Implementation of a Prototype of ERP–RFID Interface for the Swiss Luxury Manufacture

Matteo Lanini, Luca Canetta, Martino Casanova, Eric Müller and Pierre-Yves Voirol

Company Profile

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Founded in 1987 under the name of ProConcept SA by three passionate visionaries completely oriented toward the best of new technologies, the company established itself over the years and through its growth as a robust and reputable company. The company independently designs, develops and distributes its business management integrated software, ProConcept ERP. In the course of 20 years it has built a strong position on the ERP market in Switzerland with over 1,000 sites implemented. In 2009 the company unveils its ambition of becoming a leader in providing management solutions to Swiss SME’s. In order to support this new objective, the company becomes SolvAxis SA and expands its product portfolio by offering other ERP solutions. SolvAxis SA sees to the implementation of its applications, training, and follow-up and maintenance for these activities through its team of professional consultants. These consultants are respected for their expertise in business management, as well as for their experience in this field; they are the ones who take on the total management of projects, while benefiting from business and management advice as the applications are deployed Figs. 1–23.

SolvAxis SA is present throughout the Swiss market, and accompanies its customers wherever they might be in the world (China, Japan, United States, The European Union, etc.).

**Reasons for Adopting DiFac Solutions**

**Problem Assessment**

In this case study we present the implementation of a prototype of ERP–RFID interface for a Swiss Jewel company (afterwards called Jewel Company) focused on high-end luxury market. The prototype has two objectives: the first is to acquire RFID knowhow through a pilot project and the second concerns field test of the ProConcept data interface.

The Jewel Company has already been using an RFID-enabled system for the optimization of point of sales (POS) operations, in particular for inventory and selling operations on finished goods such as watches and jewels. The added value of an RFID infrastructure consists in preventing losses of highly valuable goods.

The RFID system was composed by the ERP (Proconcept), a third party application, to locally manage the RFID transactions, and some RFID hardware including readers, antennas and tags. After a pilot period, it was planned to extend the RFID solution to all of their boutiques and other enterprise sectors, but, although the solution was developed correctly under the technical aspect, the roll-out was temporarily suspended. In fact, one of the most limiting aspects has been recognized in the scarce adoption of the new procedures by the employees, mainly for the following reasons:

- Despite the actual gain of time for the inventory, other operations have been perceived as being more complex and there was not apparently any added value;
• The manipulation of the goods, as originally planned, did not guarantee the permanent association of the RFID tag to the tagged object because the label was removed when a customer was wearing it;
• The users did not interact directly with the ERP but with an intermediate application.

Other known systems issues were:
• The inefficient synchronization of goods data along the system (ERP only gather data from third party application which had his own local database);
• The RFID infrastructure was not extended to all the enterprise’s units.

Before undertaking any further expansion to the remaining units, required improvements and reflections were mandatory.

The mentioned scenario is an ideal substrate for the development of our prototype and to verify the advantages of the proposed solution.

Objectives and Strategy of the Prototype

The objectives of the project are hereby summarized:
• Create specific RFID know how for Solvaxis-Proconcept through the implementation of a prototype;
• Test the developed ERP–RFID interface in a real case (as generic, flexible and human oriented as possible);
• Implement a prototype and analyze the key factors for the identification and the implementation of an RFID system minimizing risks and threats.

Moreover, the prototype must fulfill the following end-user requirements:
• Define optimal procedures to introduce RFID technologies in the high-end luxury market (borrowing and presentation to customer);
• Improve the employees acceptance of the particular tagged items handling procedures;
• Improve traceability of the goods;
• Minimize costs and counting errors by improving the inventory time (similar products might have very different value);
• Improve the efficiency and the quality of the service.

The strategy adopted for the achievement of the mentioned goals has been the identification and development of a prototype for just one application where most of the typical operations are present, thus minimizing the risk on the normal operation and facilitating the adoption of the RFID technology.

DiFac Solution

The DiFac solution will be the implementation of an ERP-RFID interface as generic, flexible and human oriented as possible and its test in a real case.
Case Assessment

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<th>Strengths</th>
<th>Weaknesses</th>
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<td>Proven interesting and “profitable” item-level RFID application in jewellery</td>
<td>Performance of the previous RFID applications leads to employees skepticism.</td>
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<td>Availability of RFID infrastructure</td>
<td>Current system implementation do not simplify inventory management.</td>
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<td>(currently not exploited)</td>
<td></td>
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<td><strong>Opportunities</strong></td>
<td><strong>Threats</strong></td>
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<tr>
<td>Possibility to leverage previous investments in RFID infrastructure</td>
<td>Wide field of application, necessity to focus on a meaningful application to successfully roll-out the project.</td>
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<tr>
<td>Inventory process analysis and redesign</td>
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Process Analysis

The existing processes of the Jewel Company have been analyzed and the material flow has been mapped (single parts, semi finished or finished goods). The following chart summarizes the ERP domain limits and the manufacturer’s units that could benefit from the ERP’s introduction. The arrows represent the material flow and the line thickness indicates the critical paths in terms of parts volume transferred per time.

There are two external elements of the system: customers and suppliers. The suppliers are temporarily excluded from the ERP system because of their small size and large quantity: they are in fact numerous, more than 300–most of them are specialized artisans. It will therefore be difficult to introduce them to the RFID technology in order to get control on their internal activities. The artisan’s parts are warehoused differencing them in three stocks: watches parts, semi-finished parts and finished goods stock.

The final assembly process usually concerns the watches, which are differentiable by materials, body, internal movement and wrist. These parts are picked up from the row parts in the warehouse. The finished parts may be idle stocked in the warehouse or directly sent to the stock sale’s points (POS). The sales and the after sales process take place in the boutique. There, the customer has the possibility to buy jewels and in particular cases also to borrow it for special events like galas and fashion shows. A client might also request a customization, therefore the product returns to the production site and, when the jewel is adapted, it is sent back to the POS ready for the delivery.

Apart the normal operations, a very important activity along the year are exhibitions. Most of the company’s energy is conveyed in organizing and participating in these events. During those occasions, most of the jewels distributed worldwide are exposed all together. This process is hereby described.

The various worldwide distributed POS do a local inventory, check and send the products to the main POS where an entrance inventory is performed. Then the items are collected and sent to the exhibition’s place where another inventory is necessary.

During the exhibitions the products, that exceed the number of thousands, is exposed on trays over three stands. Every evening a detailed inventory is
requested. Therefore, an RIFD system would be helpful to permanently track the items and to:

- Know in which stand a specific item is exposed (might vary) in order to improve efficiency and quality of service;
- Improve visibility and reduce risk of losses;
- Avoid theft;

At the end of the exhibition an exit inventory is performed. The products return to the headquarter where the items are inventoried and eventually they are redistributed to the boutiques.
Fig. 3  Project proposal

Fig. 4  GUI starting print screen
Currently, the exhibition preparation is very time consuming because many inventory have to be carried out by hand, counting and identifying one product after the other.

**Project Proposal and Development of the Details with the Client**

The best application for the prototype highlighted by the process analysis has been the exhibition because it represents a company microcosm. In fact, the RFID technology could be very useful in shorting the inventories time and allowing the products tracking. In this way the employees might understand the benefits of this technology and afterwards it will be easier to extend the infrastructure to the various boutiques.

To reach an appreciable result compared with the actual situation it is expected that the scanning procedure currently in use should be modified, increasing the reading capability of the tags and making the interaction between the user and the system easier (human oriented). The suggested solution foresees the continuous monitoring of the items that could be realized in the future by means of intelligent trays identified by means of an active RFID tag and with an on board passive tags reader. As it has been observed that during the fair period there is a difficulty in following the trays that are frequently manipulated and moved along the stand, the priority will be given to the real time location (RTL) of the trays and then to the identification of the items on them. The proposed solution is presented in the next figure.

From the security’s point of view it is assumed that a tag might not be recognized at the stand’s exit, therefore it is planned to implement an alarm system like the Electronic Article Surveillance (EAS) which is able to alert when a jewel is removed from a pre-assigned position without authorization.

**Choice of the Components**

Nowadays the RFID technologies used for jewellery applications are LF (125 and 135 kHz), HF (13.56 MHz) and sometimes UHF (860–960 MHz).

To develop the prototype no purchase of component has been necessary because both the RFID infrastructure and ERP were available at the jewel’s manufacturer and the middleware has a free licence when not used commercially.

The decision has been to use the pre-existent HF RFID infrastructure, to tag all the jewels and to develop a user friendly RFID/ERP interface able to automatically share and filter the data collected from the RFID tags with the ERP system. One method to obtain this result is to use a middleware, a software layer that sits between the RFID readers and the ERP readers.
Personalization of the Critical Parts

In a project, mainly when the components are given, a personalization of crucial parts must be performed. The encountered problems and their implemented solutions are hereby described.

- **Trays optimization and tags positioning**: The trays, which holds up to some dozens of items, are made of plastic covered with velvet. It has been verified that the tags reading is problematic because they are not always identifiable. In particular a random placement of the tags did not guarantee them to be always readable. Therefore, the tags positioning must be done carefully for example using dedicated slots in the trays in order to space metallic objects.

- **Tag optimization**: Until now, the tag was placed inside a cardboard and attached to the item through a wire. It can therefore happen that the tag is hidden by the jewels.

  In fact, due to its physical characteristics, metals are the first tags enemy, as they could make it unidentifiable causing detuning–reducing its performance (e.g. reading range)–and shielding it. To avoid this problem other solutions like the use of dielectric spacer between the metal and the tag or the use of a tag less sensible to metal could be taken into account.

- **Graphical user interface (GUI)**: Employees at the POS should be motivated in the use of a innovative technologies like RFID facing them with an easier and intuitive system. This is the reason why the new GUI must be kept as simple as possible and should include the following features:
– Permits the employees to perform their work faster and in the easiest way,
– Introduces the least possible number of operations that the employee are not
used to make,
– Will not include unnecessary data like the unique identification code (UID) of
the tags or other data available through the RFID system.

The solution is a GUI with drag and drop options that present only the selling
and tracking information. A first prototype without the selling information is
hereby presented:

**Obtained Results**

This solution, compared with the previous system, allows a more efficient
management in terms of ease of usability of the system (human interface) and of
identification and localization of the products.
SmartBrick: Intelligent Web Platform for Multination Industrial Use

Claudia Redaelli, Myrna Flores and Lorenzo Sommaruga

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Reasons for Adopting DiFac Solutions

CEMEX is a global building materials company, the world’s largest building materials supplier and third largest cement producer, providing both products and services to customers and communities in more than 50 countries throughout the world. Initially when CEMEX began acquiring organizations around the world during 1990s, organizational leaders realized that organizations best practices were not frequently shared. Best practices usually refer to proven techniques or methods that have provided efficient and measurable economic returns. Some identified reasons against implementing best practices from one CEMEX location to another which were the differences in culture, processes and the lack of a friendly user tool that can enable employees to share their knowledge. Thus, CEMEX faced that challenge, the need to deploy a new tool to enable employees to share best practices in a simple way to optimize its operations at a global level.

Problem Assessment

Competitive companies need to evolve into knowledge-based organizations by motivating and rewarding specialists and creating a vision that can unify an organization of specialists. In such context, SmartBricks, the web 2.0 prototype developed in SUPSI and tested in CEMEX, focused on enabling CEMEX business process management (BPM) specialists to share information and knowledge by exploiting web 2.0 and semantic web technologies. The main objective, as shown in Fig. 1, is to catalyze the development of skills to be deployed in new process
improvement projects by allowing the following key functionalities: search, obtain, use, improve and share new knowledge globally in an open collaborative space that provided web 2.0 functionalities. Relevant contents will be easily found by the use of tags and specialists co-authoring contents.

**Objectives**

It was identified that a new tool was required to embrace the different layers in which different stakeholder’s interests, needs and knowledge are reflected for the same and different process. In the current scenario, BPM specialists could be considered as “passive consumers” of business process contents, who can evolve to be “active contents as developers” using web 2.0 technologies. These contents can be generated following the open source philosophy in an open way through new forms of interaction producing the emergence of collective intelligence that could provide multiplying effects. Open is twofold: on one hand it refers to the way of content generation by users, and on the other hand it refers to the possibility of enabling distributed knowledge for to workers to interoperate. Web 2.0 refers to an improved form of the traditional world wide web where communication tools and social networking, stimulates and optimizes online collaboration and sharing among users.

**DiFac Solution**

The main selected elements during the requirements phase for the BPM SmartBricks prototype are: BPM Wiki, Training, Methodologies, Best practices, Business process architecture (BPA), Process change management (PCM) and BPM research projects. Each of these elements is considered a “Brick”. Each BPM knowledge worker who will have access to this tool is considered a “Bricker”. Each Brick has web 2.0 and web 3.0 functionalities such as blogging and tagging. Every Bricker will have their own space known as “My Brick”. Figure 2 presents the main interface of the tool presenting all the available BRICKS that are contained in the different web 2.0 functionalities.

This research also included the development of a knowledge management framework to improve collaboration at internal practices in parallel to the SmartBricks development at a testing. An e-survey has been designed and analyzed where a sample of 25 persons from processes and IT in CEMEX have provided inputs that show that besides the SmartBricks tool, incentives, training and a common strategy are also needed before the implementation of such novel tool.

The SmartBricks developed by SUPSI on the basis of the first primitive AWI (application web intelligent—intelligent web application) prototype is a web based architecture organised in three layers: data, logic and presentation. Figure 2
presents the architectural and implementation choices made for the software development: mySQL database has been chosen for storing all the data, both the semantic and the AWI ones; the Java programming language and Java persistence layer has been used for the business logic of the application and the JDBC driver for connecting to the database; on the client side, for the presentation to the end user, i.e., the graphical user interface (GUI), the Adobe’s Flex technology based on action script has been adopted, providing support for web 2.0 style of interaction.

In particular, the logic layer is the back-end part of the application which manages Java objects within the Tomcat application server. Jena API are integrated as library within it in order to manage the semantic web implementation of data through RDF resources, the ontology editing, and inferences on the semantic world of resources. In the first AWI prototype, all these data are stored in the mySQL database (Jena DBs), providing data persistence, and managing all the domain specific resources about the business process management and its PPRH (process, product, resource and human) classes.
Role in DiFac Solution Development

CEMEX research group provided the requirements and specifications for the development of the tool to SUPSI. Once a first prototype was developed, it was then tested with different users from the process department.

Case Assessment

The SmartBricks Web 2.0 platform was tested with about 30 CEMEX employees both in Switzerland and Mexico. A questionnaire was designed integrating some questions from the ergonomics and flow for presence questionnaire (Chaps. 4 and 5). An interregional team composed at the human factors experts, CEMEX reference person and SUPSI developers composed an articulated questionnaire evaluating usability, ergonomics and Presence of the web-based platform.

Unfortunately the testers were ten men working in different positions and with different duty in the enterprise, the number is too low for a comprehensive data analysis, but the ten questionnaires gave us useful information about the actual state of the platform and further improvements.
The first section of questions gives general indication about the usage of the system. It results easy to be used not complex to such an extent that testers judge the SmartBrick immediately usable with no experts’ help.

Users are satisfied with the functionalities integration, even if some testers deplore some characteristics of the interface that make the navigation among different functionalities non-immediate. Main problem of this beta test version is the very low speed of the connection that blocked an immediate information exchange.

The SmartBrick is a useful “place” where the knowledge is stored and the wiki modality is a positive way for implementing it. The users (four of them) asked to give the possibility to upload information in different formats (i.e., real demo or videos), and not only using written text. The different pages appear too much full with text, even if the design of the different pages is good; the written parts have too much weight. The functionality appreciated is the quick possibility to consult some specific terms by tagging modality.

The third part of the evaluation questionnaire is comprised of a selection of questions by the flare for presence of questionnaire (for more details, please refer to Chap. 4 of this book). The users want to repeat the experience of the SmartBrick, it has been shown by the general index mean of 4.4. The flow, or the condition of optimal experience during the use of the different sections, has a rate on the border. Actually the skill and challenge balance brings the users’ to a state near to anxiety as the image here it showed below. This means that users’ skills were not balanced with the perceived challenges of the SmartBrick. The users need more time for training, and this first trial had a precise time schedule immediately followed by the questionnaire. As one of the interviewee wrote: “We need more time to review the tool over a longer period”, this will lower the anxiety, making skills higher and the users much more used to the system.

The sense of presence is quite low, but navigating in a web site is not really immersive. Even if the SmartBrick is a 2.0 web site and the users are the actors of the web, they can participate but the intelligent web does not represent the real life, it is a synthetic environment in which people interact via internet clearly.
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<td>One to one tool in usage, but knowledge sharing with others</td>
<td>Not sure that SmartBricks can be applied for all the levels and areas of the company. Obstacles can be culture and education of the employees. Uploading file not only under .doc format, but also movies or demos</td>
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<th>Opportunities</th>
<th>Threats</th>
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<td>Have a common idea about a term</td>
<td>Overlapping with other platforms already used in the enterprise with similar but partial functionalities</td>
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The validation, besides the scarce number of testers, shows the line to be followed for further implementation. First of all higher flexibility of format integration for uploading the files to be shared. The community repository ready to be used by everybody is an important tool for creating a common view and understanding of information. The possibility of easy and fast consultation is a positive point. The different tools in SmartBrick should be much more integrated in the platform.

**Obtained (Expected) Results**

Overall, the SmartBricks tool showed to different employees in CEMEX the different challenges and opportunities to share knowledge and collaborate within the company. Besides the technical aspect of the tool, it was also identified during the project the need to develop a framework for knowledge management (Fig. 7) that could enable top management to define a strategy and a vision with a clear process, governance and indicators that could facilitate the implementation and cultural change to profit novel digital tools such as SmartBricks. Additionally, an internal team in CEMEX documented an inventory of 70 best practices using a proposed taxonomy. Those practices were documented in CEMEX during the DiFac project and were uploaded to the prototype in order to have available contents for users to test the tool. The proposed taxonomy and the availability of those practices were considered a very useful deliverable within the company.

To conclude, CEMEX has always been a company that believes that Information Technologies are key enablers to gain operational efficiency. Thus, the company, by the time the Swiss DiFac was ending, decided to invest in the deployment of the Connections tool developed by IBM which offers all web 2.0 functionalities. This technology will be implemented world wide in all CEMEX locations and the scope is also to enable an increase in innovation, thanks to the knowledge sharing of employees when collaborating in multidisciplinary projects. The customized version of the tool will be known internally as SHIFT. In summary, the SmartBricks tool developed and tested during the DiFac project enabled the users to get to know and understand in the BPM contexts the web 2.0 functionalities and the different challenges a company needs to take into consideration to become a learning organization.
iPortal and Factory Hub

Ciprian Candea and Gabriela Candea

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Innovation, Quality and Delivery on Time is our objectives since 1994 when Ropardo S.R.L start as Technology Company based in Sibiu and Romania. Our expertise is in software development, implementation of complex software solutions and maintenance of software/IT systems for world wide customers.

We are specialized in custom software development for different branches/industries: tourism, automotive, logistic, industrial production (food, plastic), public body, real estate, building/construction and web hosting using different IT technologies.

We provide services in domains like: system and application development, business application, web and e-business/eCommerce, software re-engineering, software test, maintenance and support.

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Ropardo S.R.L provides its customers with a profitable software development source, fast time to market and low operating costs.

Well-defined processes and highly skilled and dedicated team allow us to work with customers from all over the world. Efficient, simple, adaptable and open, Ropardo S.R.L. meet demands and exceed the requirements, overcoming geographical and cultural differences.

Our objective is to provide optimized and innovative solutions, focused on customers’ needs. We accomplished this purpose taking into account the evolution of software technologies on the market.

Our company develops and provides software solutions and applications, keeping in mind the real necessities of a successful organization.

Our company, Ropardo S.R.L. works to solve the needs of small, medium and enterprised-sized businesses that work/use software in their activity.

**Reasons for Adopting DiFac Solutions**

**Problem Assessment**

Nowadays, business processes change rapidly, especially when a company is involved in making highly customized products or simultaneously running different projects.

This leads to changes in the manufacturing processes and hence to business process reengineering. For these changes to be done after customer requirements a permanent communication is required.

For an enterprise to be successful in such environments, it has to establish a corresponding culture for continuous improvements and be supported by IT responsive business processes.

Another aspect of contemporary manufacturing enterprises is the need for interdisciplinary teams to collaborate frequently with team members who are distributed in different locations i.e., plants, research departments or are external specialist; and because their activities need to be co-ordinated.

When a project team is located at more than one site, it is very difficult to synchronize their tasks and optimize the usage of these distributed resources. Therefore, it is essential that all participants contribute to the creation of the process models in the early stages of the project. In addition, such geographically dispersed teams need a suitable interactive environment to model business processes concurrently. The objective of such collaborative model development is to enable teams to improve their business processes and shorten product lead-times.

A digital factory depicts a hybrid persistent community where a rich virtualized environment, representing a variety of factory activities and processes, will facilitate the sharing of factory resources, manufacturing information and knowledge and help with the simulation of collaborative design, planning,
production and management among different participants and departments.

Based on these aspects we consider a factory hub with corresponding functionalities to support project oriented activities on digital factory. Because users are dispersed geographically we consider a web-based solution and taking into account that we like to support SME also we consider an open source solution as technology base.

**DiFac Solution**

The raised issue is that of process coordination in large distributed business environments. Our solution for this is based on a web software application that supports documents sharing, real-time communication solutions, decision-making processes and other collaborative practices.

Since the users are internal employees, external collaborators-customers and suppliers—a customizable, web-based portal with secure browser access was chosen.

A web-portal or commonly referred to as simply a portal is a web site or service that offers a broad array of resources and services, such as e-mail, forums, search engines and other on-line services. It provides a single point of entry, in the form of a web-based user interface, and is designed to aggregate information through application-specific portlets [Java Community—JSR168]. iPortal may have sophisticated personalization features to provide customized content to users.

Portlets are pluggable user interface components that are managed and displayed in a web portal. Portlets produce fragments of mark-up code that are aggregated into a portal page. Typically, following the desktop metaphor, a portal page is displayed as a collection of non-overlapping portlet windows, where each portlet window displays a portlet. Hence a portlet (or collection of portlets) resembles a web-based application that is hosted in a portal.

iPortal allows registered users to personalize their view of the website by turning on or off portions of the webpage, or by adding or deleting features.

At a closer look through portal features, such as:

- Aggregation of content,
- Customized views,
- Personalized content,
- Collaboration features,
- Web services access,

And so on, we also meet our solution requirements.

**i-Portal Technology**

To also support SME we choose as portal an open source implementation: Liferay Enterprise Portal (www.liferay.com) which provides a tremendous amount of
Fig. 10  Schema of the interactions within a portlet container and interaction with the user

Fig. 11  Homepage for iPortal
value for very little hassle. It supports a wide variety of J2EE application servers and databases.

iPortal is based as technology on Liferay but it comes with other specific flows that needs to be addressed for Manufacturing environment.

Essentially, to quickly download, set an environment variable, run a shell script, and you have an enterprise portal. It is setup to quickly provide an easily configurable corporate portal, with such nice features as a Mapquest lookup of your company’s address, showing an overview map.

Extensive portlets come with it, including search, message board, Wiki, journal, news feeds, weather, calendar, stocks, general RSS, instant messaging, SMS messaging, unit conversion, translator, dictionary and user directory.

The whole framework is built upon Spring, which provides a high likelihood that it would be easy to extend. Being built after the JSR-168 specifications first and for the newest version after JSR-268 other portlets, java-based, are easy to develop and install—at just almost three “click’s away” (upload the portlet web application and press the install button and all is done, the portal deploys the application and automatically registers it within the specified category).

**iPortal: An Enterprise Collaborative Portal**

The architecture of the iPortal considers two issues:

- Allowing stakeholders to collaborate in the context of different activities (project-based tasks)
• Supporting different tools/applications that follow specific targets (VR, factory design, etc.)

In order to efficiently cooperate, stakeholders need a virtual space to access data and to transform it into information and knowledge. The proposed architecture allows integration of any kind of communication tools such as instant messenger, email, while providing a central location to store documents related to different projects.

To enhance specific tools usage for each activity, the proposed architecture aims at integrating different 3rd party solutions resulting in integrated data and processes. Each of these tools runs in its own environment (it is also possible for all the software tools to run in the same environment), while some of them need specific hardware. An extensive range of collaboration features specific for digital factory, including virtual reality, ad hoc tasks, discussion forums, live meetings and interactive polls enables group members to share information asynchronously or in real time. It is possible to integrate the corporate email that makes it easy to track all project related communication, even that taking place outside the collaborative environment.

iPortal presents specific functionalities for collaboration but also one important feature for any company—project-based activity.

The iPortal also features centrally managed, role-based security. Administrators control security for members of the enterprise and their group assignments. They can only configure roles and assign users to them, and will not be able to override security policy on an individual level.

iPortal can integrate applications like enterprise email server (i.e., Domino, Exchange) and successfully integrate emails, chat, calendar and tasks; it allows different components to send/verify data (agenda, emails) related to a specific user and project; the actions to be performed refer to assigning emails to a project, or saving chats into the projects section.

User and Role Management provides identity management, multi-layered and object security to ensure that only users authorized to access sensitive business information are provided access. Standard-based authentication with industry leading LDAP directory servers and single sign on (SSO) providers—this means user and group information is managed and maintained within the corporate security infrastructure. This feature is designed in a way to allow integration with other corporate solutions in case those are already implemented (i.e., Active directory, Open LDAP etc.). This component is designed to manage the roles of each user for each application—with this an integrated and centralized place to manage rights is being achieved.

Web Portal is a virtual location with a dashboard-like interface integrating all modules and therefore offering the user a central information point. From here the user can log-in and access information depending on his/her given access rights. iPortal database stores only filtered data from each integrated application. For example, in case of decisional support system, the user will see for each project: the data posted by team members for a specific thread (comments, new input);
deadlines and inputs required etc.; all this information belongs to the decisional support application, but through the portlets technology it can be accessed from iPortal dashboard. At the iPortal level project related actions are defined and managed via User and Role management component.

Third party applications will communicate with iPortal to fetch specific information relating to projects, while all complex behavior including specific GUI runs at application level (i.e., CAD solutions). Some information—job summary, to do actions, etc. are communicated to iPortal and pushed to the end user.

The concept of “project-based” activities is being introduced, focusing collaboration around projects. This enhances managing data and capturing knowledge on specific topics, and also determines a better organization of tasks and solutions. Project content stored in the repository can be easily referenced and accessed from the existing applications. There is no need to create duplicates of the documents or go through additional authentication procedures. Tasks in the iPortal environment can be part of defined enterprise workflows, where the workflow stops until the collaborative work inside the project is completed at a point which it automatically continues processing.

Each project is spread in iPortal in the sense that each project has its own wiki space, its own main folder in the document library and the information about each project is also propagated to each 3rd party tool (iDSS, prototype designer etc.). This way, project data can be easily grouped and structured.

Projects are created based upon templates which can also be managed in iPortal by the users. There are by default a set of templates for each implementation/customer (i.e., Factory Constructor, Prototype Designer and Training Simulator) and, besides these, custom templates can be created based upon certain needs.

The Project wiki space is generated upon the project template and it contains all the initial information about the project (workflows, tool links, general information etc.). From this wiki space, the document library folder can be opened to manage the project related files.

**iPortal: Services**

**Agenda Planning**

In any form of collaborative work, agenda planning is a key feature. iPortal provides an inner calendar for planning different events (meetings, reminders, appointments, etc.) which is accessible through the Calendar portlet. This portlet displays a summary of events that take place in the current day and also can display a detailed list of events for the current day, (for two days, five days etc.).
Decision Support

In order for the iPortal to support decision support functionalities, it is used an existing Ropardo, called *iDecisionSupport System* (iDSS). This is designed to be a collaborative decision-making support system with safety, utility, efficiency, effectiveness and usability. The development of iDecisionSupport is based on the principles of DSS (Decision Support Systems), interactive software and related development techniques. By taking advantage of abundant information on the Internet, networking and database technologies, iDSS provides decision-makers: comprehensive information access to internal and external data, communication facility and friendly interface with multiple-user access.

The iDSS component provides intelligent workflow and decisional support customized for specific DiFac needs, enhancing organizational memory; decision-making tools (brainstorming, voting, categorize etc.) integrated within iPortal and customized for Manufacturing flows. Advantage of using integrated decisional support tools in iPortal consists of better quality group decision for their tactical and operational activity. Also, iDSS is developed as a conceptual tool where any third party can contribute with creative ideas for modeling the decision-making processes—“third party” tools.
iDecisionSupport is made up of few initial tools aiming to assist the user in the decision-making process:

- Electronic brainstorming is an idea–generating tool that allows participants to share ideas simultaneously and/or anonymously on a specific question(s) posed to the group.
- Categorizer assists groups in three common group activities: generating lists of ideas, brainstorming comments that elaborate on or support the ideas, and creating categories for the ideas.
- Topic commenter (discussion list) helps groups comment on a list of topics. Participants can also be given the ability to add topics.
- Vote is an evaluation tool capable of providing the basis for a group decision. This tool is also commonly used to determine the degree of group consensus.
- MindMap tool—used for action plans and brainstorming.

Collaboration Work (e-mail, Message-Board, Skype)

iPortal contains a suite of collaboration support tools in the form of portlets. Among these the most important are Mail, Calendar and Skype.

**Mail** is a small portlet that displays a short preview of your e-mail inbox. The user can open his/her mailbox from this portlet and also start composing a new mail.

**Calendar** displays a summary of the events in the form of user’s personal calendar.

**Skype** is a web-based Skype “clone” which provides features such as: skype-to-skype calls, conferences, user profile or user status. (The user status can be seen only if the user allows this by checking the *Allow my online status to be shown on the web* option in the Privacy Settings of Skype).

**Document Explorer**

This component is a document library that provides users with centralized file storage and retrieval access with check-in/check-out functions as well as...
possibility to add Meta information tags. With this users can work on same versions of files improving cooperation and quality info into projects. Knowledge database creates organization memory that can be accessed/reused for new projects/decisions as experiences. This document library can be accessed using the document explorer application and through the Web DAV internet protocol.

The procedure of editing a file can be done in two ways that have a common starting step. First of all a file must be locked for edit by clicking on the Edit button in the menu. Then, the file can be downloaded, edited locally and then published, this way generating the new version. The second way is to leave the file in the server (lock it but do not download it) and use the WebDAV mapping URL to edit and save it directly in the document repository with the specific editor. Of course in this case, the editor must support these WebDAV operations and there is also a library for implementing them if desired.

Identity Management

The iSecurity (solution for Identity Management) is focussing in delivering a central platform and security services to managed applications. It can be seen as a buffer between the client applications and their specific backend data-store. The system is not only supposed to integrate applications which already have such a backend data-store available, but also new applications seeking to integrate security features in their implementation. Exposed and supported operations are described as follow:
• **Application provisioning** capable of interacting with the customer’s applications providing a single common communication interface, while in the backend will be able to integrate different directories like LDAP, relational databases, etc. (here “directory” represents a generic term describing different types of data storage solutions).

• **Identity management** that provides a centralized identity management module allowing the administrators to take users from different directories and manage them in one place. Multiple user directories can be plugged transparently under the same umbrella and conveniently managed via a unique management console.

• **Single Sign-on** with the ability of querying different directories (with different physical implementations—e.g. LDAP or database oriented, etc.), the system will be able to consolidate the user authentication through all provisioned applications and use a single, common security interface for it.

Through web-services all the provided services are made available, so that it allows different client implementations to be accepted. So the iSecurity server can very well communicate with a.Net, PHP or Java clients—feature that gives great development flexibility.

Having the iSecurity framework developed the iPortal and additional by developed portlets/applications are fully integrated with it creating a mature and enterprise collaborative solution for customers, suppliers and employees.

### Knowledge Management

Knowledge management is a pure and abstract utilization of information with a touch of wisdom in a collaborative space. Knowledge is the object that can be manipulated, identified, associated and handled in information systems. Knowledge is not information, the latter is a single part of knowledge, focused on describing, defining an entity.

The management perspective is the practical view of an organized collection of knowledge. A statement of business has its own definition by using knowledge management. Dismissing what is redundant and overcrowded in terms of management process from a business, creates an effective motor that charges from its own mechanism. In a knowledge management, information is the key, and knowledge is the tool with which we create strategies, methods of usage for existing data and approaches to current issues.

Into iPortal we introduce wiki techniques to address knowledge aspects. Using wiki users are collaborating and transferring knowledge and they have access to all the information that is available with the relationships between them.

A defining characteristic of wiki technology is the ease with which pages can be created and updated. Generally, there is no review before modifications are accepted. The *wiki* of iPortal is a component that supports project content generation and project templates generation. Using this component any user can
create documents where he can share his experience and expertise with the new members of the community or just exchange ideas with professionals who are part of the entire virtual environment.

The wiki includes a number of professional features:

- User rights management (by wiki/space/page, using groups, etc.)
- PDF export
- Full-text search
- Version control
- Content and site design export and import
- Plugins, API, programming...

**Future Perspectives**

The iPortal concept and technology has reduced the time and expense of new product development as well as provided the ability to have 24×7 communications with customers on new product features and status. Being an enterprise solution and integrated with iSecurity the portal also provides highly secure environment so confidentiality and privacy can be maintained.

The goal for this project, therefore, was to find and deliver as much information as possible to those who needed to make the daily decisions that are part of running any business. Using wiki any user can create documents where that can share experience and expertise with the new members of the community or just exchange ideas with professionals who are part of the entire virtual environment. An entire businesses process can be included in wiki, the latter making the experience of designing, creating a product, brainstorming with your group or other group members, testing and learn into from professional experience.

iPortal had to provide the information in a collaborative environment that would provide real-time customer, supplier or employee metrics and other information to desk tops, laptops and PDA’s, so decisions could be made with the greatest amount of knowledge and wisdom.

Through iPortal both the manufacturer and their customers now have better visibility into what and how their businesses are doing.
Service and Remote Maintenance

Pietro Pittaro

Company Profile

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<tr>
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<tr>
<td>Via Antonelli 32 10097 Collegno (TO) ITALY</td>
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<td><strong>Products</strong></td>
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<td>Laser cutting robot and machinery for metal sheet working.</td>
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<tr>
<td><strong>Markets</strong></td>
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<tr>
<td>All over the world for Metal sheet processing, electronics, automotive, aerospace and energy and others</td>
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Prima Industrie S.p.A. is one of the worlds major companies currently operational in the development, manufacturing and marketing of robotic laser cutting equipment.

The Prima Industrie group has the headquarters in Collegno, near Turin with about 300 employers. It designs produces and sells worldwide laser cutting and welding robot for 2D or 3D applications.

Prima Electronic, located in Moncalieri and Barone Canavese, near Turin, is the company that designs and produces the electronic and software parts, CNC numerical control, motor servo-amplifier and laser control unit not only for the Prima group but also for the market.

Convergent laser located in United States of America produces the laser source for our systems.

P. Pittaro
R&D Department, Prima Industrie via Antonelli, 32, 10097 collego, Torino-Italy
e-mail: p.pittaro@primaindustrie.cm
Prima laserdyne produces specific laser system for drilling.
Some joint ventures in China produce laser system for domestic market.
Last year Prima Industrie bought FINN-POWER, a Finnish company worldwide leader in machinery for metal sheet working.
The Prima Industrie—Finn Power group have about 1,700 employers in 40 countries.

**Reasons for Adopting DiFac Solutions**

The DiFac innovative tool offers a complete and integrated solution for the SME machinery manufacturing Industries like Prima Industrie S.p.A.
Many components of the DiFac project can be useful for Prima Industrie S.p.A. starting from prototyping design, portal solution, virtual factory planning but we start focussing our effort on the training simulator and remote maintenance tool from Metaio Gmbh. The three DiFac pillars components: presence, collaboration and ergonomics are the new approach at the manufacturing process using digital tools.

**Problem Assessment**

Prima Industrie S.p.A. designs, manufactures and markets high technology systems with more research centers, factories and service offices in different countries. With more than 2,300 installed systems and a high rate of new products Prima Industrie S.p.A. also need new and innovative tools to manage the know-how and communication flow.

**Objectives**

Using the DiFac–Metaio Gmbh solution for service and remote maintenance, we offer our customers a quicker, cheaper and better answer for technical problems that are caused by our systems.

**DiFac Solution**

Metaio Gmbh tool-based on augmented reality technology is the easiest solution to create and use the procedures having all the advantages of the real world images superimposed with virtual information to guide effectively the technician on site.
Role in DiFac Solution Development

Prima Industrie S.p.A. is an end user in the DiFac project and in this rule shows the real information and steps sequence to create a service and maintenance procedure for industrial machinery systems. The customer service experience of our technicians allowed to define all the information the tool needed to guide the procedure execution and how to call easily a skilled remote technician to interact with voice and video on IP using integrated auxiliary tools. The skilled operator can also modify directly the procedure if necessary and download it immediately on the portal server.

Internal the Enterprise

The first augmented reality (AR) procedure was made with Metaio guide that explained to Prima Industrie technicians how to use the package. This first “Lens cleaning procedure for Platino system” started from the the standard “static” procedure we already have in our manual to translate into Metaio workflow using the authoring tool. Otherwise Metaio package was customized for Prima Industrie to show and work with all the maintenance information the worker on site need for this typical operation. After the first test-guide procedure our service technicians started to choose and create new maintenance procedures to use for our Platino laser cutting robot system. The new AR procedures created showed a better communication worker on site—skilled technician if some questions occur during the procedure. Watching the system and speaking directly during the procedure helps strongly our
skilled technician to understand better and immediately the problem on the machine site. Executing the new procedure we also verified some problems relating to the image tracking in workshop environment. Some limits are present with reference or small parts and not good lightness also related at not easy positioning of the camera on the machine system. Increasing our experience in the video camera use I think we can solve most of these problem related to the image acquisition.

**Externally on the Market**

Using the AR procedure for remote service and maintenance we verified the possibility to solve quickly the problems of the customer with great satisfaction. We also verified the costs reduction we can have directly related at the communication we execute now completely through IP other than the cost related at the time and travel than greater cost related to the web camera the cost we need for the AR procedure is small; less than 100 € for a good quality device. Consider that having a web camera on the system is in any case a good opportunity for a better and immediate communication between worker on site and skilled technician also out of the AR procedure.

**Obtained (Expected) Results**

The result obtained after starting to use the AR procedure for service and remote maintenance seems encouraging. By using the AR procedure for remote service and maintenance for the most common and critical procedure we think to reduce the machine stop time and overall cost. AR technology is a new methodology for our procedures but it is good to start using this approach as we think this will have more and more development in the future.
Company Profile

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MASA Group is a leading provider of advanced software solutions using Artificial Intelligence technologies for modeling and simulation. The group operates out of Paris (France), Norfolk (Virginia, USA) and Singapore. For more information, visit http://www.masagroup.net/.

Reasons for Adopting DiFac Solutions

Problem Assessment

Emergency training in factories is currently very rudimentary. In most cases, safety managers re-issue each year a disaster mitigation plan to comply with current
legislation. This plan contains a possible strategy that experts consider as the optimal solution to the problem. This assertion is often fragile: this was unfortunately demonstrated by many large-scale industrial disasters that occurred in the past twenty years. Real-life exercises are time and human resource consuming and they remain limited also for practical reasons. With this scenario training is more than ever necessary for safety managers practicing less and less real incidents due to the increasing quality of risk prevention. Procedures, techniques and situation assessment skills must be easily and repetitively tested without endangering trainees, and without the need for expensive real size training infrastructures.

Virtual reality simulations are now widely used for training in safety emergency applications. Some examples of possible emergency reaction training applications are: training airport crews in handling airline crashes (Weiss and Jessel 1996); training in first aid procedures (Kizakevich et al. 2006) and training of fire-fighters (Stone 2001) among others.

Behavior simulation study is particularly interesting for this sector. Actually, simulations are directly amenable to automation by using autonomous agents to populate training environments and increasing the realism. MASA developed its DirectIA decisional AI engine to create autonomous agents capable of adapting to situations that are not programmed or predicted. This characteristic is extremely important in many occasions: it permits to stimulate decision-makers in several situations as in military command posts, crisis response and incident management teams to train and prepare for unplanned situations. In fact, virtual environment enhanced with human behavior simulation offer an increase in training efficiency as this allows the incorporation of human factors, thus creating more complex training situations. Behavioral simulation also results in a reduction in training costs as it reduces the number of training personnel required for the exercise by taking in charge part of the burden of animating the simulation.

**Objectives**

Planning emergency situations and have correctly trained employees at dealing with them is a critical success factor in SMEs, which often have limited financial and human capabilities to recover from such events. Real training and emergency exercises are expensive in time and resources. The idea raised by the project is to provide tools to make emergency planning and exercising a day-to-day practice in European SMEs.

**DiFac Solution**

The functional architecture of the Factory Emergency Training Simulator distinguishes among several training types, depending on the kind of virtual environment used. In the military sector, training simulations are usually classified
in three levels: either live, virtual, or constructive. In each of these categories, the
degree of human participation in the simulation is variable, as is the degree of
equipment realism.

The Training Simulator provides four functional steps, which are:

1. Select the purpose of training: The domain expert chooses the topic of the
   training, either on their own, or together with the trainee. Several factors may
   have contributed to this, for example, training needs analysis, succession
   planning or company training initiatives.

2. Setup the procedure: The domain expert sets up the training (downloads
   relevant files, opens relevant software applications) before inviting the trainee
to join.

3. Execute training: The training can take several forms (for example virtual or
   constructive simulation as described above) although common to all of these is
   an exchange of information between the domain expert and the trainee. This
   could be done either directly, in a question and answer session, or indirectly,
   when the trainee issues orders which are implemented into the training
   simulation by the domain expert. Alternatively, in a self-train situation the
   domain expert’s knowledge is already captured in the training system, and
   the trainee can learn through experimentation and practice, asynchronously to
   the domain expert’s input.

4. Review and evaluation: The trainee should review their performance (possibly
   with the domain expert, or alone if self-training) to identify whether they have
   learnt satisfactorily the skills identified in Step 1. Automated performance
   indicators can support this review. Furthermore, the domain expert and/or the
   trainee can evaluate the training material, with a view of improving the
   efficiency and effectiveness of the training. The results of this would feed back
   into step 2.

Figure 18 shows the emergency training full component architecture. The
training system is typical client–server architecture, composed of two sides: on one
hand a simulation server, and on the other hand, two types of clients (for trainer
and trainee). They provide visualisation and general services for interacting with
the simulation. Several databases are read/written by both the server and its clients.

In Fig. 2 the hardware architecture shows the physical components required for
the training simulator, and the relationships among them.

---

1 Training simulations are usually classified in three categories: either live, virtual, or
constructive (US DoD, 1995). The commonly accepted definitions are:

- Live simulation: a simulation involving real people operating real systems.
- Virtual simulation: a simulation involving real people operating simulated systems. Virtual
  simulations inject human-in-the-loop in a central role by exercising motor control skills, decision
  skills, or communication skills.
- Constructive simulation: a simulation involving simulated people operating simulated systems.
  Real people stimulate (make inputs to) such simulations, and in turn are stimulated (receive
  outputs) by them, but are not directly involved in determining the outcomes.
In the self-training mode, students have the same view as in the trainee (see Fig. 4), but they can give themselves using the same interface as the instructor mode (see Fig. 3).

By opening the after-action review tool, one can choose which training session to replay among the list of available past training session records. Once a session has been chosen, a 3D window opens, similar to the instructor window, with a time slider which allows controlling the replay. This time slider allows the instructor to move the time forward and backward. The start exercise/pause exercise button allows the user to start/stop replaying the training record, from any moment in time.

**Role in DiFac Solution Development**

MASA Group, partner in DiFac, has entirely developed and tested the Factory Emergency Training Simulator, on behalf of the DiFac consortium.

**Case Assessment**

*General training market:* The training market in Europe has undergone recently important changes with the advent of e-learning, which has allowed software-
Factory emergency training architecture – HW component architecture

**Fig. 19** Emergency training hardware architecture

**Fig. 20** Instructor mode (bird’s view). The instructor mode has several parts: a menu, a tool bar, and a 3D view
based training to become nearly as important as the more traditional presential training (Price Waterhouse Coopers 2004). However, MASA simulation-based training, either virtual or constructive, could be considered in fact as in-between e-learning and traditional presential training.

MASA develops simulation-based training solutions allowing those who make decisions in a crisis or operation to see the potential effects of those decisions in exercises. These tools allow experimenting with new concepts, courses of actions, or systems to help commanders or managers in the field. The success of these training simulations comes from the fact that they require less human or material resources than traditional training.

More precisely, all MASA technological modules can be either (i) embedded as components to enhance existing simulations or (ii) interconnected with a geographical information system (GIS) to populate a synthetic terrain. Three kinds of application areas can be targeted:

- **Preparedness**: to immerse groups or individuals in realistic situations in order to improve their skills and experience.
- **Serious gaming**: to study and improve operations concepts, courses of actions, techniques and procedures.
- **Technical lab**: to stimulate operational systems in order to simulate environment and effects for system development and future decision support.

![Fig. 21 Trainee mode (immersive view). The student is immersed in the 3D scene through the subjective view of the trained worker](image-url)
Factory emergency training with virtual simulations: These virtual simulations are aimed at primary intervention teams. They are immersive, game-like application for factory safety training and decision support. They immerse the primary intervention team group leader in a simulated environment to test its decisional skills, and rehearse intervention procedures.

Since most emergency teams in factories are firemen, a specific tool for training firemen group leader could be of particular interest within DiFac, by allowing the conception, test and optimization of emergency plans and procedures, with respect to the specifics of each site.

Factory emergency training with constructive simulations: These constructive simulations are aimed at civil security command posts and incident management teams who want to train and experiment. Beyond providing training capabilities, the system could be used to validate interagency emergency and crisis management plans, and/or drill a specific structure (fire rescue services, energy providers, water distribution and health services) while simulating the others.

While more and more crisis management structures become equipped with digitized information management systems, these constructive simulations provide for them a way to train, rehearse on experiment on the real terrain of operations.

Future Perspectives (Future Applications of the Tool, Future Development)

Innovation can be found in MASA behavior model technology used for complex behavior modeling within the training simulator. Behavior models allow embedding autonomous entities displaying complex behaviors into any kind of computer simulation or serious game. Their main benefits are:

- Providing simulated entities with more realistic behaviors (i.e., displaying autonomous behaviors and/or following given operational doctrine).
- Decreasing cost and improving performance of existing systems (entities do not need to be fully supervised by a human operator).
- Allowing users to be closer to their operational work (i.e., entities understand operational level orders, rather than raw simulation ones).
- Allowing simulation providers and end-users to create any kind of entities based on provided behaviors, easily modified to exactly fit their use.
- Behavior Models provide data and tools gathered into Behavior Libraries, together with tools and interfaces to easily integrate behaviors into any kind of application.

Finally, innovation is provided through the use of autonomous agents displaying realistic behavior in virtual environments for improving presence. Currently, virtual environments contain only human players (such as in Second Life™) or are populated with autonomous agents displaying unrealistic behaviors.
(such as in World of Warcraft™). Thanks to situated AI technology, it is now possible to add to virtual environments a new type of agents that are both robust and exhibit a rich set of behavioural patterns, including typical human mechanisms, such as compromise.
Integrated Scenario

Claudia Redaelli

Company Profile

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<td>Markets</td>
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Seconda is not a real company. The Integrated scenario presented here is a hypothetical but real-possible industrial case in which all results from European DiFac project are applied in a unique company making passing from a digital to a virtual factory. Seconda Laser Machine Company builds laser machines on demand. They can provide 2D and 3D laser machines following requirements from clients.

Reasons for Adopting DiFac Solutions

Problem Assessment

Seconda Company has different departments delocalized in different places in Europe. The General manager, the different engineers and designers work in

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e-mail: Claudia.redaelli@itia.cnr.it
different places but they have to meet together for taking decisions. For saving time and money they want a virtual, collaborative tool to work together remaining in their respective offices. The problem is not only to have a meeting, which is already solved by video calls, but also to work in real time staying in different places. So the engineers can collaborate with designers for designing new products, the general manager can use a decision-making instrument with all her collaborators to reach the better decision, finally engineers can collaborate together with ergonomics experts and training people for having an effective and safe environment to produce a new product.

Seconda’s general manager decides to go to her office today. Usually she can carry out much of her work from home, which means that she is able to live where she has always wanted and not have to deal with traveling everyday on congested roads. But her office is equipped with the latest projection technologies and various virtual reality and augmented reality devices and she needs new technologies today.

**DiFac Solution**

Seconda’s general manager has to organize with her colleagues the design and production of new customized Platino laser cutting machine for one of their client: PACOM.

The realization of this product implies some phases done in a collaborative way among people physically located in different places in Europe. Using DiFac iPortal (already presented in a previous case study) for designing the machine components, evaluating them and presenting the cell to the PACOM customer, the entire process results easier and faster. The new project generates consequent changes at the shop floor, through the iPortal the factory planner and the general manager can re-plan the production line and evaluate it on ergonomics and emergency level.

Finally the augmented reality technology allowed the customer to have a remote maintenance service through the DiFac iPortal.

The general manager uses the DiFac solution to launch the new project.

First she logs-on to the iPortal to review her dash board. She needs to schedule a meeting with the designer, assembly engineer, maintenance engineer, factory manager and safety manager.

By using the on-line calendar, the general manager chooses an appropriate date for the meeting. She invites the designer, assembly engineer, maintenance engineer, factory manager and safety manager to participate.

At eleven o’clock, she hears virtual knocks signal that other members of the development team are arriving for the meeting in a shared collaborative virtual space. The GM explains the project and asks the team to use the DiFac solution to:

Design a customized Platino cutting laser machine
Design the laser cutting cell
Re-plan some parts of the actual shop floor
Organizing the meeting in a virtual space enables the use of many sources of information to support it, for example documents, videos, the internet and 3D models.

The designer and the factory planner are working on the same project. After authenticating in the iPortal they create a new design project through the prototype designer’s link.

Both designers can see each other’s modifications.

After the session with the designer the factory planner understands that they need a new shop floor layout. The factory manager accesses the iPortal and downloads the layout of the present shop floor. He starts the GIOVE Virtual Factory and he imports the downloaded layout. After a sequence of operations that makes the environment exactly as he wants like as move/rotate, duplicate machines, add trolleys and workers include some machines and workers into the process and link them together, he saves the layout into a new project and uploads the new layout using the iPortal.

The new factory layout is going to be reviewed by the factory manager and a blue collar worker in a collaborative way. The blue collar checks the ergonomics aspect of the workstations and he optimizes them. The new layout is now ready to be simulated with a web-based user interface.

The simulation expert, in a collaborative session with the factory manager, adjusts the parameters of the resources. The simulation run returns with the aggregated statistical results evaluated.

At the end of this session the factory manager contacts the security manager for preparing a training session checking the emergency constrains of new organization.

In the meantime the project of the new Platino manichine is completed and the general manager reviews it evaluating the final design and assembly options.

She calls the designer; both access the prototype designer and share the same file. The designer explains that there are two different options for the design of a specific part. She can see any changes he makes and she also can make changes too. The general manager cannot decide between the two options as they both have advantages and disadvantages.

She asks the designer to set up a voting session. Different subjects like the factory manager, the assembly engineer, the designers and the general manager are called to evaluate the importance of some instructions.

SECONDA’s assembly engineer shows to the PACOM’s representative the new laser machine. During the session, the assembly engineer demonstrates to the customer the different options, the physical constraints and the set safety rules.

The customer is now joining the collaborative session with the assembly engineer, who shows customized Platino laser cell configuration and to the lens box. The customer asks for some modifications in the head.

After the customer is satisfied, the production of the new machine is started with the new designed production layout. Now the security manager needs to organize a training session for checking the safety procedures with the proposed layout. This appears as more realistic training experience with no physical danger, or costly interruptions in the production line.
The Platino machine has been sold and during the last 3 months it worked at PACOM site. But one day it stopped due to unknown reasons.

The worker on site needs to perform a maintenance task at a Platino laser machine of SeConda Company. He can perform the maintenance task by himself supported by Augmented Reality technology. He starts the SeConda remote maintenance application, points the camera at the Platino machine and loads the maintenance procedure workflow. The augmented reality view of the application shows him the necessary tasks in an intuitive 3D way accompanied by textual information. During execution the worker encounters a problem and needs to ask for an expert’s help. That way she can quickly understand the problem.

The maintenance manager then decides to update the procedure to avoid such a problem in the future.

Case Assessment

When analyzing the strengths, weaknesses, opportunities and risks of the Seconda Company, it should be emphasized that the Integrated Scenario is a theoretical example. It was created in order to test the feasibility and practicability of

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innovativeness of solutions for SMEs using new technologies</td>
<td>Lack of real industrial application for the entire DiFac toolset</td>
</tr>
<tr>
<td>Organisation flexibility, production efficiency, and a good attitude towards innovation</td>
<td>New technologies to be customized for specific industrial needs</td>
</tr>
<tr>
<td>Collaboration in real time from different places, saving time and money</td>
<td>The new solutions can be added to pre-existent technologies, but an expert must fix the set and train the people from the SME.</td>
</tr>
<tr>
<td>A link among different locations helps to promote team spirit, motivation and communication. Even though the people are distantly located they still feel present and part of a virtual office.</td>
<td></td>
</tr>
<tr>
<td>Being a theoretical case all project results are clearly presented and their use underlines advantages</td>
<td></td>
</tr>
</tbody>
</table>

Opportunities

New technologies adoption. Answer to SMEs needs by applying VR tools and collaborative instruments

EU-funded project has given the opportunity to create a concrete set of tools, moreover, a network of contacts and relationships with a wide range of entities.

Technological evolvements can be applied and tested within a theoretical test that is mirror of a real one.

Threats

Industrial requirements identification for customization of the results.

Persistence of results passing from prototyping to real manufacturing production.
innovative new technologies. The main purpose of the integrated scenario is to present some possible applications of the DiFac EU results to the manufacturing sector.

The SWOT analysis provided in the table below attempts to take into account industrial partner’s suggestions and the ideas from the external SME group who participated to the validation phase of the project.

One of the major strengths also lies here: the innovativeness of the adopted technologies and the offering of an integrated toolset for co-design product and factory, training people, simulating production and decision-making that meet the needs of companies with different geographical locations.

**Future Perspectives**

Since this case study is theoretical, there are no specific future perspectives for this. Foreseen action at the end of the project is the exploitation of the results. The toolset will be customized entirely to be suitable for other manufacturers.
A Korean Automotive Case

Y. Rim

Company Profile

<table>
<thead>
<tr>
<th>Company data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
</tr>
<tr>
<td>Address</td>
</tr>
<tr>
<td>WWW</td>
</tr>
<tr>
<td>Year of foundation</td>
</tr>
<tr>
<td>Number of employees</td>
</tr>
<tr>
<td>Industry</td>
</tr>
<tr>
<td>Products</td>
</tr>
<tr>
<td>Markets</td>
</tr>
</tbody>
</table>

This case study deals with an automotive target company which produces different vehicles for the world-wide market. There are a lot of workers for manufacturing products on the shop floor.

Reasons for Adopting DiFac Solutions

Problem Assessment

To produce a car, a lot of information and processes are required. These data are managed by various computational systems. They are sometimes changed to

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different format or contents with the several processes from whole car product lifecycle. In general, concerning manufacturing aspects of product, most important information in the entire car production lifecycle can be specified with PPRH (product, process, resource and human) information. In particular, human information is essential in terms of ergonomic analysis. So far, most engineering researches are just focused on product, process, and resources information. But, nowadays, workers management is becoming a common issue. Ergonomic analysis such as risk analysis with usage of tools, lifting works and assembly works are very important tasks. PPRH information can be used by heterogeneous applications and systems. But the reason for different data structure is that there should be a defined-rule or methodology for defining the aspects of data exchange among heterogeneous applications. Basically, PPRH information is managed by PDM (product data management) systems. Based on the information in PDM systems, the engineering tasks as planning, designing, process planning, ergonomic analysis, simulation, material handling and system design can be performed with their specific application in distributed environment. Because of these backgrounds, an integrated management of PPRH information and framework for collaboration is essential. A web-based framework for collaboration in distributed environment and integrated schema of PPRH for the interoperability among heterogeneous systems is required to maximize the profit.

**List of jobs for the door installation process (Scanned table from Rim et al. 2008)**

<table>
<thead>
<tr>
<th>Line</th>
<th>Process</th>
<th>Operation</th>
<th>Unit work</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trim line</td>
<td>23rd process front</td>
<td>Remove the front door from a hanger and then fit to the car body</td>
<td>Grip the door using a manipulator Remove the door from a door hanger Fit the door to the body Match the front door Match the door to the car body using a manipulator Check the front door and assemble with the car body Check holes on the door and the car body Assemble two bolts Adjust torque using a torque wrench</td>
</tr>
</tbody>
</table>
| line     | door install trim      | line      |                                               |"
and flexibility and to minimize the cost, time and delivery date.

As previously mentioned, there are many manual assembly operations in the automotive general assembly. Especially, the door installation process presents the majority of worker’s exaggerated joint movements in the human upperbody. Because of these reasons, we applied the DiFac hub and the ergonomic evaluation module to the door installation process in the automotive general assembly. The detail of the work process is as in the table below.

**DiFac Solution**

DiFac hub is a kind of engineering hub which operates on the web environment for the collaboration in the distributed environment. On the basis of DiFac hub, there is a PPRH schema of various engineering information, including human information for ergonomic analysis, which are from PDM systems. With this schema, DiFac hub provides the neutral XML file of PPRH information from PDM systems to each engineering systems and applications via web for collaboration in distributed engineering departments of automotive company.

Figure 1 presents the web environment of DiFac hub and the XML files generated by PPRH integrator.

Figure 2 presents the results of ergonomic simulation for the given working conditions with regard to the automotive general assembly tasks. The ergonomic analysis solution analyzes human movement pattern based on the developed digital human model and the PPRH information from the web environment of the DiFac hub.

**Case Assessment**

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well-applied PDM/PLM systems</td>
<td>Existing out-of-date engineering tasks(Manual)</td>
</tr>
<tr>
<td>Well-applied digital virtual manufacturing</td>
<td>Existing out-of-date HW and SW</td>
</tr>
<tr>
<td>Extensible schema of PPRH information</td>
<td></td>
</tr>
<tr>
<td>Collaboration Environment via web</td>
<td></td>
</tr>
<tr>
<td>Advanced digital human modeling technique</td>
<td></td>
</tr>
<tr>
<td>Opportunities</td>
<td></td>
</tr>
<tr>
<td>Impossible to apply fully-automated production system—Needs of ergonomic analysis</td>
<td>Huge and extremely various engineering information—Difficulty of integrated management</td>
</tr>
<tr>
<td>World-wide market—external engineering department</td>
<td></td>
</tr>
</tbody>
</table>
Fig. 22  Web environment of DiFac hub

Fig. 23  Ergonomic analysis solution
• **Internally**: DiFac hub has extensible schema of PPRH information and it works on the web for the collaboration. The target automotive company already applied and keeps pursuing PDM/PLM system and digital virtual manufacturing technology. But, there are still out-of-date engineering tasks for manual analysis, and out-of-date HW and SW.

• **Externally**: In general, it is hard to apply fully-automated production system to automotive industry. So, there are needs of ergonomic analysis. And, for the world-wide market, collaboration in distributed environment is essential. But, with growth of society and related technology, the amount and variety of engineering information is increasing.

**Future Perspectives**

Nowadays, most of all technologies are becoming to be focussed on human and flexibility. In particular, there have been researches for human centralized manufacturing system. Also, for the flexibility of manufacturing system, integrated management and exchange among heterogeneous systems is essential in terms of PLM (product lifecycle management). DiFac hub supports collaboration via web and interoperability with PPRH schema. In addition, ergonomic analysis S/W incorporates ergonomic analysis into working conditions of the digital factory. So, there is possibility for applying DiFac Hub and ergonomic analysis S/W for other industries, for example, shipbuilding, semiconductor, electronic product, and construction.
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PPR⁺H Product, Process and Manufacturing
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