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BUSINESS PROCESS SIMULATION: A FUNDAMENTAL STEP SUPPORTING PROCESS CENTERED MANAGEMENT

Marc Aguilar
Tankred Rautert

Banque Générale du Luxembourg, S.A.
50, Avenue J.F. Kennedy
L-2951 Luxembourg, LUXEMBOURG

Alexander J.G. Pater

Andersen Consulting
Apollolaan 150
1070 AT Amsterdam, THE NETHERLANDS

ABSTRACT

Business processes are increasingly recognised as the key to competitive survival. The important opportunities inherent to this invisible economic asset are the foundations of process centred management.

Simulation of business processes creates added value in understanding, analysing, and designing processes by introducing dynamic aspects. It provides decision support by anticipation of future changes in process design and improves understanding of processes.

The example of Banque Générale du Luxembourg shows, how simulation is used successfully to support the building of process centred management in a banking environment.

1 INTRODUCTION

Remember what purchasing a car was like 20 years ago? People agree that the commonly used expression of 'good old times' is a purely euphemistic notion of a desolate state of affairs that has tremendously improved since.

Customers at that time were clearly suffering from the constraints of production. "Customers had little choice and all competitors were equally bad (Hammer 1996)". Production planning and not customer preference determined products and their availability.

Pressured by suddenly powerful international competition and ever more demanding customers, companies were forced to change their attitude completely. Companies came to the conclusion that customers were the key to business success. This enlightenment triggered a revolutionary development: the migration from a production-oriented to a customer-driven business.

Customers' perspective on business is a process perspective because it is the result of processes that creates value for the customers. Therefore management had to become process oriented too. The idea of process centred management was born (Keen 1997).

Successfully applying process orientation enabled car manufacturers to achieve milestone improvements, which helped them to win the fierce battle for competitive survival.

Banks are facing a similar situation today. The increasing number of mergers and acquisitions in the banking sector indicates augmented competitive pressure triggered by ongoing globalisation and development of new technologies (Michael 1998). On the edge of this second industrial revolution and the 'customer's victory' (Dupuy 1998) banks can ensure their competitive survival by adapting the process centred approach from other industries.

After a brief introduction into the relevance of process centred management (Section 2) the Paper outlines the methodology used by Banque Générale du Luxembourg (BGL) to develop and implement this concept in the financial industry (Section 3).

The role of simulation in building a process architecture, it's added value, the critical success factors and the importance of careful expectations management are discussed in the following (Section 4).

Results of business process simulation performed by Banque Générale du Luxembourg, in collaboration with Andersen Consulting are described in Section 5.

2 THE RELEVANCE OF PROCESS CENTRED MANAGEMENT

2.1 The Building Blocks of Process Management

The success of process orientation and it's impact on corporate management is based on a fundamental paradigm shift. Based on the definition of a process as 'a complete end-to-end set of activities that together – and only together - creates value for the customer' (Garvin 1998; Hammer 1996) the four building blocks of process management are identified: *Crossing of boundaries in the operational structure; customer; flexibility and change; strategy*.

The *crossing of boundaries in the operational structure* is one of the main characteristics of processes. Whereas traditional structures are usually suffering from isolated departments, poor co-ordination, and limited lateral communication, process orientation emphasises interactions between different organisational units.

Customer is the second key to process orientation. Creating value to the customer became the essential mission of companies. Since this value is the result of processes, companies started to orient their managerial behaviour on processes.

Process orientation enables *flexibility and ability to change*. Companies that work and think in traditional hierarchical structures are stable but inflexible. Process centred organisations, on the contrary, are built with an emphasis on flexibility and ability for rapid change.

Strategy is entirely oriented on business processes. 'The building blocks of corporate strategy are not products and markets but business processes. Competitive success depends on transforming a company's key processes into strategic capabilities that consistently provide superior value to the customer' (Stalk et al. 1992). Continuous evaluation of process performance lead to improved strategies, which again trigger changes of process design and adaptations of the operational structure. This iterative development of new strategies in time improves process design and changes the operational structures as illustrated in Figure 1.

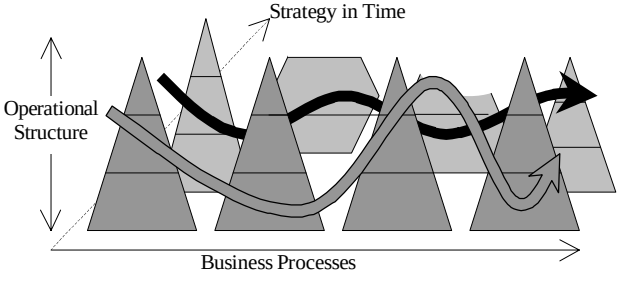

Figure 1: Strategic Development of Business Processes and Operational Structures in Time

Business processes (arrows) flow across different units (triangles and other shapes) of the vertical operational structure. Development of strategy in time triggers improvement of process design and induces changes of the operational structure (light grey shapes and grey arrow – dark grey shapes and black arrow).

2.2 An Example from the Computer Industry

The following example illustrates how process centred engineering was successfully applied in the computer industry. It shows how a company developed an important competitive advantage by orienting it's strategy entirely on the optimal designing of business processes.

Based on the conclusion that to earn higher returns they should put their "capital into activities where they can add value for their customers, not just into activities that need to get done" (Margetta 1998, p. 74) the American Dell Computers created a $12 billion company in just 13 years. Dell concentrated its efforts on optimising the design of the process of 'providing a personal computer (PC) to a customer'. The result is a highly efficient and successful but also surprisingly simple process.

Focussing on inventory cycle times rather than on inventory size was one of the key success factors. Dell succeeded in decreasing their inventory time within the process to 11 days. Compared to 80 days of competitors this means being ahead by 69 days on the market. It also represents a reduction of the massive risk inherent to inventory in a fast developing industry like computers. If costs of material go down 50% it is much easier to live with 11days of inventory than with one or two months.

The enhanced process design enabled Dell to offer better services to the customer taking advantage of new distribution channels. On the internet customers can order tailor made solutions that fit their individual needs. They can select parts and arrange configurations according to their personal preferences. Assembly actually starts only after the individual order has been received.

Buying a computer via internet is not only easier for the customer, it also drastically reduces distribution costs. Rent for shops, provisions for salesmen, inventory costs and other expenses of indirect distribution are completely eradicated.

2.3 Significance for Banking

Banks today are facing a situation similar to the one of PC manufacturers in the recent years. On one hand the competitive pressure increases and banks have to become more customer-focussed. On the other hand an extensive network of branches as it exists today is not longer affordable. For example expenses for the location of the 49.000 bank branches in Germany are estimated at Euro 7.5 to 10 billion (Salmony and Denck 1999).

There is only one way out of the dilemma: Focus on the new distribution channels that are offered by technological innovations like the internet and smartcard technology. E-commerce and electronic financial services will be the motor of banking business in the future. Forrester Research estimates the world-wide turnover of e-commerce to be $ 100 billion in 2000 and $ 330 billion in 2002 (Salmony and Denck 1999).

Innovative and effective process design is absolutely necessary to access new distribution channels, use the new technologies at the fullest and support customer oriented business strategies. Therefore borrowing the techniques of process centred engineering bears an enormous potential of improvement for banks.

The following example shows an innovative way of re-positioning in the investment fund business: Instead of just selling another fund on a saturated market the

innovative bank offers Electronic Portfolio Management (EPM) via Internet, providing customers online with tailor-made investment solutions. As the customer introduces online his specific investment profile, it will be automatically translated into an individually designed portfolio as illustrated in Figure 2.

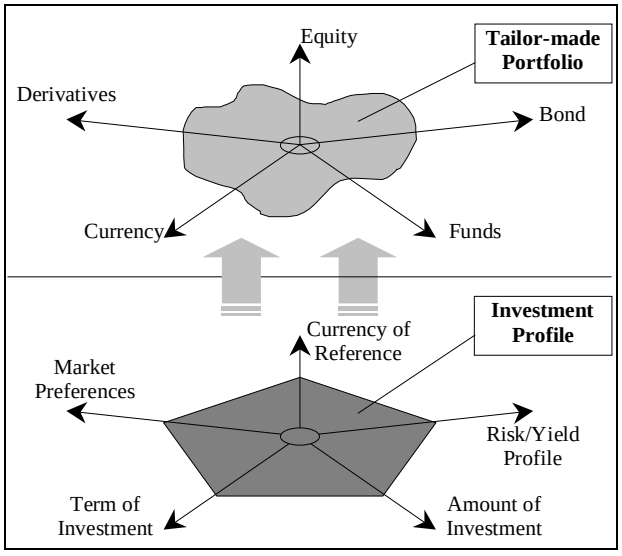

Figure 2: Tailor-made Portfolio for Individual Investment Profile

A tailor made portfolio is built according to the customer's individual investment profile.

Contrary to currently existing investment funds, EPM offers a flexible one-to-one customer service. Rapid execution, settlement and confirmation of orders are guaranteed by using data throughput processing.

At the moment online EPM via Internet is admittedly still a vision. In the same way Dell's business concept, described in the previous section, was visionary at that time. From a process perspective the analogies between the two examples are striking, which proves, that both approaches are funded on the same idea. Dell's success is therefore a good indicator for the enormous potential inherent to the idea of EPM.

Where Dell's customers select and compose the parts of their PC individually, investors use EPM to choose financial assets and combine them into their portfolio according to their personal preferences. Like Dell's customer orders are transmitted directly to the different part manufacturers, EPM orders are also forwarded directly to different brokers for execution and settlement.

Concentrating on the core business of providing customers with individual solutions was the key to Dell's success. The actual manufacturing of PCs was left to others. In the same way a bank using EPM will outsource the majority of operational activities like order execution and settlement to specialists who do it cheaper, better and faster. Banks could concentrate on portfolio management and make individual investment consulting their core business.

Smooth, effective and fast processes are the building blocks of Dell's business success. In the same way superior process design and process oriented management is needed to enable banks to offer innovative services like EPM.

However, strong traditions and intrinsic business values made banks head towards stability and continuity rather than towards flexibility and innovation. Therefore rigid hierarchical structures still dominate in banks.

3 SIMULATION METHODOLOGY IN PROCESS ANALYSIS AND DESIGN

3.1 Building Business Process Architecture

Developing and implementing the comparatively new concept of process centred management in banks is not straightforward. Next to a sound methodology and powerful support tools, sponsorship from the top management is essential.

BGL, one of the leading banks in Luxembourg, is currently investing in building a 'Business Process Architecture'. The environment for process centred management is built in two phases: the assessment of the currently existing situation ('Assess As-Is') and the building of an enhanced future process structure ('Build To-Be'). Each of these phases consists of several distinct steps as illustrated in Figure 3.

Assess As-Is: A first step consists in identifying, describing and mapping the processes of a company. The results have to be communicated carefully so that everybody in the company understands the concept of process orientation and the mapping results.

In order to detect weak points and opportunities for improvement process performance is evaluated and benchmarked.

Build To-Be: Based on the results of the assessment the future process is developed. Andersen Consulting's Process Excellence Principles (PEP) provide guidelines for the effective design of processes. Applying PEP's seven "R's" (Rethink, Reconfigure, Reassign, Resequence, Relocate, Reduce, Retool) creates new processes with superior performance.

Enabling the environment to support the new design and *implementing the new process* represents the last step in building the new process structure. The creation of a process oriented structure in the organisation is essential for the successful implementation of new processes.

Feedback Loop: To keep track of a constantly changing environment it is necessary to integrate a feedback loop in the framework as illustrated in figure 3. After implementation of the new design measurement of performance starts again to enable benchmarking and

further analysis. This ensures continuous improvement of the process.

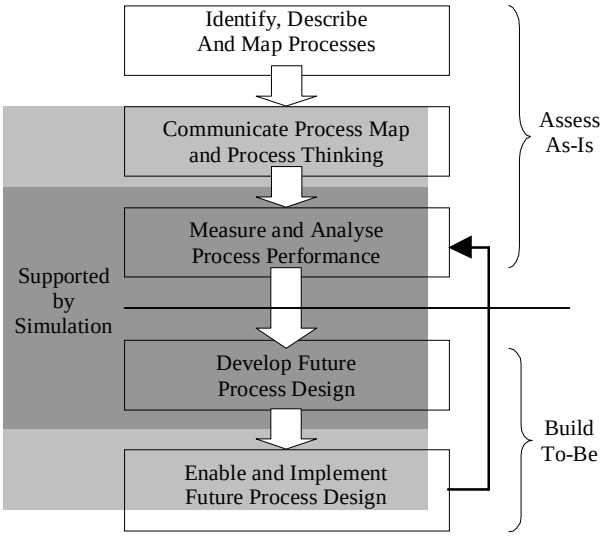

Figure 3: Building Process Centred Management

Building an environment process centred management is done in two phases: Assess As-Is and Build To-Be. Each phase consists of several distinct steps. The framework is designed to include a round-trip: After implementation of the new design measurement of performance starts again to ensure continuous improvement of the process. Support provided by business process simulation is illustrated by the grey boxes (major support in dark grey, additional support in light grey).

3.2 The Impact of Simulation

The main impact of simulation is directed towards performance analysis and design of future processes as illustrated by the dark grey area in Figure 3. Thus simulation is bridging the gap between assessment of the existing and the design of the future.

By introducing dynamic parameters of the process, like times, volumes, capacities and quality simulation fundamentally enhances process performance analysis. It provides a much better picture of bottlenecks, hand-over times and dynamic performance than a static analysis (e.g. by flow charts).

Investigations and analysis necessary to build the simulation model improve the knowledge about the process itself. This leadsy to valuable ideas for future process design. Any envisaged change in process design can then be anticipated and evaluated by simulation. Thus experimentation results significantly contribute to the decisions about future process design.

Simulation further supports the communication and implementation steps illustrated by the light grey areas in figure 3. Modelling an entire process in simulation helps all participants adapt a process perspective, understand their contribution to the process result and reflect about the interactions with others in the process. Thus simulation has a catalytic effect: It facilitates communication and re-directs people to the most important objective: improving process performance.

Last but not least simulation increases the acceptance of re-design solutions. Graphical animation communicates *what* is going to change. Simulation experiments explain *why* change happens, i.e. what kinds of improvement are achieved by the re-design. Thus simulation enables the working environment and prepares the implementation of changes. It helps to avoid that re-design is understood as 'something plucked out of thin' and met with a lot of scepticism.

3.3 A New Dimension of Corporate Organisation

Process centred management creates a new dimension in corporate organisation. In addition to the traditional vertical perspective that focusses on operational structures, management now takes a lateral, process oriented view on business.

Within vertical operational structures work and responsibilities of one process are often divided into different units. Stakeholders' interest is focussed on task performance rather than on process performance. This results in a *local* and not in a *global* optimisation which usually causes inefficiencies in the complete end-to-end process. To avoid such inefficiencies and enforce global process optimisation, BGL implements a new process oriented structure in it's organisation. Adding this process structure to the existing vertical operational structures results in a matrix view of business.

The key sponsors and actors in the new structure - Top Management, Process Sponsors, Process Owners and Process Performers - concentrate on the performance of the entire process including all tasks across different units in the operational structure.

Sponsorship of the *Top Management* is absolutely required to build a process oriented structure. It helps to smooth inter- and intra-departmental friction that might arise because the whole organisation at all hierarchical levels and throughout all different units is affected.

Process Sponsors are needed to enable analysis and re-design of a group of processes with common business interest. They are typically managers that assume the responsibility for large parts of these processes in the existing operational structure.

Process Owners are responsible for an entire process. As processes cross departmental boundaries, this is typically a new, cross-departmental job. Process Owners are involved as soon as possible in the development of a process architecture, in order to participate already in identification and description of processes.

Process Performers are carrying out the work in the process. Compared to their jobs in traditional vertical

operational structures, a fundamental change arises from a shift in perspective from single tasks to the entire process.

4 BANQUE GENERALE DU LUXEMBOURG – A BUSINESS EXAMPLE

4.1 Business Process Architecture

BGL is currently pioneering in the field of process centred management. In collaboration with Andersen Consulting BGL developed a structured model of the company's 'Business Process Architecture' (BPA) providing a comprehensive description of all business processes in the bank. It contains essential knowledge about structure, functioning, and key parameters of BGL's business processes that enables the company to set-up process centred management.

The BPA model describes business processes at different levls of detail. Starting from a generic macro-level representation of a bank's global business processes, it subsequently breaks down the global picture to more detailed descriptions of processes.

Four *Macro-Level Processes* are used in the model to define the fundamental business mission of the bank: 'Fulfill demand', 'Generate demand', 'Develop products and services' and 'Plan and manage the enterprise' – a classification derived from a standard model of Andersen Consulting. By extending and refining this model BGL created a generic reference for companies in the financial service industry.

The BGL Process Map in Figure 4 shows the 78 major processes (Level 2) of BGL, grouped into 21 core processes (Level 1) and the repartition on the four macro level processes.

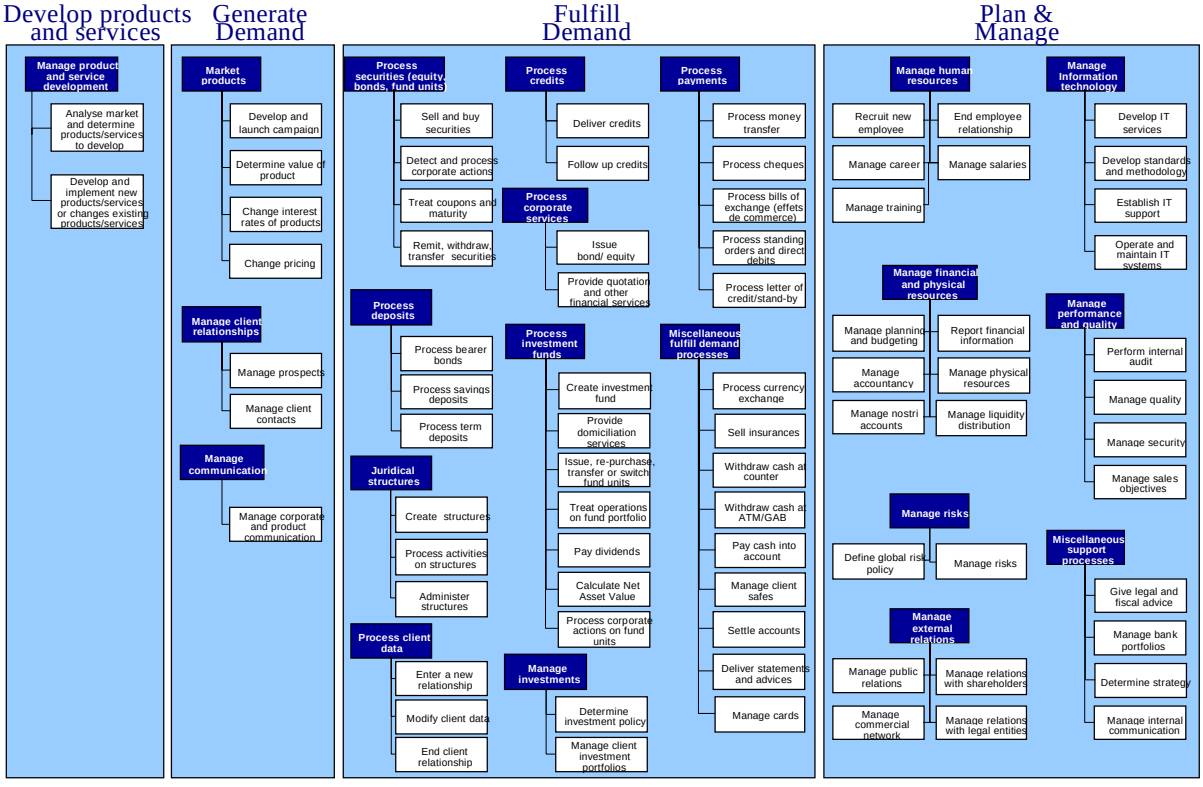

Figure 4: The BGL Process Map

BGL's 78 major business processes (white boxes) are grouped in 21 core processes (dark coloured boxes) and divided into four fundamental business missions of the bank (large light coloured cases).

The entire documentation of BPA has been elaborated between October '98 and February '99 by a team from BGL's Organisational Department. Information about processes was collected from existing business documentation, structured and built into a conceptual model for the process architecture. Working in close co-operation with the business experts on the field the model was then completed, refined, confirmed and validated. Future process sponsors and owners have been identified at this stage of the project already, which constitutes the first step towards the implementation of a process centred management structure.

For further documentation about BPA please contact the authors Marc Aguilar and Tankred Rautert.

4.2 Simulation of Core Processes

In a second phase of the project, between December '98 and April '99, two core processes - *'Deliver Credits'* and *'Recruit new Employee'* - were analysed by means of simulation.

Simulation methodology was chosen, because currently existing problems in both processes have been clearly related to dynamic parameters, such as time, volumes, capacities and quality. Simulation enabled the migration from a static towards a dynamic process model. It was used to provide insight into dynamic features of current and future process design, that could not have been obtained with traditional, static modelling tools. BGL used the software package Arena® of Systems Modelling Corporation for computer simulation.

Process 'Deliver Credits': One of the major concerns in the process *'Deliver Credits'* is the throughput time, i.e. the time between client interview and decision respectively disbursement of the credit. From a client perspective these times essentially determine the quality of BGL's service in 'delivering a credit'.

The screen shot of the animation in Figure 5 illustrates the process and shows the interactions between the three parties involved in the process: the customer, the branch offices and the credit department.

Exchanging information between the branch offices and the credit department was known as a critical area of the process. Hence the target parameter was the rate of missing information on credit request files which are transmitted from the branch offices to the credit department. Retrieving such missing information causes delays and additional communications and therefore increases the total throughput time.

To improve this situation it was planned to implement a task force in the credit department that completes missing information and at the same time assists the branch offices to improve the information quality in the future.

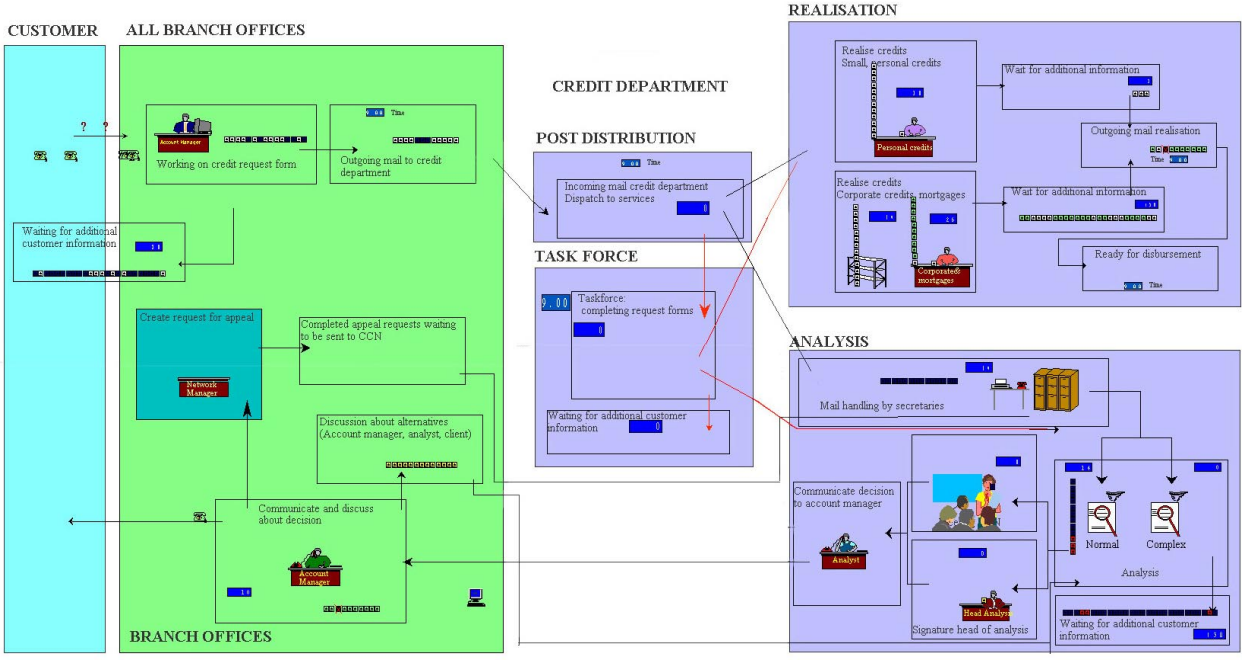

Figure 5: Simulation of the Process 'Deliver credit' - Animation

The screen shot of the graphical animation shows the flow of a credit request from the customer, via a branch office, through the credit department, back to the branch office and finally to the customer. The credit department is divided into different sections responsible for the distribution of incoming mail, the realisation of credits and the analysis of requests. Implementation of a task-force in front of the analysis and realisation units is planned to retrieve missing information on incoming credit requests.

Objective of the project was to provide management with key information about the possibilities to reduce the throughput time of the process, in particular to

- evaluate the impact of improved quality of transmitted information on the total throughput time,
- evaluate the impact of increasing transactional volumes on throughput time,
- advise about the best way to implement the task force in the process.

Based on comprehensive measurements regarding throughput times and rates of missing information for different types of credits (small personal loans, mortgages and corporate credits) and different delegation levels (decision in branch or in credit department), simulation provided the following results and recommendations regarding the objectives:

- Improving the quality of transmitted information on credit request files reduces average throughput times. A differentiated result per type of credit and type of information has been elaborated that leads to a prioritisation depending on the possible gains in time.
- Increasing volumes of up to 3% can be handled by the process as it is now, without penalising throughput times. Increases of more than 3% need to be compensated by adapting capacities.
- The minimum capacity needed for the task force - a specific number of files that has to be processed per day in average - was derived.
  Implementation of the task force generally increases throughput times due to an additional hand-over in the process. In certain situations (depending on credit type and transmitted information) throughput times are penalised by the new way of processing the collection of missing information, in other situations throughput times are reduced.
  In view of these results focussing on specific types of credit requests and types of errors was recommended for the implementation of the task force.

The managers responsible for the credit process based their decision concerning the implementation of the task force on the results and recommendations of the simulation project: The task force concentrates on it's training mission and corrects only credit request files that are routed directly to realisation in order to avoid a penalisation of the time to decision.

Taking this decision based on process analysis and with the objective of improving process performance is clearly part of a process centred management strategy.

By improving and extending existing measurements and statistics simulation further contributed to the continuous supervision of process performance. It is thereby providing essential support for process centred management.

Process 'Recruit new Employee': As BGL keeps on growing at considerable pace, recruiting is a strategic issue for the company. Although the Human Resources (HR) department is the central piece in the recruiting process, many other departments also actively contribute to this process. Since the time to recruit a new employee was perceived as 'too long' by many department managers in the company, the objective of the project was to

- provide measurements that allow a precise evaluation of the current process performance,
- elaborate improvement suggestions to reduce the recruiting time without changing the quality of new employees.

Measurements performed during the simulation project proved that the major part of the recruiting time is composed of elapsed times caused by internal and external communication. Except for certain scheduling issues, resource capacities were only a minor issue in this process.

Simulation of various improvement ideas led to the following major recommendations:

- Introduce an end-to-end planning to formalise and pre-schedule all major process steps especially if interactions between HR and other departments are involved. This helps to reduce recruiting time considerably (at least 30% on average).
- Shift the entire pre-selection of candidates to the HR department. A second pre-selection by department managers, that currently confirms the HR choice anyway in 90% of the cases can be avoided. This helps to reduce recruiting time on average by 2.8 weeks.
- Measure and control process performance based on vacancies. Integrating the two IT-systems currently used in the recruiting process is therefore strongly recommended.
- Adopt an increasingly pro-active behaviour to the labour market. Delays can be avoided by searching qualified personnel even before vacancies arise.

- Treat incoming applications continuously rather than in batch mode. The time to find an appropriate candidate might be reduced by up to 35%.

The recommendations have been approved by responsible of the HR department and other departments concerned with recruiting issues. At the moment of writing a project is being set-up to implement a prioritised selection of the improvement suggestions issued by the simulation project.

5 SUCCESS FACTORS OF SIMULATION

Whereas simulation of business processes is widely used in manufacturing companies, it represents a novelty for banks. How is simulation to be used in a banking environment and for what kind of problems is it most suitable ?

BGL's experience with simulation shows that the success of a simulation project essentially depends on four factors: The process characteristics, the objectives of simulation, the quality of input data and the management of expectations.

5.1 Process Characteristics

Industrialised and complex processes are more suitable for simulation. '*Industrialised*' means that activities in the process are not entirely individualised but subject to rules and patterns. Processes with highly divergent activities, which cannot easily be categorised are difficult to model. It is therefore essential to recognise rules and patterns of process behaviour. Often such rules and patterns exist but have never been identified. Then the problem rather consists in identifying and assessing them.

Simulation of the process 'Deliver Credits' in BGL showed for example that the process is actually very industrialised. It required however much time and effort to obtain a suitable description of rules and patterns from the process specialists who were not at all familiar with such a perspective. On the contrary the recruiting process of BGL proved to be not very industrialised. Attempts to identify rules and patters were not always fruitful, so that a part of the process had to be simulated as a 'black box'. However, the effort led to valuable suggestions for process improvement.

Only a certain degree of *complexity* in the process logic and in the statistical distribution of parameters justifies the use of simulation. If a process appears so simple that it supposedly could be analyzed by means of a calculator or spread sheet, using simulation seems disproportionate. However, problems that seem simple at first sight, often turn out to be complex after a detailed analysis, especially if statistics are involved.

During both BGL's credit and recruiting simulation some problems seemed to reduce to simple arithmetical operations. A closer examination of statistical background proved that simplifying methods would have lead to incorrect results.

5.2 Simulation Objectives

The value possibly added by simulation must be considered in view of the simulation objectives. It is important to clarify what can best be shown by simulation, and what can better be shown by other means.

Problems having no evident solution are easier accessible by simulation. Where no one has a clue, a new method is more easily accepted. On the contrary cases where solutions appear evident and well known to everybody - although they are not yet in place - are harder to tackle.

In this case a waterproof explanation about the choice of simulation as decision support tool is necessary as well as a careful management of expectations. Simulation might show that the commonly accepted off-hand solution is not a good one. This situation must be expected and prepared.

In the simulation projects performed in BGL examples for both cases were encountered: During simulation of the process 'deliver credits' a suggestion for re-design existed beforehand. As simulation experiments showed weak points of the suggested solution and indicated other possibilities, the results had to be defended against the firmly established ideas. On the contrary the simulation of the process 'recruit new employee' was not confronted with a pre-defined evident solution, which supported an unbiased approach of the problem.

5.3 Quality of Input Data

Input data must be reliable, exact and statistically relevant. In order to avoid the 'Garbage-In-Garbage-Out' (GIGO) effect, data requirements should always be watched very carefully when choosing target processes and defining objectives in a simulation project.

Both simulation projects of BGL were confronted with heavy data requirements. The effort for collection, verification and continuous improvement of data represented an important part of the project's budget.

5.4 Expectations Management

Careful management of expectations is an important issue for projects using simulation methodology. If expectations are completely unrealistic, they might become difficult to handle or even dangerous. Creating realistic expectations requires communication and building of a good deal of insight into simulation methodology and tools, which is not easily obtained.

Simulation might be perceived as a 'magic box', providing absolutely precise, true and reliable information out of nothing. Such exaggerated expectations can have the effect of a time bomb if they are not satisfied by the simulation results. In order to solve the problem, it is necessary to repeatedly explain objectives, constraints and assumptions used for simulation. In this context it is important to emphasise that simulation is a decision support and not a decision-taking tool.

People might perceive simulation as an 'expensive toy', which delivers results that could be easily obtained by cheaper means. To convince these people, it must be shown that simulation adds value by providing new and unique results. Emphasising the additional effects of simulation in early project phase and explaining the complexity of the model, the tool and the statistical analysis also increases the acceptance of non-believers. However the risk of confirming people in their negative expectations still persists.

Animation has positive and negative effects to be considered in the context of expectation management:

On one hand animation is a very appealing tool. In an event-triggered environment animation might be even more powerful than the actual results of simulation. All presentations of the animation in BGL's simulation projects were extremely successful. However, it must be ensured that animation is not confused with the actual results of simulation in terms of decision support. Animation merely illustrates these results.

On the other hand people who are used to take decisions based on facts and arguments, might perceive animation as somewhat ridiculous and useless. They don't take simulation for a serious tool. Strange enough people who judged animation as 'only things moving around on the screen' often still admit to be quite impressed.

6 CONCLUSIONS

Business Process Simulation is a powerful tool supporting analysis and design of business processes. The added value of simulation is based on four factors:

- Simulation enables the migration towards dynamic models for business processes.
- Simulation provides essential decision support by anticipating changes.
- Simulation (especially animation) is an effective tool to communicate process thinking and process analysis results.
- Process performance analysis is improved by simulation-triggered measurements.

Successful application of business process simulation in banking by BGL in collaboration with Andersen Consulting shows that simulation generates added value in the context of white-collar business processes.

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REFERENCES

Dupuy, F., 1998. *Le client et le bureaucrate*. Paris: Dunod.

Garvin, D.A., 1998. The process of organization and management. *Sloan Management Review*, Summer: 33-50.

Hammer, M., 1996. *Beyond Reengineering: How the process-centered organization is changing our work and our lives*. New York: Harper Collins.

Keen, P., 1997. *The Process Edge*. Boston: Harvard Business School Press.

Margetta, J., 1998. The power of virtual integration: An interview with Dell Computer's Michael Dell. *Harvard Business Review*, 2:73- 84.

Michael, C., 1998. Bankenkonzentration: der gro• e Wurf steht noch aus. *Bankmagazin* 10:10-13.

Salmony, M., Denck, M.A., 1999. Multibanking: Auf dem Weg zur neuen Bank. *Harvard Business Manager* 1:66-74.

Stalk, G., Evans, P., Shulman, L.E., 1992. Competing on capabilities: The new rules of corporate strategy. *Harvard Business Review*, 1:62-73.

AUTHOR BIOGRAPHIES

MARC AGUILAR received his master degree in mathematics in 1987 and his Ph.D. degree in parallel and distributed systems in 1993 from the University of Fribourg, Switzerland. Before joining Banque Générale du Luxembourg S.A. (BGL) in 1995, he has been working as a researcher in computer science for the Swiss IPP research program, was president of the SI-PAR association (Swiss Informaticians Society – Group for Parallel Systems) and senator of the University of Fribourg. Today he is head of the Organization Department and Director of BGL's CARAT Program (Competitive Advantage Realized through Advanced Technologies).

ALEXANDER J.G. PATER is a manager with Andersen Consulting and leads the European part of AC's global simulation and modelling group. Lex Pater received a M.S. degree from the Faculty of Technical Mathematics and Informatics at Delft University of Technology in 1992. Before joining AC he had set-up a simulation division in a Dutch consulting firm.

TANKRED RAUTERT works as business analyst at the Organisation Department of Banque Générale du Luxembourg (BGL). He is specialist for simulation in a team of business process experts. He received a M.Sc. from the Faculty of Applied Mathematics at Trier University, Germany in 1995. Before joining BGL he worked in software development and product management for software packages.