due to changes in business processes should be discovered in order to decide whether to spend resources for re-organising or re-training employees or to run a process on a sub-optimal level.

What happened in the competency-based simulator scenario "educational publishing"

In this framework, the educational publishing scenario simulation based on different blueprints of the defined business process and requirements raised by organisational issues brought up starting from "real" work-situations can play a significant role in making business process changes smoother. In concrete, Klett's issues are to find options to e.g. reduce costs, raise quality, save resources, use competencies adequately in the described business processes. Especially the competency levels needed to fulfil a process step and the person power with adequate competences for each process step are critical for success from the Klett perspective. So, the need for an "ex-ante" simulation of real business processes could help especially decision-makers and responsible managers deciding about a business process according to their specific needs. Based on a pre-defined setting of the educational publishing process steps the process chain manager can start simulating this setting by adjusting performance indicators for the whole educational publishing business chain and/or for some of its sub-process steps. As a (round-based) result, the process chain manager receives information about the condition of the business process that varies for each process step. So, non-ideal conditions can easily be re-adjusted until they fit to the pre-assumptions or desired conditions. As a result, e.g. the product realisation phase could be qualitatively enlarged by a competence increase of the involved employees. This means, competency gaps that are specific for a process step can be identified. Furthermore, the simulation can support the decision e.g. to spend money for a process-step-focussed training.

The main benefits for Klett are:

- To increase the awareness for business processes and their costs
- to identify business process gaps in advance,
- to estimate costs and quality levels in a better way for specific business process conditions,
- to use an appropriate condition for a quick-start learning scenario for employees and

- to reveal capacity and competency bottlenecks in the planning phase for a business process

5 Conclusions

Simulation is a tool that is used to predict performance and to understand the impact of change. This ability of simulation, not only to provide answers to different "what if" questions, but also to transport users into a virtual environment where they can experience alternative pictures/views? of the future, makes it ideal for supporting both decision making and experiential learning. It represents a particularly animated and participatory form of learning, where users learn by virtually "living" in a reconstruction of the real-life environment, where they will soon have to apply their new knowledge. In the latter case, simulation techniques are used to validate decisions associated with the learning solution.

Currently there are numerous process simulation tools available on the market. But there is a shortage in simulation tools integrated in a process- and competency driven framework for interlinking business process intelligence tools with knowledge management and learning environments. The simulation of real working situations, easy adaptable to different companies' scenarios, is still an issue for many simulations dealing with work processes. Especially, solutions for modelling simulation settings in the area of HR, e.g. competencies of staff and their behaviour in real work-contexts, are weak. The conduction/bringing together of learning goals and business processes, including didactical strategies, competencies and the modelling of specific learning processes configurations is still unsolved for simulations.

References

[1] Aldrich, C.: Learning by Doing, Wyley, 2005
[2] Pannese, L.; Cassola, M.; Grassi, M.: Interaction with Simulation Tools: Analysis of Use Cases, I-KNOW Conference, 2005
[3] Kelten, W.D.; Sadowski, R.P.; Sadowski, D.A.: Simulation with Arena, Boston: McGraw-Hill, 1998
[4] Kindley, R.: The Power of Simulation-based e-Learning (SIMBEL), The eLearning Developers' Journal, 17 September 2002.
[5] Prensky, M.: Digital Game-Based Learning, McGraw-Hill, 2000
[6] Quinn, C. N.: Engaging Learning, Wiley, 2005.
[7] Pannese, L.; Nitti, V.; Santalmasi, M.: Simulation-based solutions for performance enhancement in companies from different industrial sectors, Stuttgart, "Professional Training Facts" conference, 2005
[8] Watkins, K.E., and Marsick, V.J. Sculpting the learning organisation: Lessons in the art and science of systemic change. San Francisco: Jossey-Bass, 1993
[9] Greasley A. "Using business-process simulation within a business-process reengineering approach" Business Process Management Journal Vol. 9 No. 4, 2003 pp. 408-420
[10] Gopinath C., Sawyer John E., (1999) "Exploring the learning from an enterprise simulation", Journal of Management Development, Vol. 18 No. 5, 1999, pp. 477-489.
[11] Van Eck R., "Digital Game-Based Learning", Educause, March/April 2006, pp. 17-30.
[12] PROLIX ("Process-oriented Learning and Information exchange") Integrated Project, IST FP6-2005-027905, www.prolixproject.org