IMPLEMENTING AN ENTERPRISE INFORMATION SYSTEM TO REENGINEER AND STREAMLINE ADMINISTRATIVE PROCESSES IN A DISTANCE LEARNING UNIT

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ABSTRACT

During the past three years, we have developed and implemented an enterprise information system (EIS) to reengineer and facilitate the administrative process for preparing and teaching distance learning courses in a midsized-to-large university (with 23,000 students). The outcome of the implementation has been a streamlined and efficient process which has delivered higher faculty satisfaction at a substantial cost reduction. In this paper, we propose a new conceptual and operational framework for process reengineering (PR) in higher education institutions. We also share our practical experience gained while designing, developing, and integrating three subsystems into an EIS. We hope that our experience, delineated in this paper, will help other universities' distance learning efforts and will encourage them to implement enterprise information systems to effectively manage their administrative processes.

KEYWORDS

Distance Learning; Enterprise Information Systems; Systems Integration; Business Process Reengineering (BPR)

I.   INTRODUCTION

Enterprise Information Systems (EIS) and Enterprise Resource Planning (ERP) are complex systems used to integrate and manage dispersed processes and transactions, using a common data source. Many sophisticated systems have been developed to assist in reengineering business processes in manufacturing, in customer relationships, and in supply chain [1, 2]. EIS has also penetrated higher education administrative and academic systems as a planning, decision-making, and information management tool.

Following Pairat & Jungthirapanich's [3] chronological review of ERP implementation in business and industry, we have identified three sequential phases in the history of the implementation of EIS in higher education institutions. During the first phase, EIS were implemented as a replacement to aging legacy systems; EIS have traditionally been adopted to manage administrative systems such as human resources and student, financial, and development information [4, 5]. During the second phase, EIS implementation has progressively evolved to include academic systems and services, including portals, course management systems, digital content repositories, e-portfolios, and e-services. Finally and more recently, under the pressure for greater accountability and the development of data mining techniques, EIS are used as data sources for academic analytics tools aimed at improving enrollment management, fund-raising,

and overall teaching and learning [5, 6, 7].

For example, both the California State University system and DePaul University (IL) have implemented customer relationship-management systems to manage the process of developing and maintaining long-term relationships with students [8]. Brigham Young University-Hawaii recently implemented Oracle's enterprise software (PeopleSoft Solutions) to enhance its service to students, to streamline processes, to improve interdepartmental communication, and to strengthen security across its IT system. As Villano [8] describes, these integrated systems communicate with students at critical points throughout the lifecycle of their relationships with their institution's processes at recruitment, at admissions and enrollment, and upon graduation.

However, EIS implementation is still absent from the routine administrative and academic transactions of higher education institutions where administrative and academic units' processes and procedures are still paper-based. On-campus units are still using word processing and spreadsheet applications to collect, manage, and track most course-related information, including syllabi, textbook ordering, copyright clearance, software requests, coursepak requests, and exam proctoring forms. This paper-based process is particularly cumbersome, inefficient, and difficult for distance learning units [9], and it appears to increase faculty workload and dissatisfaction.

Moreover, in spite of the substantial growth in distance and online learning offerings [10], our review found that the majority of the literature regarding online and distance learning has paid little attention to reengineering or streamlining operational processes within distance learning units. Curiously, this inattention is not aligned with the increasing internal and external pressures demanding greater accountability and efficiency from higher education institutions.

By implementing Enterprise Information Systems to streamline administrative processes and to integrate data, distance learning units are likely to improve their organizational efficiencies and to reduce their operational costs while enhancing both their services and their communication with faculty and students. In this regard, EIS implementation is achieved by following or combining one of two options: by using either vendor-packaged or in-house-developed systems.

We chose the second option because we intended to reengineer our unit's administrative processes while developing the application, a goal hardly achievable when using a vendor-packaged option. From this perspective, our decision to develop an EIS was driven by three specific goals: a) to replace a cumbersome and inefficient paper-based logistics process with a streamlined and efficient Web-based process, b) to increase distance learning faculty satisfaction while enhancing our unit's quality of service, and c) to reduce the overall cost associated with preparing and teaching distance learning courses for faculty as much as possible, using innovative technologies. Of these three goals, we consider faculty satisfaction (as reflected by workload reduction) as the most important indicator of success for our initiative, because faculty satisfaction is a key motivator for faculty participation and involvement in distance learning, [11].

Although we used (Business Process Reengineering) BPR as methodological framework, our initiative differs from traditional business BPR approaches in that it didn't have specific cost-saving nor downsizing goals and targets. Based on a departmental initiative, our reengineering process was structured to focus solely on rethinking processes and procedures within our university's distance learning unit.

II.   PROCESS REENGINEERING FRAMEWORK

The concept of reengineering was defined in the early 1990s. Hammer and Champy [12] defined reengineering as "the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical temporary measures of performance, such as cost, service, quality and speed" (p. 46). Closer to the organizational culture of higher education, and prior to Hammer and Champy [12], Penrod & Dolence [13] defined reengineering as "using the power of modern information technology to radically redesign administrative business processes in order to achieve dramatic improvements in their performance" (p. 8). The ultimate goal of process reengineering is to achieve efficiency and effectiveness by radically rethinking existing processes. This contrasts with Total Quality Management, which undertakes process change gradually by working in incremental steps [14]. As our initiative was to replace a paper-based logistics process with a streamlined and efficient Web-based process, and to achieve major improvements through this reengineered process, our unit decided to thoroughly redesign the process by following the BPR approach.

Using the BPR approach, we proposed, and have successfully initiated, a framework inspired by two main sources: (1) a retrospective analysis of our own experience in reengineering several internal processes (faculty development program management, online course development, syllabus creation process, and learning assessment lab registration), and (2) our reading of the BPR literature [13, 15, 16, 17]. By combining these two sources (in which theory has been nurtured by practice), our framework [18] provides a well-grounded tool for use when reengineering any process in higher education. As shown in Figure 1, this framework for process reengineering in higher education is structured around four sequential non-linear phases:
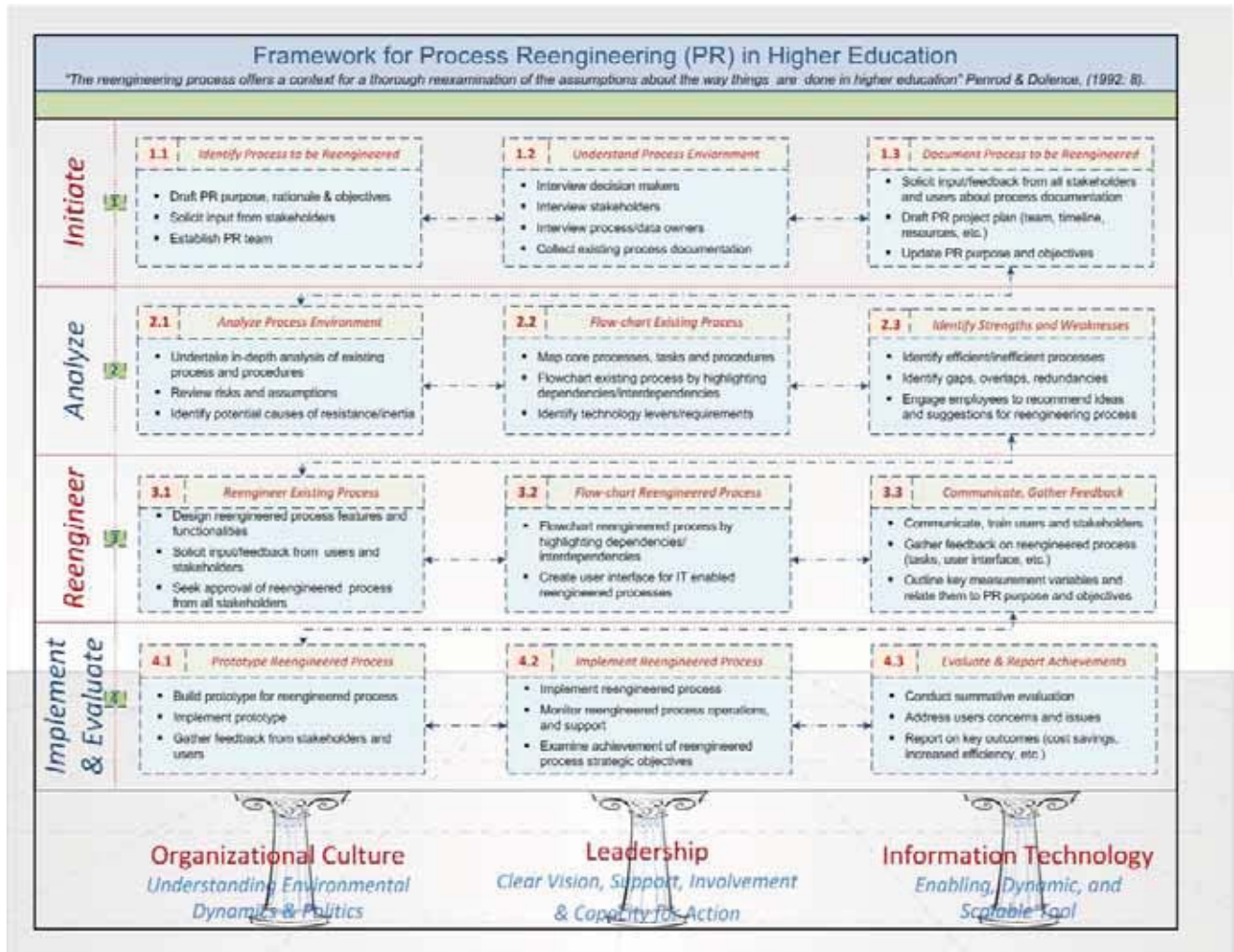
Fig 1. Proposed Process Reengineering Framework

A. Initiation

The first phase is aimed at identifying and understanding the purpose, the rationale, and the objectives of process reengineering. This phase requires active participation from all stakeholders, both to document and to understand the environmental dynamics and the risks associated with the proposed reengineering process [19].

B. Analysis

The second phase is an in-depth analysis of the process tasks and procedures which is completed by analyzing tasks, by reviewing risks and assumptions, and by identifying potential causes of resistance and inertia. Along with the documentation obtained during phase one, the outcome of this analysis phase is used to flowchart the process. A visual presentation of the existing process dependencies and interdependencies is not only critical to mapping the core tasks and procedures of the process, but is also foundational for the reengineering process itself.

C. Reengineering

In the third phase, the features and functionalities of the reengineered process are redesigned. This phase includes active participation and feedback from all appropriate personnel and users. As the process is redesigned, the flowchart outlined in phase two is updated to include a clarification of the key measurement variables. In this phase, information technology is used as an enabling and facilitating tool.

D. Implementation and Evaluation

The implementation and evaluation phase is intended as a first step toward prototyping the reengineered process in order to address users' and stakeholders' issues and concerns. In a second portion of this step, the reengineered process is fully implemented and monitored to ensure successful operation. A summative evaluation is conducted, and achievement and outcomes are reported.

Successful implementation of this framework requires three key pillars: 1) a deep understanding and familiarity with the organizational cultures of both the distance learning unit and the larger university, with full knowledge of their dynamics and politics [19]; 2) a clear vision, involvement, and support from senior leadership [14] sustained by a "capacity for action" [20]; and 3) the intelligent leveraging of information technology as an enabling, dynamic, and scalable tool [17, 21].

III.   DEVELOPMENT AND INTEGRATION OF THE ENTERPRISE INFORMATION SYSTEM IN OUR UNIT

Our distance learning unit is part of a large public research university at which roughly fifteen percent of enrolled students are taking distance learning courses. The university is nationally regarded as a leader in technology-mediated distance learning, having offered technology-delivered distance learning since the mid-1980s. In order to rethink our processes and procedures, we built three subsystems guided by the process reengineering framework and then integrated them into our large-scale enterprise information system. To successfully integrate these subsystems, we used a faculty orientation website which has allowed us to streamline and simplify administrative processes for faculty preparing and teaching distance learning courses.

A. Organizational Situations Before the Implementation of EIS

Before the EIS applications were developed and deployed in our unit, we used a combination of paper forms and Excel spreadsheets to manage our operations. As an example, between Summer 2006 and Summer 2007, 37,688 registrations were recorded, and 593 instructors taught 1,281 course sections. Faculty manually completed a plethora of paper forms and then submitted them to the Office of Distance Learning for processing and routing to different units across the nation and across the globe. With such a large volume of paper in motion, managing administrative processes (such as syllabus preparation, the collection of various course-related forms, the distribution of course materials, and the logistics of scheduling paper-based exams) was challenging and sometimes overwhelming [9]. Indeed, in addition to burdening faculty members with the completion of numerous paper-based forms for each course, this manual approach burdened the distance learning (DL) staff with a variety of tracking, processing, and retrieving problems. It was discovered, as semesters went by, that the storage and retrieval of these forms became cumbersome and problematic. In short, the submission of paper forms was costly, cumbersome, and inefficient, and made tracking and managing difficult.

B. New Enterprise Information System Implementation

Our System implementation followed the four-step framework outlined in Figure 1, above.

1. Initiation

In this phase, we identified the administrative process to be reengineered using our unit's years of experience in dealing with the preparation and propagation of distance learning course material, syllabi, and exams. We established our understanding of the process a) by reviewing a variety of sources including original paper reports, manuals, and forms; and b) by interviewing current staff and administrators in distance learning and, perhaps more importantly, by interviewing faculty members teaching distance learning courses.

In order to thoroughly examine the administrative processes in our distance learning unit, we conducted a number of meetings with related stakeholders (DL administrators, DL staff, and DL faculty) in order to cultivate a supportive environment, to gain feedback, and to document the process to be reengineered. Through these multiple meetings, we established our project development team, drafted our project plan, and defined team roles, accountability, expectations, and timelines, in order to facilitate the project management process.

2. Analysis

In this step, we conducted an in-depth analysis of the tasks and procedures involved in the administrative process. In-depth evaluations and analysis of the current paper-based approach were made and artifacts were collected. As a result, we flowcharted the existing process and identified a list of issues and problems to be addressed. After ten formal meetings, our team made a number of recommendations for the reengineered process which included new features, functionalities, requirements, and ideas. Enhancing the performance of actual users (faculty members) in the context of their real-world activities was a major design focus of our system design. For example, at least three staff members recommended that the new system should allow faculty to adopt forms from previous semesters for current use so that faculty could reuse/update previous semesters' forms. This suggestion was built in to our new system. User profile information was used to pre-populate generic form fields in order to reduce the data entry time for faculty. After the faculty filled out the online forms, PDF documents should be automatically generated for viewing and printing purpose. From the outset, reducing faculty workload associated with distance learning courses logistics was a major design focus of our system design.

3. Reengineering

In this step, we designed the features and functionalities of the reengineered process, based on the results of the analysis in the second step. We created a conceptual model of the phases, tasks, and functions, which led to a series of database-related entity-relationship diagrams. Subsequently, we formalized this conceptual design by creating a web-based user interface involving all system users. We realized the importance that all system users need to be involved from the start, and continuously throughout the implementation because it is not realistic to expect no change in designs while a system is being built. Thus, these designs were also regularly reviewed and updated with all system users to reflect new changes. This participative approach during the design phase enabled us to capture users' concerns and feedback early in the process and to reach a consensus as to the workability of the reengineered process.

During the reengineering process, an instructional designer, two instructional technologists, and an interface designer were involved in the actual system programming and development. All applications

chosen were database-driven environments intended to streamline the administrative process. To deploy the system on the Web, a Microsoft MSSQL server was used as the backend database environment. This server was chosen because of its rich capabilities in supporting the required functionalities. In order to create dynamic web content by querying the database, PHP was used as the scripting language. CSS was used to ensure the overall consistency of the system's look and feel. A user-account authentication system maintained by the University's Center for Learning Technologies was incorporated in order to prevent unauthorized access to the online form services, thereby enforcing the security of the application.
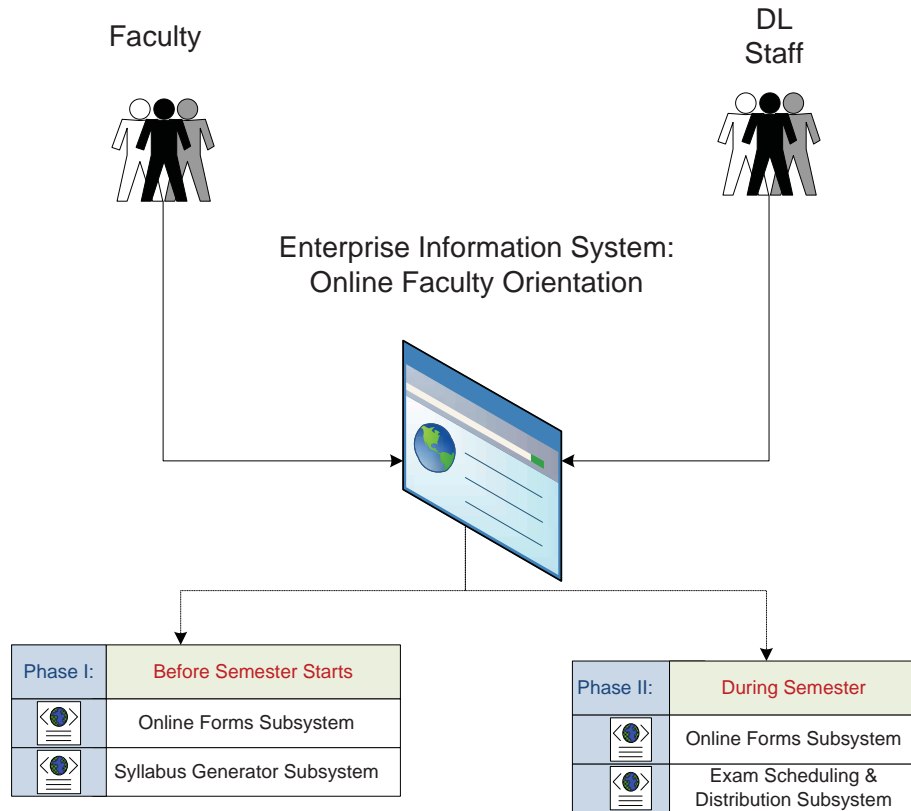

Fig 2. Reengineered Process Features and Steps

4. Implementation and Evaluation

The development team adopted a rapid application development approach [22] in building the three subsystems (the syllabus generator, the exam scheduling and distribution, and the online forms). Based on the entity-relationship diagrammed in Step 3 above, we designed a database using a Microsoft SQL server followed by a shared login/authentication module. Next, we created a separate module that included access privileges and features for each user. The three subsystems were then integrated into a fully functional system through the faculty orientation website. The user features and functions were prototyped and tested three times with real data prior to the actual deployment of the subsystems. The three applications have now been through multiple revisions, based on feedback collected from hundred of users.

IV. EVALUATION OF THE ENTERPRISE INFORMATION SYSTEM COMPONENTS

As the success of an enterprise information system often depends heavily on its usability, we surveyed our distance learning faculty to capture faculty feedback and to explore their overall satisfaction with the functionality and user interface of each subsystem. Since faculty concerns about the workload associated with distance learning are often reported as a disincentive to their participation in teaching distance learning courses [23, 24, 25, 26], the top management of our unit considered the faculty's level of satisfaction to be a key indicator of the success of this BPR implementation.

At this stage, two surveys were administered to users of the Syllabus Generator and the Online Exam Scheduling and Distribution subsystem. (The online forms subsystem was not yet finalized, and so users could not yet be surveyed.) In addition to the formal data collected from the survey, DL staff working with faculty collected informal feedback from faculty using the system. This non-systemic survey approach generated dissimilarities in terms of the number of surveyed faculty per subsystem and the overall response rate for each survey.

A. Syllabus Generator Evaluation

The Syllabus Generator was designed to streamline syllabus creation and management as it provides faculty with a step-by-step tool to create, manage, and submit syllabi online. We conducted four hands-on workshops in which faculty members were asked to create syllabi without any help and without any instructions from the workshop facilitator. These workshops, and this approach, provided us with intuitive feedback and valuable suggestions. After we made the changes based on the feedback and suggestions we received during and following the workshops, we sent a web-based survey to all faculty members using the syllabus generator in order to explore their overall satisfaction and to assess their perception of the usability of the subsystem.

A quick analysis of the survey data indicates that 29 faculty, representing various disciplines and colleges, completed the survey. Overall, approximately 68% of the reporting faculty noted that they were satisfied with the Syllabus Generator. Their feedback indicated that the Syllabus Generator is easy to use (68.18%) and reduces their time in preparing syllabi (40.91%). It might be noted here that the first time anyone uses a new system, unfamiliarity with its workings can serve to diminish satisfaction rates, which usually rise in conjunction with user familiarity with the system. Faculty members also reported that the Syllabus Generator helped them to communicate their course goals and expectations to their students (54.54%). As a result, this tool reduced students' questions about course logistics (45.45%). Most participating faculty members (59.09%) expressed their willingness to recommend the tool to their colleagues.

B. Exam Scheduling and Distribution Subsystem Evaluation

The Online Exam Scheduling and Distribution Subsystem was intended to streamline and facilitate exam and material distribution to Distance Learning students. A total of 32 faculty members representing various disciplines and colleges completed the survey about the Exam Scheduling and Distribution Subsystem. Overall, 51% of reporting faculty members indicated that the subsystem was easy to use. Their feedback indicates that this subsystem: a) enables faculty members to accomplish tasks more quickly (54%); b) reduces the time and effort in managing exam schedules and in distributing materials to Distance Learning students (42%); and c) makes it easier to meet submission deadlines (60%). The evaluation results suggest that more than half of the participating faculty members have a positive attitude about the subsystem's ability to assist them.

C. Online Forms Subsystem Evaluation

The online forms subsystem was designed to offer required forms for face-to-face, hybrid, online, and televised courses. The forms available include the textbook order form, software installation form, coursepak production request form, and copyright permission request form. Each year, more than 100 faculty members use the online forms subsystem to submit various course-related forms. Informal feedback collected by DL staff indicates that the majority of faculty using the system are pleased with the change from paper-based forms to the new online form. Faculty report that the subsystem is a time-saving and convenient tool for the management of forms and that it improves the performance of DL operations. The subsystem also enables all parties involved in the process to work together asynchronously and remotely.

Since a cost-benefit analysis is traditionally required to demonstrate cost savings in BPR projects, we cautiously report that our project has generated both direct and indirect cost savings. Our unit accounting office has calculated the annualized cost-saving attributed to the reengineered subsystem at $7500, which accounts for the portion of the mailing budget spent on sending paper forms. This estimate includes only the direct costs associated with mailing charges that were saved (roughly 8% of the total mailing cost). We expect that this percentage will increase once all DL faculty members use the subsystem. In indirect cost savings, the new functionalities of the subsystem have freed faculty and staff from several time-consuming clerical tasks and have increased faculty and staff productivity in handling the logistics process. Unfortunately, the exact amount of cost savings resulting from increased faculty/staff productivity, reduced faculty/staff labor, and reduced faculty/staff time spent on the exam distribution and scheduling process is difficult to measure.

As for the costs associated with implementing these projects, we mainly used our existing hardware and software resources, and spent only around $2000 in purchasing software (such as a PDF document converter). The rest of the cost was merely the cost of staff time given to the projects. A thorough analysis of the costs and cost savings associated with reengineering the logistics process is suggested as future research. It is important to note that the tangible and non-tangible benefits associated with faculty satisfaction, considered one of our main goals of this initiative, are difficult to quantify. Among those intangible benefits is the fact that faculty satisfaction affects students' learning experience and satisfaction, and might lead to greater faculty interest and involvement in teaching distance learning courses.

V.   LESSONS LEARNED

Overall, the whole process of development and integration of the three application subsystems (the syllabus generator, the online forms and the exam scheduling and distribution) took nearly three years to complete. Through the development and subsequent use of the three subsystems by distance learning faculty, a number of lessons have been learned, including the following:

Providing faculty support is crucial. Faculty members have different needs and proficiency levels with technology. In order to be responsive and to help faculty use the EIS, technical help and individual training is provided to answer faculty questions.

An easy transition to the electronic forms is critical. In order to avoid disruption of normal course delivery operations, both paper and electronic forms have been made available to faculty for a given transitional time. We also chose to implement the new system via a phase-in approach, in order to facilitate faculty involvement. Convincing and encouraging faculty to use the EIS will lead to the

discontinuation of paper-based forms.

Tracking the timely submission of syllabi, forms, and exams is essential. Some faculty members are tardy in their completion of required tasks. This system provides DL staff with the capability to track and remind faculty of upcoming due dates.

Faculty involvement and top management support are important factors for success. The changes from a paper-based approach to an EIS approach must involve both DL staff and faculty in the design and implementation of the reengineered processes and systems. Also, top management support is critical to the success of the development and implementation of the EIS.

VI.   CONCLUSION AND FUTURE WORK

In sum, despite a slight resistance from staff (which is typical of BPR implementation, when building around any legacy system), we believe that we have achieved our stated goals in terms of: 1) replacing a cumbersome and inefficient paper-based exam distribution and scheduling process with a web-based, streamlined, and efficient process, and 2) reducing both the faculty/staff workload associated with the clerical tasks of scheduling exams and the overall costs associated with exam distribution. The increased level of satisfaction from both faculty and staff proves that our effort and investment in this project were worthwhile and indicates the success of our initial BPR implementation. We believe that the increased familiarity of faculty with the EIS will undoubtedly cause their overall satisfaction rates to rise.

The next step in our research is to conduct a thorough analysis of the costs and cost savings associated with the reengineering of the logistics process using accurate metrics such as ROI (return on investment) to reflect the financial impact of this BPR implementation upon our unit. We also like to conduct a longitudinal study to investigate whether the BPR implementation has an impact on the overall expansion of our distance learning programs during the next five years.

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