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Role of Information Systems in Organizational Agility: The case of eClasSkeduler at Universidad de Chile

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ABSTRACT

Organizations need to exhibit characteristics of agility in order to stay ahead of their competitors, and to even survive in dynamic environments. One major concern for organizations is how to develop and implement Information Systems (IS) for their agility. However, IS are mostly regarded as a black-box related to organizational functions and structures. For this reason, organizations tend to overly spend their resources to change whole IS instead of one component that causes problems, or even making a good diagnosis. In this paper, we provide a way to open the IS black-box with a case study. The case is about how the department of Management Control and Information Systems at Universidad de Chile improves its organizational agility with a course scheduling system, eClasSkeduler. The case analysis illustrates not only how the organization improves its agility through eClasSkeduler but also how this information system is related to organizational functions in agility.

Keywords

Organizational agility, IS black-box, effect of IS in organizational agility, and agility framework.

INTRODUCTION

Organizations are made up of resources (assets) and processes (capabilities) (Leonard-Barton, 1992; Teece, Pisano and Shuen, 1997) that need to be adjusted endlessly and as fast as possible to survive in hyper-competitive environments (Volberda, 1996). The challenge is to have the right resources and processes dynamically tuned for present and future market conditions (Tushman and O'Reilly-III, 1996, 1997). Having the right resources for competition is a necessary condition, but insufficient by itself for organizational success in terms of surviving in dynamic environments (Reich, Konda, Subrahmanian, Cunningham, Dutoit, Patrick, Thomas, Westerberg and Grup, 1999). Moreover, organizations not only need to be agile in acquiring and keeping their resources up-to-date, but also have nimble operating structures and processes that allow them to react to changes. An organization must be effective and efficient to adapt in a timely manner, with speed and vigor, especially when faced with rapid and unexpected changes. The abilities to anticipate change, to marshal resources, and to react successfully to the unanticipated are how an agile organization will differentiate itself in the marketplace and build up competitive advantages (Ashrafi, Xu, Sathasivan, Kuilboer, Heimann and Waage, 2005).

Information Systems (IS) have been identified as an important factor that shapes organizational abilities, including agility, by speeding up the communications and especially processing and analyzing data (Boudreau and Robey, 1996; Robey, Ross and Boudreau, 2002). Orlikowski and Iacono (2001) emphasize that Information Systems (IS) have been treated as a black-box affecting organizational form and capability. IS Black-box means that IS are assumed as "a stable, settled artifact that can be passed from hand to hand and used as is, by anyone, anytime, and anywhere" without observing what or how each element is used for (Orlikowski and Iacono, 2001), which is significant to analyze and explain how IS can enable or disable organizational capabilities.

We see IS as one of the pillars supporting the organization and generating competitive advantages, instead of an independent and reactive object. As a human-being has many tangible and intangible components such as nervous, digestive and

circulatory systems, memory, and intelligence, an organization consists of many elements that depend on the performance of each other, and on the capabilities that arrange the elements; IS are one element that affects tangible and intangible parts of the organization (Latour, 1987). As one unhealthy organ affects the overall performance of a person, inappropriate IS impact the overall organization. For this reason, we take a holistic view to study IS to analyze organizational agility.

Continuing with the analogy of the human being, a physician can diagnose a patient by listening to symptoms, examining the patient, analyzing samples, and using his/her knowledge to discover the exact organ that causes a problem. If we took IS as a black-box, the diagnosis for a rigid organization might be such as “you have a problem with IS”, but if we consider the components of IS, and evaluate the impact of each component on the overall agility, we may be able to provide more precise diagnosis.

In financial and operational perspectives, it costs a lot to change the whole IS whenever there is a problem. As a major surgery is not necessary for all illnesses, the replacement of whole IS is not necessary for all problems. If an organization can open up IS black-box and diagnose an exact problem, agility can be improved with minimum effort, cost, and risk (Verstraete, 2004). Organizations can use this concept not only for problem solving, but also for prevention. Beyond embracing changes, agility is about aggressively creating changes – creating new markets, new business processes, and new organization structures (Goldman and Nagel, 1995). As Truex, Baskerville and Kelin (1999) point out that the continuous improvement of IS is significant for organizational capability, organizations should examine their IS continuously to find weaknesses and improve organizational agility. Then, the question is how to open up the IS black-box in the context of organizational agility?

This paper provides a way to open up the IS black-box to enhance organizational agility through analyzing how the Department of Management Control and Information Systems (DMCIS) at Universidad de Chile developed and implemented eClasSkeduler, a course scheduling application (Miranda, 2010). First, we adopt the several components of the organizational agility framework proposed by Seo and La Paz (2008). Second, we will apply this framework to analyze the case and to illustrate how DMCIS improves its organizational agility. Our analysis will explain how the software impacted each component that influences the overall organizational agility. Organizations can use the framework to diagnose their organizational agility problems and to predict how the implementation of a system like eClasSkeduler can help in their agility.

THEORETICAL BACKGROUND

Before diving into the case analysis, we will define organizational agility and identify how information systems are related to organizational agility. Researchers have defined organizational agility as below:

- Amos (1998) defines agility as “the nimbleness of a company to quickly assemble its technology, employee, and management via a communication and information infrastructure in a deliberate, effective, and coordinated response to changing customer demands in a market environment of continuous and unanticipated change” in the manufacturing context.
- Meyer (2001) stresses that organization should “make decisions fast, change direction nimbly, and figure out when to enter and exit markets.”
- Ashrafi et al. (2005) mention, “operational agility is a catalyst to enforce quality, cost effectiveness, and delivery, thereby meeting organizational objectives.”

Haeckel’s adaptive enterprise framework (Haeckel, 1995, 1999) brings an interesting point, even though he does not say ‘agility’ explicitly. He emphasizes the Sense-Interpret-Decide-Act (SIDA) model rather than make-and-sell model for organizations to be an adaptive enterprise in dynamic environments. The SIDA model based on John Boyd’s Observe-Orient-Decide-Act (OODA) model provides a way to analyze organizational behaviors to be agile through understanding their capabilities and resources from sensing the surroundings to interpret and decides to act.

The field that lethally requires agility is a warzone as John Boyd studied for the U.S. air force. According to him, a pilot should observe her/his surroundings, orient in a right direction, and decide accordingly to act quickly. This process is cyclical. Once s(he) makes a mistake in one part or delays this process, (s)he possibly confronts an irrevocable situation.

Extending this idea for Information Systems (IS) related to organizational agility, and considering the definitions of agility provided in the literature, we think that major ways of IS to help organizations in achieving agility are: 1) to perceive surroundings through collecting data, 2) to process the data into information or knowledge so that they can be used for organizations, and 3) to respond properly. In addition, IS should assist organizations 4) to (re)align their resources in a timely manner if necessary. To operate this process cyclically and continuously, organizations need fundamental capability

including learning to support four above activities (Seo and La Paz, 2008). Using these components of IS as a starting point to assess agility, we will analyze the impact of eClasSkeduler in the organizational agility of Executive Education Unit (EEU).

The first four components are operational parts for organizational agility (Seo and La Paz, 2008). It means that organizations daily use these components to operate their business. As Haeckel (1995, 1999) emphasize, the process from perception to responsiveness supported by aligning component is cyclically continuous. However, for successful establishment of organizational agility, a fundamental capability including learning has been added to the framework, because organizations have different abilities to run their business processes, and they permanently learn while performing the four operational components. It is important to recognize that 1) perception, 2) processing, and 3) response are executed sequentially, while 4) (re)alignment can influence all of three components. These four operational components go through organizational fundamental capability including learning before it feeds back to them. Although the fundamental component (including learning) is not directly involved in the daily operation, it is a necessary condition for organizations to be agile.

With the described framework for organizational agility, we assess and analyze the case of a course scheduling system, the eClasSkeduler in the DMCIS at Universidad de Chile. We will explain how the eClasSkeduler system directly impacts the agility of daily operations in the Executive Education Unit, and indirectly influences others such as financial costs and university reputations. By applying the framework to the case, and being open to find new components and key factors of agility, we will provide a way to open up the IS black-box.

METHOD

The method adopted for this research is the mixture of case study with a still ongoing action research. This study is not confirmatory, but inductively corroborates the feasibility of the framework that provides a way to open the IS black-box through a case analysis. A case study is an in-depth and longitudinal investigation of an event (Yin, 1994). To understand how the existing manual course scheduling system (Foulds and Johnson, 2000; Hinkin and Thompson, 2002) became a barrier for the organization to be agile, a longitudinal observation with an in-depth analysis is necessary. Action research goes beyond the analysis of observation. It is an interventional process to solve a problem (Azhar, Ahmad and Sein, 2010). In this research, the authors were actively involved in the organizational problem of being rigid, partly by the use of a manual scheduling system. Through this involvement, the authors are able not only to observe the existing and changing systems and interact with users and administrative staff, but also to control the project to analyze how newly developed eClasSkeduler is actually related to organizational agility.

CASE ANALYSIS

Management Control and Information Systems was founded in 1991 as one of departments in the Faculty of Business and Economics at Universidad de Chile. This is a public university, the oldest (founded in 1842), and one of the most prestigious in the country. The university's operations are financed by the state in about 14% and each faculty is responsible to finance the remaining 86% through first- and second-mission activities (research and teaching). However, these traditional activities may not suffice. Additional incomes can be generated by third-mission activities (executive education, consulting, sponsored research, and services for private and public institutions) and this stream of incomes allows the departments to subsidize teaching and research and provide an opportunity to contact practitioners.

Until 2002, the DMCIS obtained funds from the Faculty of Business and Economics about M\$180, and needed to raise M\$120 by itself to cover its operational expenses. In the period between 2003 and 2008, the DMCIS had increased the funds twenty five times along with the increase of student enrollments from 200 to 2,700 every year in the Executive Education programs.

The principal mission of the EEU is to develop teaching materials related to economics, information technologies, business, and management control and educate managers and professionals from industry, government, and commerce in Chile. Those managers and professionals were eager to find this kind of educational opportunities in Chile, because not many of the prestigious universities and educational institutes used to offer this type of programs. By offering a wide array of executive programs, DMCIS started to contribute to transfer knowledge to the community, and particularly, to professionals, executives and companies that are interested in the development and update of their employees' skills.

EEU has become an important unit for DMCIS for two principal reasons. The first is that it generates a large amount of financial resources, representing about 70% of the total income of DMCIS to finance a variety of basic and applied research projects including creating new research centers and subsidizing graduate research assistant to study abroad. The second is that it provides opportunities for researchers and students to build a significant network with industry, which is a valuable asset for potential applied research and the visibility of DMCIS in terms of its research and education activities. In addition,

with the resources, DMCIS has been able to build new computer labs, acquire specialized software applications, and cover other operational expenditures such as books purchase, subscriptions of scientific journals, and travel costs for researchers to attend international conferences.

Every year, EEU offers more than 50 courses. The number of students and courses has increased significantly since 2003 (see Figure 1). This sudden environmental change increased the pressure on DMCIS to organize the schedule better in terms of the efficient use of facilities and the effective allocation of instructors, because a person manually planned the scheduling. This manual system eventually made Universidad de Chile a rigid organization in managing information, resources, and facilities for the EEU programs.

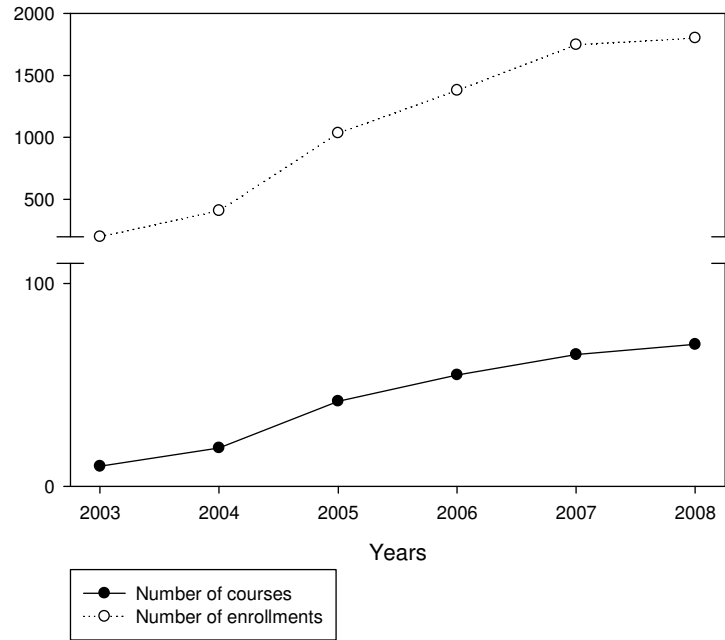


Figure 1: Annual growth in enrollments and number of courses.

It is important to mention that EEU has offered “closed” courses for companies since 2005. The “closed” courses are exclusive programs designed and customized for particular organizations upon their requests. Offering closed courses has brought great opportunities for DMCIS not only to generate financial resources but also to strengthen ties with the major industries in Chile. Through the first hand interactions with practitioners in classes, the department also gains knowledge about the market needs that can be used for the university to develop curricula and research plans more pragmatic. Companies can require these closed courses anytime, which affect the initial schedule of the given academic year and forces DMCIS to reschedule facilities and instructors several times during a year according to incoming requests. Table 1 shows the number of closed courses with the number of enrolled students from year 2005 to 2008.

Year	Number of closed courses	Number of students
2008	25	600
2007	15	280
2006	17	250
2005	2	50

Table 1: Number of closed courses and enrolled students between 2005 and 2008

LOSING ORGANIZATIONAL AGILITY DUE TO THE ENVIRONMENTAL CHANGE

Until the early 2000s, there were small number of courses and students in executive education programs, so the manual scheduling of instructors and facilities worked properly. However, as the programs prospered so quickly, DMCIS faced a complex and challenging situation triggered by several complaints from students and instructors about inefficient service since 2008. They perceived the service quality extremely low, because of the frequent changes and problems related to the scheduling and timetabling of ongoing courses and classrooms. Common problems reported were assigning a classroom with smaller capacity than the actual number of students or too large and expensive classrooms for courses with small number of students, assigning an instructor for two courses at the same time, changing classrooms frequently without proper notices, and assigning computer labs to wrong classes. Those problems were not systematically detected or foreseen. The ad-hoc solutions for the problems were either unfeasible or extremely expensive. For example, to solve the conflict of two courses assigned to the same classroom at the same time, DMCIS had to re-schedule one course, implying that DMCIS must compensate students who could not attend the re-scheduled class. Another solution was leasing a classroom outside the university facilities such as conference rooms in nearby hotels. In this case, DMCIS was changing the location of a classroom without re-scheduling time, incurring in costs as high as 200% of the usual fare. In addition, leasing external classrooms caused other situations to be solved. First, there was an issue with logistics and transportation to move instructors and students to the new location. Second, if the course required a computer lab, the external classroom had to meet the course requirements, and therefore, EEU had to install licenses and software applications. These were all extra costs for DMCIS. Beyond financial cost, the worst damage for the university was that this situation deteriorated the organizational image as an extremely rigid organization that could not cope with this simple environmental change (the increase of enrollment and number of courses) caused by its successful development and implementation of executive education programs.

In order to face these problems, DMCIS realized that it had to be agile to deal with the situation. First, DMCIS assessed its organizational agility with the proposed framework. In the last quarter of 2008, DMCIS assessed the EEU business unit in the five areas of agility, namely, perception, processing, responding, (re)aligning, and fundamental capability (including learning) and concluded as below.

1. **Perception:** A person in the EEU business unit manually collected data about number of courses to be offered, number of students for each course, time slots and instructors availability through e-mail, phone calls, and internal memorandums. Such procedure took on average one week, was unstructured and caused data inconsistencies.

2. **Processing:** The same person who collected, processed all the data for scheduling courses. This person built and used a large matrix to describe courses in size, time slots, and availability of instructors and facilities. The resulting match usually maximized the feasibility of logistics, which is, having a classroom available for each course to be offered. However, the objectives of cost minimization or the avoidance of using classrooms outside the faculty facilities were not included at all. If a problem (e.g. assigning the same classroom for two courses at the same time) was detected or a change was required, the matrix had to be adjusted with new data. This procedure took about seven to ten days; and this action was repeated every time at change was required.

3. **Responding:** The responding function presented several difficulties due to the manual processing. The major problem was matching among time slots, classrooms, the number of enrolled students, and instructors. To respond this problem, DMCIS leased conference rooms from nearby hotels with higher financial costs that brought other issues about transporting students and instructors. This type of response was ad-hoc and pressured to improve on its (re)aligning capability.

4. **(Re)aligning:** Due to the fact that DMCIS responded the issues in ad-hoc manner, the re-alignment of resources resulted ad-hoc as well with a short term vision. The repetition of these situations (e.g. the cancellation of a class and the unmatched capacities between a classroom and the number of enrolled students) would keep requiring the inefficient (re)aligning of organizational resources.

This kind of operational routines did not help DMCIS to develop its fundamental capability to build organizational agility either. The history of solving problems (learning) had resided in the person producing the scheduling matrix. However, the experience was not systematically accumulated, neither analyzed by the person, because this person was also responsible for many other tasks during the entire academic year. Consequently, DMCIS as an organization did not have any agility capability to cope with the changing environment in terms of scheduling courses. In fact, it did not strategically plan and optimize the use of facilities that could generate the competency to provide a great quality service in coordination of courses with minimal costs.

After the assessment, DMCIS recognized that it did not have enough capabilities for all components in the dynamic environment, particularly, responding to changes in the number of students enrollment (e.g. the allocations of classrooms, instructors, etc.). It would be great if DMCIS could gain capabilities in all components at once, so DMCIS evaluated the

possibility to purchase software applications to handle the data and react accordingly, however, there was no software application found to solve the particular business problem that executive education had at a reasonable price. Therefore, DMCIS decided to develop its own information systems to handle the situation. To gain its organizational agility, it researched and defined necessary operational steps. In defining operational steps, DMCIS prioritized the processing component as the first part it should gain capability, because the processing component directly impacted the allocation of classrooms and instructors. Although better perception tended to lead an enhancement in processing, it was more urgent for DMCIS to improve its processing capability even with the given perception so that it could respond quickly and properly to frequent changing needs. Thus, it started to develop and implement an automated computational system, eClasSkeduler, to gain more effective and efficient processing and responding capabilities in scheduling courses.

GAINING ORGANIZATIONAL AGILITY WITH ECLASSKEDULER

The eClasSkeduler system is a decision support system based on mathematical models and has four modules that follow the classification provided by Liang, Lee and Turban (2008). This implies that eClasSkeduler tries to find an optimal solution within a series of constraints and objectives. Therefore, eClasSkeduler allows optimization in scheduling according to the constraints (e.g. numbers of classrooms, instructors, courses, enrolled students, etc.) and the most relevant objectives pursued by EEU such as minimizing classrooms leasing costs, minimizing unused classroom capacity (difference between the nominal capacity of a classroom and the number of students enrolled in a course), and avoiding courses clash in the same classroom. Given the constraints as initial variables and the objectives as economic variables and as parts of a total cost, eClasSkeduler system tries to find a minimum cost as an optimal solution.

Before the implementation of eClasSkeduler, it took on average two weeks to process data for scheduling. DMCIS took sequential steps to generate a timetable as below: 1) the collection of data such as the courses offered, the availability of classrooms, and the number of enrolled students took about a week; 2) the construction of a scheduling matrix and reports took two weeks; 3) the validation and adjustment of the proposed schedule with academic directors added another week.

After implementing eClasSkeduler, the second stage – the construction of a scheduling matrix and reports – takes only 30 minutes, which is a drastic decrease. Reducing the data process time is extremely important, because it makes possible to process data multiple times when DMCIS confronts unforeseen requirements (e.g. sudden requests from companies about closed courses) before the schedule is released. It is worth to mention that real demands (number of enrollments and number of closed courses) are unknown until a couple of weeks before the start of the course. The processing improvement also decreases the time for the validation and adjustment, because DMCIS can run eClasSkeduler many times a day upon directors' requests. The eClasSkeduler allows not only generate a solution quickly, but also analyze multiple scenarios and compare them while differently weighting the constraints and objectives. It means that the improvement of processing component by the eClasSkeduler system helps DMCIS to respond faster and more flexibly even though the perception component has not improved yet, because the eClasSkeduler allows DMCIS to reprocess data whenever it perceives new data.

The improvement of the processing component also reduces the total operating cost of EEU. Especially, it reduces the cost of leasing classrooms outside the university. It illustrates that the improvement of the processing component enhances the (re)aligning function through increasing the efficiency in matching classrooms, courses, and instructors without clashing them, which again leads to cost reduction. EEU has become the most important income source for the department. Although the university is a non-for-profit organization, it is important to secure the necessary financial income. With this income, DMCIS assures its operations in teaching and particularly in basic and applied research.

The cascade effect of the processing improvement on responding and (re)aligning components is validated with below visible evidences. In 2008,

- the 45% reduction of unused capacity in classrooms – with the processing improvement, DMCIS is able to properly allocate enough sized and rightly equipped classrooms to courses;
- over 60% reduction of clashing courses – it also leads the efficiency in (re)aligning, because it allows DMCIS to avoid cancelling courses and to minimize costs in hiring external instructors. Consequently, it makes possible for students to select courses more flexibly and increases its corporate image as an agile organization that appropriately responds and (re)aligns its resource in a timely manner; and
- reductions of leasing conference rooms for classrooms (from 18 to 3 rooms) and computer labs (from 8 to 1) – also leads to decrease the cost of the logistics and transportation caused by leasing external places.

Although DMCIS could not develop IS that increase capabilities for all organizational agility components at once, it selected the most urgent component to gain attainable agile capabilities. With the framework, DMCIS was able to analyze its situation

more precisely and chose the most urgent component to improve. The eClasSkeduler has improved the processing capability of DMCIS radically and accordingly, it has impacted the responding and (re)aligning capabilities as shown above. All these effects have influenced in improving the organizational agility of DMCIS. The organizational agility framework is used not only to prioritize components to improve at the beginning, but also to evaluate the consequences of implementing eClasSkeduler. DMCIS is again assessing its new situation with the framework and find the next component to improve.

The perception component is the next enabler of agility to improve. DMCIS still manually collects data for its perception that takes about a week. It means that DMCIS spends about one week and 30 minutes to generate an initial scheduling even with eClasSkeduler. If DMCIS develops on-line registration for students and companies and links eClasSkeduler with databases describing courses and requirements (e.g. available instructors and classrooms), DMCIS will increase efficiency in collecting data that eventually increases its perception capability.

As the implementation is recent and still “in progress”, it will require time to develop other information systems and to train people to adequately use the system, interpret scheduling reports, and compare them. One of DMCIS’ plans is storing all data that go through eClasSkeduler to build knowledge management system. From this system, DMCIS could mine data and develop simulation tools to forecast future demands so that it can reformulate its curricula and train employees including instructors. All these activities will become parts of its learning capability, because in this way, the knowledge will not be drained away, but captured, formalized, and accumulated. As a result, DMCIS will be able to build its agility further and make itself sitting on a virtuous cyclical procedure for building agility.

DESCRIBING ECLASSKEDULER

The computational application allows a final user to manipulate all the information necessary to generate the scheduling through friendly menu navigation. Specifically, the user can feed the system with information describing the courses, instructors, and classrooms, as well as modify the data loaded. At the same time, the user can change all the parameters associated to the solution of the mathematical model optimizing the scheduling. The eClasSkeduler architecture consists of four main modules, which are represented in Figure 2.

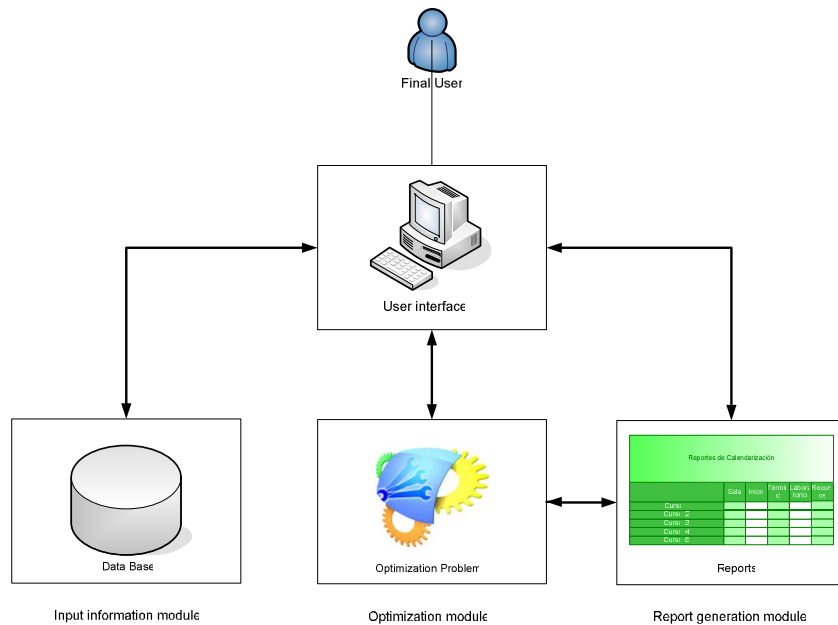


Figure 2: Modular description of eClasSkeduler.

The user interface module is used as control mechanism of the system. From this module, the information entered to the system is transformed according to the requirements and format used by the mathematical optimization model. Through this interface, a user can define and incorporate the weights that represent the importance of achieving each objective pursued by EEU.

The input information module is composed by a database storing all the information characterizing the availabilities of courses, classrooms, and instructors. Each course is defined by its duration in weeks, the earliest and latest feasible weeks, and the estimated number of students to be enrolled. The number of students to be enrolled is forecasted using historical data adjusted by the current registration at the time of the optimization. Figure 3 shows one view of the interface to edit the courses information in the database.

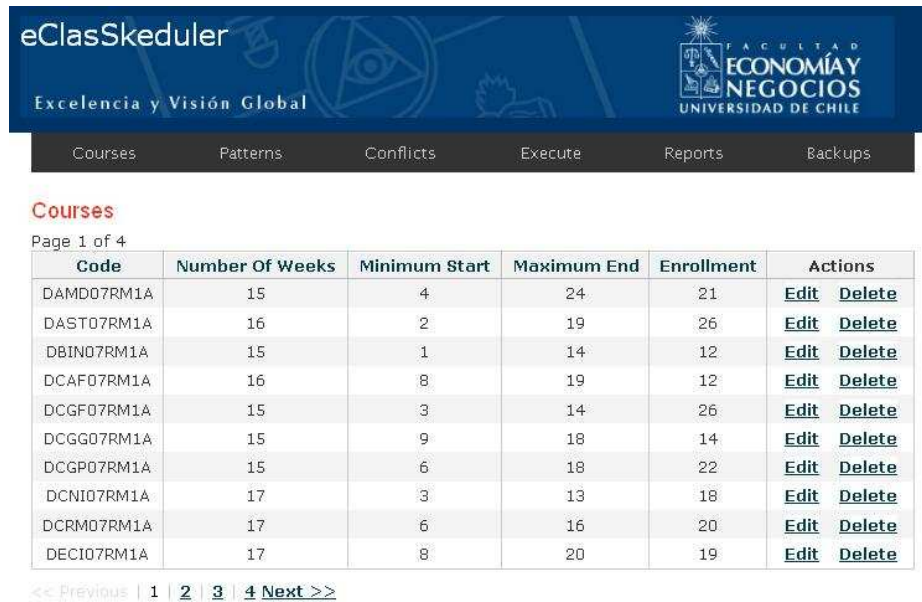


Figure 3: Courses edition interface

The optimization module is a central processing part that incorporates a folder storing the equations and solution instances. It run all input variables (constraints) to provide the most effective and efficient solution to achieve the objectives.

Finally, the reports generation module receives data from the optimization module and summarizes and organizes them in several types of reports. The generated reports include courses scheduling, classrooms assignment, number of weeks, start date, and time pattern assigned to each course (see Figure 4). Additionally, the reports have performance indicators to manage and control resources assignment, for example, the unused capacity for each term, the number of computer labs required, and the number of clashing courses.

Timetables and Classroom Assignments f										
Name	Code	Weeks	Begin	Room	MON	TUE	WED	THU	FRI	SAT
1	Curso Control de Gestión Estratégico	CCGE10RM1A	9	18/06/2010	504					
2	Curso IFRS y sus Impactos en el Management	CIFRS10RM1A	11	14/06/2010	T2005					
3	Auditoría a Mesas de Dinero	DAMD10RM1A	26	11/06/2010	H301					
4	Auditoría de Sistemas y Tic's V1	DAST10RM1A	19	05/04/2010	P205					
5	Contabilidad y Análisis Financiero	DCAF10RM1A	22	03/05/2010	1903					
6	Nuevo Marco de Capital para la Banca, Basilea II	DCBB10RM1A	21	20/09/2010	T2001					
7	Control de Gestión Financiero	DCGF10RM1A	24	22/06/2010	T2005					
8	Control de Gestión Gerencial V1	DCGG10RM1A	34	16/04/2010	606					
9	Control de Gestión Gerencial V2	DCGG10RM2A	34	06/08/2010	401					
10	Control de Gestión para Profesionales V1	DCGP10RM1A	24	23/03/2010	T2002					
11	Control de Gestión para Profesionales V2	DCGP10RM2A	24	14/06/2010	404					
12	Comercio y Negociación Internacional	DCNI10RM1A	34	16/08/2010	504					
13	Estrategia e Implementación CRM	DCRM10RM1A	21	10/08/2010	606					
14	Educación para el Emprendimiento e Innovación	DEEH10RM1A	24	10/09/2010	T2005					
17	Tributación Nacional V1	DETN10RM1A	34	04/05/2010	T2001					
18	Tributación Nacional V2	DETN10RM2A	34	22/09/2010	504					
19	Business Intelligence V1	DGBI10RM1A	24	27/04/2010	402					
20	Business Intelligence V2	DGBI10RM2A	24	13/07/2010	H301					
21	Gestión del Conocimiento	DGCI10RM1A	24	17/08/2010	T2002					
22	Control y Gestión Estratégica de Costos	DGEC10RM1A	24	26/07/2010	403					
23	Gestión de Negocios con TI para Profesionales	DGEP10RM1A	24	21/09/2010	403					
24	Gestión de Inocuidad Alimentaria	DGIA10RM1A	21	03/08/2010	406					
25	Gestión Integrada de Calidad V1	DGIC10RM1A	27	09/04/2010	T2005					
26	Gestión Integrada de Calidad V2	DGIC10RM2A	27	16/07/2010	402					
27	Gestión de Proyectos Informáticos V1	DGPI10RM1A	27	29/03/2010	T2001					
28	Gestión de Proyectos Informáticos V2	DGPI10RM2A	27	14/06/2010	T2002					
29	Gestión de Procesos de Negocios V1	DGPN10RM1A	24	10/05/2010	401					
30	Gestión de Procesos de Negocios V2	DGPN10RM2A	24	13/07/2010	404					
31	Gestión y Planificación Tributaria V1	DGPT10RM1A	34	04/07/2010	T2001					
32	Gestión y Planificación Tributaria V2	DGPT10RM2A	34	23/07/2010	403					
33	Gestión Integral de Riesgos de Negocios	DGRN10RM1A	24	18/05/2010	401					

Figure 4: Report sample from eClasSkeduler.

CONCLUSIONS, LIMITATIONS, AND RECOMMENDATIONS

The decision of DMCIS to improve its processing capability through the eClasSkeduler system has brought multiple benefits. There are immediate and visible gains as listed in the previous sections, and others are not so visible but embedded in building its organizational agility such as efficiencies in processing, responding, (re)aligning, and organizational fundamental capabilities.

The eClasSkeduler system, even as a recently implemented application, allows important improvements in organizational agility, mainly in some operational components described in the organizational agility framework – processing, responding, and (re) alignment. As mentioned, the assessment after the eClasSkeduler implementation reveals areas that need further improvement like perception and learning to gain more organizational agility. However, choosing to develop the eClasSkeduler application worked as a ‘quick win’ in the sense that it greatly impacted on organizational response-time, operational efficiency, and service quality. The successful development and implementation of this initial project, according to the assessment using the *agility framework*, lead to other projects. The following projects are about constructing new software modules to be connected with eClasSkeduler so that the integrated systems can improve perception and learning competencies as well. The last two components of organizational agility are considered more challenging to improve, because several human actors should be involved in these processes. For example, people eventually have to learn, make a decision, and develop business strategies even though the systems help them to collect and analyze data and information. The success of eClasSkeduler in improving the agility of DMCIS implies significant meanings. First, in the research perspective, it illustrates how the *agility framework* can be applicable in assessing and planning for organizational agility. Second, in the practical perspective, DMCIS achieve great socioeconomic benefits using the *agility framework* in identifying the most urgent component to improve its organizational agility.

The in-house development of the application results positively and conveys great potentials; however, it discloses some challenges too. The positive results include enhancing quality service, customer satisfaction, costs efficiency, decision support, organizational learning, and agility. The remaining challenges are further understanding and analyzing the business model of EEU to detect manually running areas that IS can help in an aligned fashion. In an operational perspective, there is still a shortfall in the number of users trained to load data, run the application routinely, and interpret the reports. Having only one trained user will soon meet problems, for example, it may delay responding and (re)aligning resources. There are also technical challenges in developing more software modules and smoothly linking them together. It is easier to operate one independent system than orchestrating multiple systems as one. Therefore, the development and implementation procedures

demand well planned schedules, tests, and governances. Another issue in the future can be about people's technology dependence. If systems are developed and implemented so well, people tend to depend on the systems too much and lose their creativity such as abilities to face and solve problems. To avoid this situation, DMCIS can use the *agility framework* to constantly evaluate its agility with changing environments.

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