

Applying Business Process Oriented Learning in Industry

The PROLIX Solution Approach Based on a Case Study

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Abstract—With human capital being critical to corporate success, aligning individual training with business priorities, emerges as a key challenge. Business process oriented learning unites corporate training and business process management. This entails integrating learning into daily working tasks and putting in place mechanisms for the effective management of business processes, organisational roles, competencies and learning processes, to reduce the time to fill competency gaps and to build proficiency according to evolving business needs. In this paper we outline the main characteristics of the PROLIX approach for business-driven training and provide a practical example of how this concept can help a typical vehicle manufacturer effectively resolve competency related business problems stemming from changes in supply chain management.

Index Terms—business process oriented learning, eLearning, competency development, business processes, competencies, Time2Competency

I. LIFELONG COMPETENCY DEVELOPMENT

The rise of the “knowledge economy” [1], combined with the effects of trade liberalization and globalisation are changing the face of the labour world. The economies of developed countries increasingly rely on data and information and less on industrial production. The economic success of modern corporations is increasingly based on “the effective utilisation of intangible assets such as knowledge, skills and innovative potential as the key resource for competitive advantage”[1]. “Knowledge workers” and highly skilled or specialised professionals are a key to the economic success of modern corporations and economies.

This has a profound effect on the structure of work, changing the way people work, the jobs they do and the competencies required [2].

In this context, human capital formation emerges as a priority for both the individual and the organisation. It can be regarded as a life-long learning process, since formal education represents only one part of learning and continuous personal development is required. People need to go on updating their skills and abilities throughout their working lives, in order to cope with the fast pace of change in the workplace, increase their personal market value and improve their employment perspective and earnings prospects.

In this paper we investigate human capital formation from the perspective of the organisation. Economic competitiveness is closely linked to the value of the human capital, i.e. to specific workforce skills and talents that need to be in place. Aligning individual training with business priorities, emerges as a key challenge for modern organisations. This entails integrating learning into daily working tasks and putting in place mechanisms for the effective management of business processes, organisational roles, competencies and learning processes, to reduce the time to fill competency gaps and to build proficiency according to evolving business needs.

In this paper we outline the main characteristics of the PROLIX approach for business-driven training (Chapter II.A) and provide a practical example of how this concept can help a company improve its business performance based on a competency-oriented management approach (Chapter III): the paper discusses the application of the PROLIX approach for business process-oriented learning in the automotive industry, for the resolution of a competency related business process improvement issue that is of particular importance to the sector: supply chain management optimisation. The analysis is done on the basis of a fictive automobile company (ProCar Ltd), nonetheless its characteristics are representative of existing corporations. Chapter IV outlines future work.

II. BUSINESS DRIVES LEARNING

In the present economic context enterprises are confronted with a number of vital business challenges to improve their operational efficiency. Gaining or maintaining a competitive advantage calls for new approaches, with regards to how companies plan, structure and manage their activities. The quality of a company’s workforce and its ability to quickly adapt to changes can play an important role in all business improvement efforts, thus calling for a continuous investment in human resource development [3]. Particularly in knowledge intensive business environments, employees are the carriers of knowledge and represent the organisation’s “intellectual asset” [4],[5]. Ensuring that employees have the right skills for the job is essential for the growth and success of an organisation. Human development processes should therefore be attuned to the organisation’s business challenges. Training services should transfer to employees all the knowledge needed to cover any deficits hindering the independent fulfilment of their daily business tasks. Accelerating skills acquisition (“Time2Competency”) can help organisations better cope

with changes in processes, products and organisational structures.

Within an organisation, learning [4], [6], [7] and business process improvement activities (Business Process Reengineering, Continuous Process Improvement) [8], [9] essentially serve the same goal, i.e. to improve the operational effectiveness of the organisation. Nonetheless, traditionally, organisations have handled learning management and business process management as two completely disjointed activities, two “separate worlds”. The systems for planning and executing training processes [10] are not coupled with business processes modelling and business information systems and executive responsibilities are assigned to different administrative entities. The task of training management is part of the work of human resource managers, who rely on traditional methods in order to assess the training needs of the employees, and often lack a full overview of the actual corporate context in which training is applied. As a result, in many organisations there is a mismatch between the training provided and the actual business needs: training is not provided on time and/or does not fully address the actual training needs of the employees with respect to their changing business duties. It is clear that the two activities (business process improvement and training) are complementary and the benefit for organisations can be enhanced if they are applied in a coordinated fashion. Aligning individual training with business priorities, so as to reduce the time to fill competency gaps and to build proficiency according to evolving business needs and daily work processes, emerges as a key challenge for corporate success. Business process-oriented learning can enable organisations to adapt to changes in their organisational structure (resulting e.g. from business process reengineering initiatives or from changing business requirements), to effectively introduce employees to new tasks, to streamline business operations (e.g. overcome performance problems caused by heterogeneous company culture among different company departments, branches or within project teams as a result of mergers or acquisitions) etc.

A deficiency in competencies may be the result of changes in:

- a business process (introduction of new business processes, business process re-engineering featuring addition or elimination of process steps, merging of business processes etc)
- an organisational role and its associated competencies profile (e.g. updating of competencies to match advances in related state-of-the-art)
- the actors, i.e. the individual employees assigned to perform the specific tasks (hiring or relocating personnel, e.g. substitution of employees)

Whenever such a change occurs, a new learning phase must be launched to fill any knowledge gaps to meet the new requirements. Apart from the need to train existing or to recruit new employees, a business-driven analysis of skills deficiencies, may reveal untapped potential of the existing staff which can be mobilised to solve a specific business problem (internal mobility).

Essentially, business process-oriented learning entails integrating learning into the daily working tasks and putting in place mechanisms for the effective management

of business processes, organisational roles, competencies and learning processes. The EU Integrated Project PROLIX (Process-oriented Learning and Information Exchange) [11] aims at the development of an interoperable service-based architecture for business process oriented learning, to interlink eLearning to corporate knowledge management and business-intelligence systems, so as to reduce the time to fill competency gaps and to build proficiency according to business needs and daily work processes.

The PROLIX approach for process-oriented learning is outlined in the following section.

A. *PROLIX: Process-oriented Learning and Information Exchange*

PROLIX [11] envisages a system to enable business process driven learning at the workplace, taking into account the single learner and their needs, as well as the corporate requirements. Linking business processes and learning is a particularly complex task. Business processes define organisational roles and associated functions, each with its own specific competencies requirements (i.e. the “competencies profiles” of organisational roles). 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 requirements of the role that may negatively affect business performance, organisations need to design and execute suitable training plans, in order to close it. Business situations that may cause such changes include business engineering, recruiting and staffing and regulatory compliance.

The PROLIX approach covers the complete life cycle from the business need that triggers learning to the assessment of the actual impact learning made on business performance. The PROLIX Learning Life Cycle (PLLC) and the tools required for each step of the process are depicted in Figure 1 [12]. Starting point is a complex business situation, i.e. a situation that translates into significant competencies deficiencies and creates the need to train employees.

The life cycle of business process oriented learning comprises the following steps:

- **Business need analysis** refers to the modelling or optimisation of business processes and the identification of competencies or roles required to carry out the functions of a business process (Business Process Cockpit & Competency Oriented Simulator).
- The **identification of competency gaps** includes the calculation of overall competency gaps (by comparing employee’s as-is and required competency profiles in the Competency Analyzer) and the prioritisation of the competency gaps to be filled by means of learning.
- The **design of the learning process** involves the identification, and in case of lack thereof the creation, of appropriate learning material. The learning material creation process may involve the selection or development of a didactically suitable learning process template (Didactical Learning Modeller) and the assignment of learning resources

to this template to create a learning process (Learning Process Configurator).

- The **execution of the learning process** consists in employees being trained, in order to fill their respective prioritised competency gaps (Learning Process Execution Platform).
- **Performance monitoring** involves an evaluation of the impact of the learning process both in terms of learning outcomes and business process performance improvements (Performance Monitor).
- During **business value analysis** the business outcome of the competency improvements is compared against the initial business need. Unless the results are satisfactory, business processes and/or learning processes can be adapted and optimised again and a new PLLC may start.

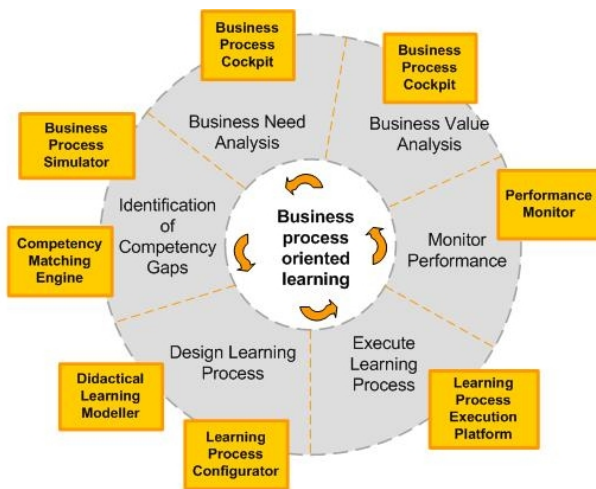


Figure 1. PROLIX Learning Life-Cycle for business process-oriented learning and solution map

The application of this framework in the case of a fictive automobile company (ProCar Ltd) is described in the following sections. The present paper outlines how the concept of business process oriented learning can help a company like ProCar improve its business performance based on a competency-oriented management approach. The following chapters will tell the story about how an average company can effectively manage a major turnaround, when dealing with changes in its supply chain. Although this is a fictive organisation, the presented case is representative of the situation in the industry. In order to draw an accurate picture of the application of the PROLIX system, we have adopted a story-board type approach, enhanced with numerical, historical and operational details about the business environment.

The PROLIX approach and prototype system implementation are presently in the process of being deployed and validated, in the course of trials with the participation of pilot users from different economic sectors. The case illustrated in the present paper, refers to a fictive organisation, yet it brings together elements found in the real-life users of the system. Therefore, we believe that it can provide readers with valuable insights regarding the scope, content and application of business process oriented learning.

III. CASE STUDY SCENARIO: CHANGES IN SUPPLY CHAIN MANAGEMENT OF A TYPICAL AUTOMOBILE COMPANY

A. The automotive industry business sector

The automobile business is a rapidly evolving sector. Global trade and manufacturing flexibility are the principal trends. Car and parts manufacturers are merging, component design and manufacture are now frequently outsourced instead of being created in-house. Brands are changing. The biggest and most successful automobile industry firms have become totally global in nature. Globalisation is the rule throughout the automobile industry, making it increasingly difficult to identify an automobile as the product of one company or country. Joint international ventures among companies and global expansion into new markets have become common practice. [13], [14], [15], [16], [17]

Automobile manufacturing is also experiencing vast changes. The original pattern of automobile production remained practically unchanged for many decades. Car manufacturers relied almost exclusively upon their in-house parts manufacturing for their production. In the late 1970s a new production model emerged, revolutionising the entire process [14]. Manufacturers began buying complete subassemblies from outside suppliers instead of individual components (e.g. completed dashboards in the place of individual instruments), around which the auto body was subsequently built. As a result, today, more than ever, car manufacturers and their suppliers are closely cooperating in the design and manufacture of new cars. Structurally, suppliers can be divided into three distinct layers: includes companies that sell finished components to the vehicle manufacturers (tier 1), companies that sell goods to tier 1 firms (tier 2) and suppliers of raw materials to any of the above (tier 3).

This and other innovative production strategies have allowed car companies to change production lines faster and produce more specialised cars faster and more economically. Subassemblies have enabled companies to cope with a fast-changing market more rapidly and effectively. Flexible factories allowed for reduced production times and costs per car, while offering a much wider range of choices for customisation to consumers. In this light, and given the fact that now 70 percent of an auto car's value is created outside the premises of an auto manufacturer [18], a tight integration with the company's suppliers is of paramount importance. Automotive manufacturers are giving more responsibility to their suppliers, while at the same time, limiting the number of their trade partners. In an effort to cut costs, shorten their time to market, and still produce high quality products, car companies are asking suppliers to produce entire systems. All companies involved in the process of delivering goods to consumers constitute a common network, i.e. a supply chain.

B. The business case of supply chain management reorganisation

An automobile producer's supply chain has fundamental impact on its business performance and can provide significant strategic, financial, and competitive advantages. Managing a vast network of suppliers and business associates and improving the flow of information, constitutes a huge coordination effort for

automobile companies, where information and communication technologies are called to play a critical role.

Supply chain performance optimisation is a key requirement in the direction of cost and cycle time reduction. The aim is to meet customers' expectations (i.e. ensure that they receive the right products at the right time at an acceptable price and at the desired location), while containing costs.

Effective Supply Chain Management (SCM) can lead to an efficient, integrated company with shorter innovation cycles, reduced inventory costs, and faster production. Hence, companies are always interested in solutions for managing their supply chain more effectively. In general, supply chain management comprises five major functions, each of which is often allocated to a different department:

- Launch Management (launching of new or existing car models)
- Production Planning & Scheduling (procurement and production line schedules)
- Inbound Logistics (part delivery from suppliers, logistics / part metering centres)
- Plant Logistics (production material control, material handling engineering)
- Outbound Logistics (finished vehicle delivery to dealers, damage handling)

Supply chain management relies heavily on the integration of information, systems and business processes across all functions of the entire supply chain, all of which are under constant scrutiny, since there cannot be an end point to the improvement process.

This may require the constant revision of processes, roles and tools.

The ProCar case study investigates how an average car manufacturing company can cope with operational and internal structuring changes that result from changes in the supply chain, by applying the PROLIX approach for making competency acquisition more efficient.

C. The company: ProCar Ltd

Our case describes the fictive car company "ProCar Ltd", with traits and characteristics that are common to a large number of real automobile companies. ProCar Ltd is a worldwide operating vehicle manufacturer. Established in 1910, the company has been an industry leader, specialising in family vehicles and SUVs since the early 70s. With 482,724 employees, ProCar achieved revenues of EUR 170 billion in 2005. Its products are sold in 200 countries. In 2005 about 5 million cars were sold. ProCar's yearly investments amount to EUR 38 billion. Presently, the company has a network of approximately 2000 suppliers and business associates (local vendors etc).

ProCar is a company striving for success in a business sector that is characterised by fierce competition and has undergone significant changes in the recent years, since difficult market conditions have managed to even put big players under financial pressure. The trend towards internal reshape and consolidation that has swept through the industry has also affected ProCar. In the past decade ProCar went through a fundamental change. The company went through a long business process improvement phase, in order to cut costs and improve performance. The turnaround process affected subsidiaries, suppliers and

customers. Currently, ProCar continues to look for new ways to improve its internal operations and increase its commercial strength.

IV. SOLUTION APPROACH

ProCar management has approved a plan for the improvement of the supply chain. Since this constitutes an important change, a new training and learning phase must be subsequently launched to fill any knowledge gaps created and meet the new operational requirements. The company has devised the following Change Plan:

- the introduction of an integrated system for supply chain management, encompassing all the required functionalities in one application;
- the use of eLearning to cater for the training needs of the employees expected to emerge after the change in the supply chain;
- the use of the PROLIX system for making competency acquisition more efficient.

ProCar Ltd is already using the PROLIX system. Contextualised competencies definitions are created and stored in the Competency Repository, which is part of the Competency Analyser. Based on these contextualised competencies, competency profiles for job roles (involved in the business processes), individuals and learning objects are created, which are also stored in the Competency Repository.

Consequently, in ProCar Ltd:

- All business processes of the company have been modelled in the BPC and annotated with competencies in the Competency Analyzer
- An up-to-date record of the competencies of all employees (actual competency profiles) is kept.
- The company maintains a repository of learning materials (configured learning processes and learning content to be used in learning courses). All existing configured learning processes (learning a set of prerequisite competencies ("required" competency profile), for an employee to be able to follow the learning process, and a set of acquired competencies ("acquired" competency profile) which will be passed over to all those who successfully complete the course. Competencies are specified together with their level.

For each business process, the optimal competency levels are determined using the PROLIX Competency Oriented Process Simulator.

Following any change in the competencies the role's task(s) require(s) or an individual possesses, the competency profile of this job role/individual needs to be updated, (e.g. when a different competency is required or acquired respectively, or when the proficiency level changes). In the case of individuals' competencies, this may be based on training results the levels of proficiency of, evidence collected "on-the-job" etc.

The application of the PROLIX Learning Life Cycle (PLLCC) to support the modification of the supply chain management process would comprise the following steps:

A. Business need analysis

The introduction of the new SCM software platform entails significant modifications in the supply chain management process (Business Process Change): business-process experts, process managers and business analysts must work together to improve the efficiency and effectiveness of the SCM business processes, overcoming the limitations of the replaced IS and making optimal use of the capabilities of the new software platform.

The process model needs to be reengineered [19]. In addition, the requirements in competencies of the related organisational roles need to be adapted.

The original SCM process involved several software systems, employed by many different users from within and outside the company:

- The eOrder, eOrderMat & eOrderComp for placing orders
- The eWarehouse for checking the availability of components and materials (inventory)
- The eAdmin for production planning and tracking, transportation tracking

A new production order could be placed in the eOrder system, either directly by an authorised ProCar merchant or by the sales department of the company. The order included all the details of the vehicles to be produced, as well as any customisation request (e.g. regarding the paint colour). This information was then entered in the eAdmin system, where it was broken down into resources needed for production, i.e. raw materials and finished components from a parts supplier. The production-planning department would then examine the availability of these items in this specific production factory or in other ProCar warehouses, using the eWarehouse application. In case of shortage, an order was placed with the respective supplier of materials or components via the eOrderMat and the eOrderComp system respectively. The supplier would then use same system to respond to this request and report on the availability of the ordered goods, the estimated time of delivery etc. The arrival of the ordered items was recorded in eWarehouse and when all needed resources

were delivered, production could begin. The end of the production phase was again signalled in the eAdmin system, which was also used for managing the distribution of the finished vehicles. The system kept track of the way the cars were delivered to the dealers that had placed the original order (by sea, train, truck etc). Upon arrival of the ordered components each dealer would have to acknowledge the receipt and this would signal the end of the process. According to ProCar’s strategic plan the aforementioned information systems are going to be replaced by the new “TotalOrder” system and the SCM-process will have to be revised accordingly. The new system is expected to bring a significant amelioration in the supply chain. The tool provides an integrated environment for SCM. The entire process, from the arrival of a new order to the delivery of the ordered goods, is now tracked by means of the new system, which allows for “one-stop” management of the flow of components, materials and finished vehicles. For example, functions such as “order components” and “order materials” can now be executed in one step. Other sub-tasks that involved the transferring of data from one system to the other are now simplified. The outbound logistics department automatically receives a notification in the system stating the successful completion of the production phase, together with all the details of the components produced. In the past this required collaboration between the two departments for the transferring of data from the component production tracking system the delivery tracking one. The supply chain process before and after the introduction of the new system is illustrated in Figure 2.

The introduction of the new IS platform leads to the modification of the SCM-process and the redefinition of all related organisational roles. As a result of the business process change, job roles are eliminated, introduced, modified or merged. Each job or function in a business process is associated with a set of competencies (a required competency profile), i.e. the competencies an employee assigned to this specific role needs to possess, in order to be able to perform the task satisfactorily.

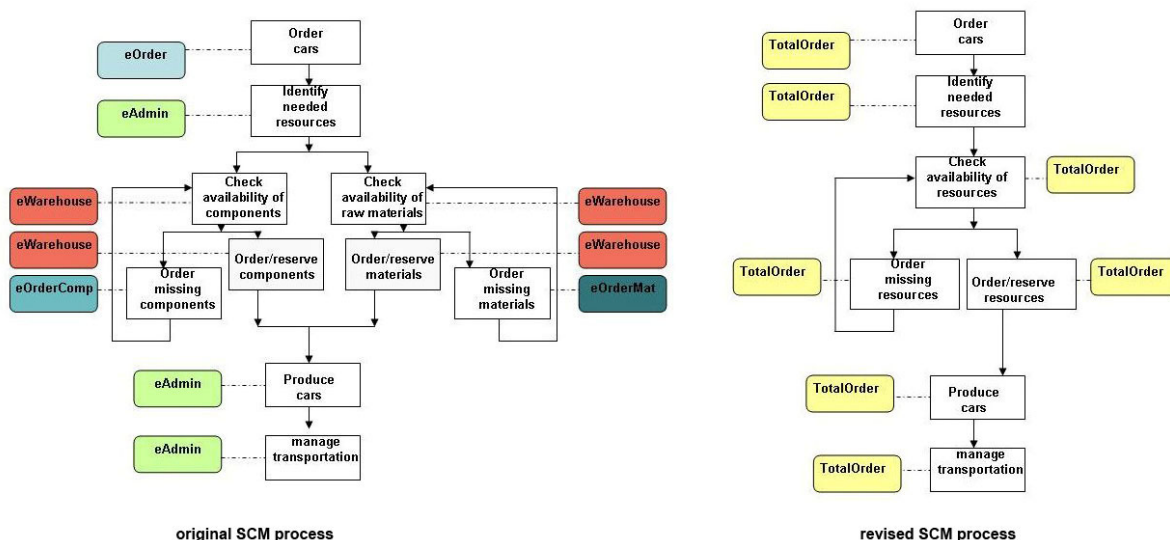


Figure 2. The supply chain process before and after the introduction of the new system

As a result of the business process modification, there can be changes in the competencies requirements of certain job roles. For example, given that now the functions “order components” and “order materials” can be executed in one step, a new organisational role is defined, taking over the two previously separated functions. The roles involved in the SCM process need to be revised and possibly extended by new competency requirements.

Business-process designers need to modify role-competency definitions and/or assign new competencies to the involved business functions and job roles.

The PROLIX Competency Oriented Process Simulator is used to calculate improvements in the business process based on the competency levels assigned to the business process. Business experts can use this to evaluate the potential business results and determine the optimal competency levels to be allocated to the business process, i.e. the competency mix that maximises the benefits for the company.

B. Identification and prioritisation of competency gaps

A business process change may create deficiencies in terms of human resources: lack of personnel to carry out specific tasks and/or adequacy of person-power but lack of skills.

Filling the competencies gaps created by the introduction of the new system is not merely a question of training all the ProCar SCM-personnel in its use. In order to maximise benefits, the HR department of ProCar needs to re-examine the assignment of personnel to roles. Each person has an acquired competency profile, which typically describes the competencies this individual has acquired during their lifetime. The competencies profiles attached to individual employees can be used for matching them with tasks. The difference between the acquired competencies of an individual assigned to a business role and the required competencies of the role represent the competency gap, i.e. the needed competencies that are not met by the individual.

In total 2.343 employees of ProCar were originally involved in the SCM process. Following the reorganisation of the process this number is reduced to 2.127 persons. ProCar Management is pushing for the immediate adoption of the new integrated SCM information system, as part of its strategic plan to reduce production costs by 5 percent by the end of the fiscal year. For this reason, the company needs to shorten the time required for the modified SCM process to reach a high performance level. Critical to this is optimising the role assignments for the modified SCM process.

In the case of ProCar two main issues arise with respect to personnel management, following the IS change:

- Personnel allocation, which is the case of newly introduced job roles and existing roles that require additional person-effort
- Skills upgrade, which refers to competency gaps that have emerged after the business process change in employees that kept their original job.

The HR department uses the PROLIX Competency Matching Engine (a) to search for employees that meet the requirements of specific roles, and (b) to calculate their actual competency gap, by comparing the competency

profiles of the candidates with the set of competencies required for the role.

Given the large number of people involved, training emerges as a particularly money- and time-consuming process. At the present stage, ProCar cannot afford a full-scale training program to fill all the competencies gaps of the SCM staff. Therefore the HR and the training departments of the company need to draw a compromise, and prioritise the filling of certain competency gaps, so as to obtain a “satisfying” result in terms of business performance, with the minimum effort, in terms of training. This process leads to the development of a competency plan for the revised business process, i.e. a competency development plan including the employees that have been selected for each job role, in order for the company to successfully implement the changes in the SCM business process. The competency plan consists of one or several {employee, as-assigned/target job role} pairs and calculates the competencies that definitely need to be acquired and/or upgraded per person. This means that, following the assignment to roles, the individual learning needs of the selected employees are calculated, based on their competency deficiency with respect to their business functions. Employees need to be trained only in the functionalities that are relevant to their role and in accordance to their individual level of proficiency. The level of existing/required skills for using the new system is expected to vary. Individual employees are only going to use specific features of the system, as required by their working role. Users with previous experience in the new system essentially only need to “update” their knowledge in the system. Others that are assigned to newly introduced roles (e.g. roles that resulted from the merging of previously separated functions) would lack other skills as well.

C. Designing the learning process

Based on the definition of the target competency gap to be filled by means of training, the Training Department of ProCar can now proceed in planning the required training program in more detail (learning planning). Based on the competency plan that was created to support the implementation of the revised SCM process, a catalogue of learning offerings is set up to cover the prioritised competency gaps, using the “match competency plan” function in the Competency Analyser (this involves searching for configured learning processes (stored in the repository of the Learning Process Configuration) to fill the competency gaps of the job candidates that are included in the competency plan).

This search is based on competencies: each of these learning processes carries its own competencies (competency profile) which are matched against the competency gaps included in the competency plan [20],[21]. There is a set of prerequisite competencies, for an employee to be able to follow the learning process, and a set of target competencies, which will be acquired by all that successfully complete a course. Based on this analysis the department can later determine whether the employee needs to be enrolled for example in a “beginner”, “intermediate” or “advanced” course, in order to acquire a specific skill.

The competency plan is later passed to the PROLIX Learning Process Execution Platform (LPEP) for the training to take place. However, in case no suitable

configured learning processes are available to cover all competency gaps in this competency plan (i.e. the search for learning resources for specific competencies in the Competency Analyser yields no results), this material needs to be created.

In this case, matching the competency plan reveals the existence of ready-to-use learning processes for the acquisition of most of the required skills (e.g. competency to choose the best supplier), except those related to the operation of the new "TotalOrder" system. For this reason the training department contracts an instructional designer, who uses the PROLIX Didactical Learning Modeller to create additional learning processes to cater for the training needs of each sub-group of "TotalOrder" users (employees responsible for checking/ordering components/raw material or for booking the received goods etc).

In order to create the required additional learning processes, the instructional designer looks for a suitable learning process template. As none is available, the instructional designer creates a template using the PROLIX Graphical Learning Modeller's (GLM), graphical editor and library of didactic models. The Training Department of ProCar has already conducted an analysis of the actual organisational context of learning in the company and the conditions that should be met to enable the successful implementation of process-oriented eLearning. This analysis has revealed that a "blended learning" solution (with classroom and online learning phases) is more in line with the company's culture and thus the most appropriate didactic model for the company's staff.

Following the creation of the learning design template, the instructional designer imports it in the Learning Process Configurator (LPC) to add learning content and configure a learning process that will fill a specific competency gap. The (configured) learning process description (IMS LD unit of learning) consists of the high level learning design (IMS LD) and learning content (embedded in the IMS LD). Learning content may include QTI tests to assess the learners' apprehension of the proposed concepts. To this end, suitable learning resources are integrated into the learning process description in the LPC. The instructional designer runs the IMS Learning Design (LD) editor specifies which LD template to use and searches the repository for suitable learning resources. Assigned learning resources are geared to close specific competency gaps. The resulting configured learning process is annotated with competencies, which are stored in the Competency Analyser. After that the instructional designer packages and publishes the learning design to the digital repository.

In the case of "TotalOrder"-specific competency improvement, no relevant material is available in the repository. For this reason, external experts need to be contracted by the Training Department, in order to author appropriate training material (learning resources).

D. Execution of learning process

Following the configuration of all the learning processes needed for this competency plan, the training department imports the competency plan to the PROLIX Learning Process Execution Platform, using the "Realise Learning program" function of the PROLIX portal. As part of this process, all configured learning process

included in the competency plan are imported in the LPEP from the LPC repository, in the form of an IMS-LD content package.

The training specialist can create course instances out of every imported course type (i.e. a configured learning process), which will be included in the course catalogue of the LPEP.

The department has opted for a "blended learning" strategy [22]. Consequently, for each learning process a complete eLearning course should be prepared, comprising a combination of web-based training modules (WBTs), classroom training (face-to-face seminars) and workshop sessions (hands-on practice). Web-based training will be performed in an asynchronous mode (at the learner's own pace). However, for each course a tutor will be appointed, to guide learners in their study. On the other hand, classroom training and workshop sessions require detailed planning, as rooms and equipment need to be reserved for specific dates and instructors need to be physically present on site on the given dates. Due to the large number of participants, this means that the course will be repeated several times. Running dates should be defined accordingly. Furthermore, in order to enhance its pedagogical effectiveness, the course will include communication means, such as chat or forums, and a document archive for the exchange of files, so as to promote collaborative learning and enhance the effectiveness of the learning process. An electronic library will be set up per course, to provide trainees with additional media such as images, WBTs, electronic reference books, etc.

Once the learning process is instantiated, the employees who need to attend a specific course should be located and the learning process should be adapted according to their individual learning needs within the LPEP (competencies blueprint personalisation). Moreover, since the old SCM-process will remain operational while employees are being trained for their new tasks, concrete courses should be planned (for the defined learning processes) and learners should be booked to them, also taking into consideration issues like the availability of employees etc.

The execution of the learning process involves the following steps from the side of the trainee. The learner should log into the PROLIX Learning Process Execution Platform, following the instructions given to him/her by the company's training department and view the courses for which he/she is booked displayed on his/her individual starting page, together with relevant instructions and other useful information. According to his/her individual training schedule (individual time plan), the trainee can open and work on courses, which have been booked for him/her, and follow the specified course steps. As the learner moves sequentially from one module to the next, self-assessment tests allow him/her to assess his/her learning progress. In addition, learners can make use of the available communication tools to get in contact with other learners and the tutor (to exchange views regarding course specific issues etc) or use the media library for additional self-directed study. For each course attended by an individual employee, the result of training needs to be assessed. To this end, a certification test aimed at assessing the knowledge obtained from attending this course is foreseen in each learning process in the PROLIX approach. The results obtained will be used to determine the post-training level of proficiency of the employees

with regards to the competencies associated with a specific learning process.

The competencies profile of the employees (kept in the PROLIX Competency Analyser) will be updated automatically according to the results of the training program, so as to reflect their new skills and abilities. When the employee uses the new competencies successfully within the work process, this can be recorded as additional evidence in the competency store.

E. Performance monitoring

Performance monitoring is critical for monitoring both learning and business performance (Learning Process Monitoring, Learning Outcome Monitoring, Competence Monitoring, Process Performance Monitoring and Business Performance Monitoring). The PROLIX Performance Monitor (PM) is used to collect data for the assessment from relevant sources such as ProCar's ERP-System, surveys etc. The controlling department of ProCar selects relevant Performance Metrics (Performance Indicators, PIs) and PI-influencing factors from available preconfigured sets or develops new ones when necessary [23]. PROLIX applies a holistic Performance Management approach, considering both business process-related and learning-related aspects. Thus PIs include Business Metrics (business process performance) and Edumetric (the learning processes and the impact of learning on the business process) [24],[25]. In both cases we distinguish between Qualitative and Quantitative metrics. Quantitative metrics constitute hard figures, while Qualitative metrics express opinions, feelings and attitudes usually collected via an empirical tool such as a survey. The Performance Indicators selected for assessing the post-training performance of ProCar's SCM process include:

- Quantitative Business Metrics: total supply chain management cost (% of revenue), on time delivery to request (%) etc
- Quantitative Edumetrics: number of courses attended, training budget
- Qualitative Edumetrics: Transferability of knowledge, Learner's overall satisfaction

By processing this data, a visual performance report is generated in the form of a Scorecard [26],[27]. Scorecards are collections of Performance Indicators that are set up to monitor the performance of an organisation, organisational unit or an individual. They can set targets to allow for strategic and operational goal setting and management.

F. Business value analysis

The controlling department is called in to judge together with training department and strategic planning department whether the trainings undertaken had the desired impact on the performance of ProCar's SCM processes. This way, strengths and weaknesses of ProCar's training management can be identified and decision support with respect to further actions for improving performance of SCM is provided.

The analysis of the data collected shows that, by tailoring the training program that supports the introduction of the new integrated SCM system according to the actual needs of the business process, ProCar has achieved a smooth transition to the new SCM process,

with an adequate output in terms of performance. ProCar management now has the opportunity to further improve the business process. Based on the conclusions from performance monitoring, the cycle can restart, either with business process re-design or with a new competency analysis. The business process analyst may return to the PROLIX Business process Cockpit to investigate potential improvements in the business process (continuous improvement). The revision of the SCM process may invoke additional changes in the involved functions and steps, the role definitions etc. Additionally, a new competency analysis may further improve the assignment of people to roles and reveal gaps that require contracting additional staff or the training of existing staff etc.

V. LEARNING PERFORMANCE AS FUTURE DIRECTION

Corporate learning is an effective way of increasing an organisation's overall performance. Business process oriented learning entails the combination of business process intelligence tools with knowledge management and learning applications. As the ProCar example demonstrates, this approach can allow an organisation in turn, to document and study its business needs as they stand after a significant business change, to identify and prioritise the competency gaps of the affected personnel, to design suitable learning processes, to train the personnel accordingly, to measure the performance improvements achieved and to analyse the results to identify actions for achieving further operational improvements. By coordinating business process management and learning management activities, organisations can achieve a smooth transition to the new business process and reduce the time needed for the revised business process to become operational. At the same time, employees can assimilate new knowledge, improve their competencies and adapt to their new duties more easily.

This holistic approach is currently being investigated by the European Integrated PROLIX project. In order to demonstrate the concept of business process oriented learning. To this end the project is developing a prototype combining existing commercial software systems and developing additional modules that are not presently available. PROLIX is specifying, designing, implementing and starting to demonstrate its tools and services in mature eLearning-aware and, therefore, lower risk environments and more pioneering settings. PROLIX approach will be evaluated in five test beds in different fields of application: "Social care", "Telecom", "Educational Publishing", "Banking" and "Public Administration", starting in June 2007. The conclusions drawn during the trials, combined with new insights from the ongoing requirements analysis work will serve as input for the refinement, enhancement and overall improvement of both the concept and the system during two subsequent iteration phases, providing advanced versions of the PROLIX system in June 2008 and June 2009.

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