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Pascal Ravesteyn

Research Centre for Process Innovation University of Applied Sciences Utrecht

Adril Kohler

Research Centre for Process Innovation University of Applied Sciences Utrecht

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Pascal Ravesteyn
Research Centre for Process Innovation
University of Applied Sciences Utrecht
NETHERLANDS
pascal.ravesteijn@hu.nl

Adri Köhler
Research Centre for Process Innovation
University of Applied Sciences Utrecht
NETHERLANDS
adri.kohler@hu.nl

ABSTRACT

During the last two decades many businesses around the world have adopted Enterprise Resource Planning (ERP) systems. Consequently the growth in the number of ERP implementations has had an enormous impact on the demand for ERP skills. This is one of the main reasons that many universities have adopted ERP in their curriculum. However many universities have struggled with the complexity, considerable cost and effort involved with the use of ERP and the way in which to incorporate it into the curriculum. This paper describes a joint effort by industry and the HU University of Applied Science in the Netherlands at designing an ERP curriculum that doesn't have these problems and at the same time bridges the gap between skills taught by academia and those valued by industry.

INTRODUCTION

During the last two decades, many businesses around the world have adopted Enterprise Resource Planning (ERP) systems. ERP systems are enterprise-wide information systems that replace separate systems for such tasks as sales, purchasing, finance, logistics, manufacturing and warehousing. "They are designed to address the problem of information fragmentation or 'islands of information' in business organizations (Muscatello & Chen, 2008)." In essence, ERP developers claimed to be able to automate all of a company's primary process and also improve them by incorporating best business practices. ERP itself is not entirely new but evolved from the Material Requirements Planning II (MRP II) system (Watson & Schneider, 1999; Lee, Chen, & Yang, 2006). It is even stated that adoption of ERP systems may be the most important use of information technology at the end of the former and the beginning of the new millennium (Hawking & McCarthy, 2000; Hawking, McCarty, & Stein, 2005). Consequently the growth in the number of ERP implementations has had an enormous impact on the demand for ERP skills. This is one of the main reasons that many universities have adopted ERP in their curriculum. Many universities, however, have struggled with the complexity of ERP software and the way in which to incorporate them into the curricula.

While the application of ERP in education is well documented in many papers on information systems education, there is still only limited proof of its added value. The influence of ERP courses in the curriculum on the learning experience of students is insufficiently supported by

research. Although there are indications that using an ERP system helps students with getting a better grip on business or information related topics (Noguera & Watson, 1999; Noguera & Watson, 2004; Nelson & Millet, 2001; Wagner, Najdawi, & Otto, 2000), "the educational benefits of instructional use of ERP systems is still mostly established on the basis of anecdotal statements from faculty and students rather than on empirical and objectively measured data secured by educational research methods" (Noguera & Watson, 1999). ERP can be used, however, as a means to demonstrate many of the methods and techniques in a broad range of business and information systems related courses and can therefore be of great value to academia. Because ERP related skills are in great demand, the use of ERP in education can also directly add to students' market value, thus helping them require jobs faster and also helping them in negotiating higher starting salaries.

Although the use of ERP in education might be coming more common, the problems related to it are far from being solved. Several authors have noted the considerable cost and effort involved with the use of ERP (Becerra-Fernandez, Murphy, & Simon, 2000; Nelson & Millet, 2001; Davis, 2004; Hawking et al., 2005). The software can be acquired at reasonable cost or sometimes even no cost (Noguera & Watson, 1999) but the time and resources needed to maintain the software, acquire the necessary skills to work with it, and to develop a new curriculum is tremendous. It is not only teachers who have to invest a lot of time, but this is also the case for the staff (e.g. IT shared service centers) that is involved. Therefore, these efforts are often dependent on relatively few staff; and once they leave a university or change direction, the curriculum usually flounders (Hawking et al., 2005). For example, in the ERP initiative mentioned by Becerra-Fernandez et al. (2000), out of the 12 members that started the project only 5 really stayed on board to carry out the courses. Seven stopped in an early stage due to job changes, other interests, and lack of recognition of the work required to implement ERP in the classroom. Rosemann, Scott, and Watson (2000) propose collaboration between universities in teaching ERP courses to overcome this problem; this, however, causes extra problems such as curricula and rosters that need to be synchronized.

Whereas introducing ERP in an educational environment means overcoming barriers, such as the cost of implementing and maintaining an ERP application and a lack of ERP related skills, the most difficult task is often to develop proper course material. Sometimes the ERP software developer provides its own training material, but transforming this to suitable material for educational purposes is not an easy process. Commonly, the provided materials require a preconfigured data set, which might not be made available; and also, commercial training exercises are often just snapshots to reinforce particular features of the system instead of comprehensive exercises illustrating the end-to-end processes that can be supported and that are relevant in an educational environment (Hawking et al., 2005).

Besides the mentioned hurdles that fast moving developments in IT have made, that industry no longer requires employees with just ERP related skills. Today a broader range of skills that support the development, implementation and maintenance of e-business solutions is required due to the continuing evolution of ERP. One of the major trends in ERP is the focus on front-office applications and inter-organizational business processes (McGaughey & Gunasekaran, 2008). ERP skills are just a subset of this. These developments are part of the so called second wave of ERP education (Hawking et al., 2005).

In this paper, a joined effort of industry and the HU University of Applied Science at the development and implementation of an Enterprise Resource Planning minor is described that is aimed at overcoming the mentioned obstacles (such as costs, lack of skills etc.), while at the same time preparing students for the new industry needs. In the following section, the choices made in the design of the curriculum are discussed. Section 3 then describes the process of carrying out the minor for the first time; and in Section 4, the outcomes and lessons learned are highlighted. The final section gives a discussion on the future of the minor.

CURRICULUM DESIGN

Before discussing in depth the process of designing a new curriculum, it must be pointed out that the HU University of Applied Science has had a long track record on using ERP systems in different courses at different faculties. As early as the beginning of the 90s, Exact Software (DOS version) was already used to let students experience an automated financial administration application. Between 1997 and 2005, Baan software was used for both financial, logistics and process management courses; and at the same time, a course on selecting and implementing ERP was given in cooperation with KPMG Consulting (now a part of AtosOrigin). All of these initiatives, however, were suffering from the problems mentioned before; and with the change of interests of particular teachers, most of ERP related courses were cancelled. Therefore, the focus during the development of this new minor curriculum was to prevent any of the obstacles that both we and other universities have faced when using ERP in their educational programs.

As a start to the project, a study was conducted to find best-practices of other universities about the development of an ERP curriculum to see if the mentioned problems might have already been solved. This still didn't seem to be the case. The study did give us a useful overview of different approaches that can be taken when developing an ERP curriculum. The following four approaches are described by (Hawking & McCarthy, 2000; Hawking et al., 2005; Jensen, Fink, Moller, Rikhardsson, & Kraemmergaard, 2005):

1. ERP training;
2. ERP via business processes;
3. information systems approach;
4. ERP concepts.

The first approach is basically instruction or training in a particular ERP system. This is very similar to the training courses that the ERP developers and suppliers provide to their customers and could be done by reusing commercial training material. The second approach focuses on business processes and related concepts (e.g. financial administration or production scheduling and planning) and uses ERP to assist in the presentation and clarification of these methods and concepts. For this approach, commercial training material is not sufficient; and new material will have to be developed. The third approach uses ERP to illustrate information systems concepts. It is very similar to the second approach; only the target group or goal differs. Instead of teaching business students and concepts, the target group will most likely be computer science / information systems students and the concepts that are taught are different. Finally, the last approach is to teach about ERP related skills, such as selection and implementation of ERP software. It is not really necessary to use a real live ERP system for this although it could give a

clearer picture of the complexity of such systems. Of course, it is also possible to combine aspects of all approaches to create a more hybrid approach.

Before choosing a development approach, it was decided that the new ERP curriculum would be given in the form of a minor, which is a coherent program of 30 ECTS (ECTS stands for European Credit Transfer System; 30 ECTS are equivalent to 840 hours or half a year of study for a full-time student). Minors supplement the student's main course curriculum (which by contrast is called the major). Students with a major in software engineering can in this way broaden their scope with a minor in project management, consulting or even Chinese business skills. Because we wanted a broad minor that attracts students with many different backgrounds, this had to be taken into account when developing the curriculum. For this reason, it was decided to use all of the four approaches mentioned above. Furthermore, to really enhance the learning experience of students, we used a research initiative that was sponsored by the National Science Foundation in the United States to identify the skills required in relation to large information systems such as ERP. In their recommendations, written down in the 'Information Systems-Centric Curriculum Document' (1999), one of the important outcomes was the advice to have ongoing collaboration with industry that also involves students. Examples of collaboration that are given are case studies, on-site projects, guest lectures, and assistance in updating the curriculum. Additionally, experts suggest three different groups of skills that an industry ready IT graduate should have.

The first group is personal skills, such as systematic-thinking, problem-solving, critical-thinking, risk-taking, personal discipline, persistence, and curiosity. The second group consists of interpersonal skills, like communication (oral, written, listening, and teamwork), collaborative skills and conflict resolution skills. The final group consists of technical knowledge skills, which consist of knowledge about enterprise computing architectures and delivery systems, information abstraction, representation and organization, concepts of information and systems distribution, human behavior and computer interaction, process management and systems development, among other topics. For the minor we developed, it was decided that the personal and interpersonal skills should receive a lot of attention. This decision was based on interviews with representatives from industry that time and again noticed the lack of these skills with our students. Besides due to the different backgrounds of the students that can enroll in the minor, a heavy emphasis on technical knowledge skills is not possible.

Because an important part of the minor should involve real life projects for the students and because we hoped collaboration with industry could help overcome most of the identified problems in earlier initiatives, we set out to find industry partners that were willing to participate in this project. The first and foremost important partner would be a supplier of an ERP package. Despite investigation into the previously mentioned authors, we decided to partner with Microsoft and use their MS Dynamics AX solution. The most important factor that influenced us in making this choice was not that Microsoft provided a better offer regarding their ERP solution (this was basically the same, so free of charge) or that the software is better. Microsoft said they would positively recommend us within their partner network, and we wanted that network to actively contribute to the minor. Because minors are always followed in the final stages of a student's education, the added value to partner companies is high. Research by Courte and Bishop-Clarke (2005) has shown that partnerships involving more senior students tend to have

higher rates of return (industry partners are interested in repeating the experience the following year) and more often lead to internships and job placements. Partnerships that involve students early in the academic program are liable to be a less successful; therefore, few universities attempt to begin them (Cameron, 2008).

Even with Microsoft's recommendation, it still took several information sessions and visits to interested partners before we had enough participants. In the end, actual partnership contracts were signed with Microsoft for the free delivery of the MS Dynamics Axapta solution. This partnership also gave us free participation to official certification program, Mprise to deliver an ERP training, five companies (SBA, HGH, Accenture, Centric and Avanade), which could provide guest lectures, sponsorship, and onsite projects for students. Expecto provided training and certification in Prince 2 project management foundations. As stated above, we used a combination of the different approaches available in developing the ERP minor curriculum. In Table 1, an overview of the curriculum is shown.

Table 1: Overview of the ERP minor curriculum.

Enterprise Resource Planning minor - Introduction Week				
Period 1 (9 weeks)	Introduction Enterprise Resource Planning	Vision, Strategy and Change	Project Management (by Expecto)	Functional ERP Training (by Mprise)
Period 2 (10 weeks)	Industry Project - introduction period	Business Process Management	Customer Relationship Management	
	Industry Project (at either Accenture, Centric, SBA, HGH or Avanade)			

The course started with a week of introduction. During that first week, students got to know each other and the lecturers; they also get to know about the companies via guest lectures and company visits. Because students were expected to come from a large variation of different bachelor studies and a large variance in knowledge and skills was expected, a basic introduction in writing papers and reports (including the topic of plagiarism) was given. On the first day, students have to make teams in which they would be working on an initial assignment during the remainder of the week. Presentations had to be given on Friday, and papers had to be handed in on Monday morning.

After the introduction week, the first period mainly consisted of modules that taught business concepts that can be automated by ERP, as well as ERP concepts. The module, Introduction ERP, covered a wide variety of topics, that ranged from What is ERP? And How to select and implement ERP? to explaining the business activities that can be implemented, such as material requirements planning, forecasting, distribution, and sales. The module Vision, Strategy and Change covered the broader perspective of how organizations function and what should be taken into account when management decides that the organization should start an ERP project. Because one of the major critical success factors when implementing ERP is a lack of project management skills (Holland & Light, 1999; Muscatello & Chen, 2008), a module on project management was included in the minor. This module consisted of the Prince2 foundation course and was given by consultants from Expecto. Students had the choice of taking the official

certification exam as an assessment and receiving the certificate when they pass or taking an exam supplied by the university if they don't want to receive certification. Besides emphasizing the importance of project management by the way in which this module was taught, it also heightened the market value for students if they obtained certification.

Halfway during the first period, a module on functional ERP training started. Again, this module was entirely organized by one of the program partners (in this case Mprise, a Microsoft Gold certified partner in learning solutions). By working together with Mprise, the university doesn't have to train teachers who wish to maintain their ERP skills. This module is also commercially available; and again, it was possible for students to receive an official Microsoft certificate. In industry, the most wanted skills are those in trade and logistics; therefore, the module consisted of a basic MS Dynamics AX training. In total, the module consisted of 12 consecutive training days that started at 9 a.m. and ended at 16 p.m. Students received vouchers from Microsoft to take an official certification examination at one of the locations provided by Microsoft. Students were told to take the exam within four weeks after the module was finished.

The second period consisted of two new theoretical modules and the introduction of the industry period. The customer relationship management module addressed the change in focus of ERP towards the front-office of organizations (as stated by McGaughey & Gunasekaran, 2008). The second theoretical module, business process management, taught students why it is essential to analyze and, if needed redesign, business processes as part of an ERP implementation. Students also learned the basics of process modelling with the Business Process Modelling Notation (BPMN). Because the skills of this course are a prerequisite for the industry project, it was given within 4 weeks by scheduling multiple sessions per week. Finally, the second period started with an introduction to the companies where students would work on real projects. During this introduction period of four weeks, students were present at the company for two days a week; they received an orientation to the company, were assigned to a company supervisor and given time to discuss the project they would be undertaking. Also a supervisor from within the university was assigned to oversee the project. At the end of the period, a project initiation document (PID), according to the Prince2 standard, was to be handed in to the university supervisor attesting to agreement between students and company supervisor as to they tasks. When this was done, the project started; and students were expected to work at the companies for four days a week. On Fridays, students come back for the CRM course at the university; and if necessary, they could meet with their supervisor to discuss their projects.

The partner companies where students were doing projects were allowed to expect a lot from the students because part of the partner contract was a 3,000 Euro sponsorship fee that the each of the companies paid to participate. This sponsorship fund was used by the university to hire commercial trainers from Expecto and Mprise. Although they don't have to pay the students for their work on the projects, it is the company's responsibility to really get value from the students. Besides the project assignment given by the companies, the university expected a report that outlined and explained the activities and processes that the students have been working including a model of this using BPMN. This was part of the assessment of the BPM module.

The minor ended with a seminar, during which students, teachers and supervisors from both the university and partner companies were present. Student presented their projects and results and

discussed these with the audience. Also, official certificates were given to students who had passed the exams. Students who had not chosen to participate in earning certificates took separate university examinations.

OUTCOMES AND LESSONS LEARNED

The Enterprise Resource Planning minor started in September 2008 and finished on January 31, 2009. A total of eleven students participated in the entire minor, and we also had several students that followed a few modules as a replacement for subjects from their major. Students had their backgrounds in five different bachelor courses (commercial economy, logistics and economy, business informatics, industrial management, and software engineering) from three different faculties. Because students were following different majors, their entry level knowledge on ERP also differed from a low level of knowledge, the student from commercial economy, to an intermediate level of knowledge, students from business informatics.

When students of the business informatics major first subscribed for the minor, they were declined by their examination committee on the grounds that the skills and competencies learned in the minor would not add to their knowledge because of the overlap with their major. It took the minor manager a lot of persuasion and handing over of extra course information before students were allowed to enroll. During the course of study, it turned out that those students did have a higher entry level compared to their fellow students; however, this could not be considered a high level of ERP knowledge.

The industry-based projects provided an active learning environment that enabled the students to bring into practice what they had learned during the first period. Also, the projects gave students a tremendous opportunity to learn a lot from practitioners with several years of experience. As it turned out, the industry partnership bridged the gap between the skills of university graduates and those required by industry. Also, the projects enabled the university to build closer links with ERP related industry.

Although the projects were diverse, they all turned out to be challenging and exciting. To give a basic idea of the types of projects that were done, here are two examples:

Accenture Delivery Method

This project was based on the Accenture Delivery Method (ADM) for packaged software development or implementation. At the core, this methodology is fairly generalized to support a wide scope of software packages. Also Accenture has developed more tailored versions of ADM for specific software packages, such as SAP and Oracle. However, for Microsoft Dynamics AX, a specific delivery method was not developed. Therefore, it was necessary to customize the basic Accenture Delivery Method for a better fit to fulfill the specific needs of MS Dynamics AX projects. Because Microsoft supplies its own methodology specifically for implementing its Dynamics AX solutions, this had to be taken into account. The Microsoft Sure Step Method contains templates, guides and specific information of the usage of Microsoft Dynamics AX. The assignment students had to work on was to compare the ADM for Packaged Development and the Sure Step method of Microsoft Business Solutions and to advice on how to tailor the ADM method for Microsoft Dynamics AX projects. Students had to analyze the Microsoft suggested

method and compare it to the needs which ADM fulfills. The differences between the two methods point towards the issues, which had to be taken into account to form a 'best-of-breed' method.

Investigating the reporting needs at a Centric customer

Students who did their project at Centric were allocated to one of its major clients in the Netherlands. At this client, a Microsoft Dynamics AX implementation was already running for over a year. Within one of the processes, it was unclear which reports would have to be generated after the implementation was completed. Students did an investigation into the information needs of the customer and also provided advice on how to standardize reports in such a way that the format could be used for other processes that were to be implemented.

Students evaluated the minor very positively. Besides acquiring a lot of knowledge on ERP in theoretical courses, students were highly appreciative of the projects and the possibility to get certificates that are highly valued in industry. Students really found that this minor was able to bridge the gap between the skills taught at a university and those required by industry. Some minor comments were made about the amount of work involved in the different courses and the fact that the project management exam had to be taken during the same week in which the ERP training was organized. Due to this, many students focused on the examination; and although they participated in the ERP training courses, they spend less time on their homework. This resulted in almost everybody passing the Prince2 examination, while everybody failed the first Microsoft Dynamics AX assessment. After the second assessment, all students had passed both exams and obtained certificates. The Microsoft examination turned out to be especially difficult; students had to learn many in depth details about the ERP functionality instead of having a general understanding of how the software works.

Overall, students' experiences were very positive, as is shown by the following two comments:

> *We really enjoyed the minor. It was fun working together with students from different faculties, and we learned a lot from this. One major positive point was the way in which the minor was organized, not only the administrative processes but especially the supervision and the possibility to achieve highly valued certificates, such as Prince2 foundation and MS Dynamics AX trade and logistics. The minor has taught us a huge amount about ERP and related aspects. The modules were well organized and taught; the integration between modules was very good and the different teachers involved were highly experienced and knowledgeable. Although the start of the minor was really heavy due to the amount of hours spent on lectures this really paid of during the projects. In one word fantastic.*" Geurt van Tuijl – student business informatics.

Another student provided the following reaction to the minor: "*I really enjoyed the minor, and I have never learned so much in such a short period of time!*" Jelle Wolters – student in logistics & economy.

Due to the very positive feedback from students, the Industrial Management department recognized the added value of this minor in relation to the major they are offering. Therefore, the department manager decided to advise all students who are allowed to choose a minor to partake in the ERP minor. Though we find this very positive, it also raises a problem. Currently the

maximum amount of students who can participate in the minor is fifteen, due to the capacity of our industry partners that take care of the ERP and project management training; if we have a much larger amount of students, we will need to renegotiate costs.

After the minor was over, we also visited all the partners for an evaluation. Each organization was asked how they found the way in which students participated in the projects, whether the competencies of the students were sufficient to start working at the company. We wanted to know if the company received value for their money and if they wanted to participate in the following year. As it turned out, all partners were positive about the students' skills and participation in the projects. Most of the companies also offered traineeships or jobs at their organization; two students have accepted this offer. When asked if the companies would participate next year, most of the reactions were less positive. Due to the current economical crisis, there is less need for new employees; and budgets for sponsorships are cut. Only two partners, therefore, have immediately agreed to participate again, while the others are still contemplating this request.

One of the prime reasons to involve industry in this minor was to prevent the problems existed during earlier initiatives at our and other universities as described in the introduction. So did it work? For the most part, it did indeed. By cooperating with industry, we no longer need to train our staff in ERP; and we were able to teach students competencies that are really valued by industry by using ERP to clarify business and information science concepts. As described at the beginning of the paper, one of the major problems is costs; and while we were able to lower them, they are not entirely gone. Instead of maintaining an ERP knowledge base within the university, we now hire it from industry. For this minor, the partners contributed exactly the same amount of money needed to hire outside trainers. This means that each year these costs and sponsorships have to be budgeted; and if there is a gap, the minor runs the risk of being aborted. One of the alternatives we have worked out is to dynamically change the content of the ERP training. The trade and logistics content that was chosen for this first time was also one of the most complicated courses and involved more training days than, for instance, the financial or business intelligence courses. Because the major goal with the ERP training was getting students actively engaged with an ERP package and offering them the possibility of acquiring official Microsoft certification, it is possible to change the content of this module without really jeopardizing the integrity of the entire minor.

CONCUSIONS

In conclusion, we can state that the way in which the minor curriculum has been developed helped prevent the major problems are involved with using ERP in an educational context and at the same time helps students attain skills that are highly valued by industry.

This does come with a major organizational effort, however. Each year, partners from the Microsoft network will have to be contacted and asked to participate in the minor. However, we expect to solve this problem by negotiating long term partnership contracts. Also, all partners have to offer projects where students can participate; and to maintain the educational quality, these projects have to be checked by the minor manager.

For now, we are working very hard at organizing the second edition of the ERP minor, which will start in September 2009.

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