Evolution of Collaborative Distance Work at ITESM: Structure and Process[1]

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Summary

Evolution of collaborative distance work at the Monterrey Institute of Technology, ITESM, is discussed and analyzed. ITESM's location, geographic distribution, organizational structure, development strategies and recent expansion throughout the Americas are described. The evolution of the institution's networking capability from a national and intra-institutional network of 26 campuses to a complex array of over a thousand inter-institutional entities of various kinds across the continent is reconstructed. This evolution is reviewed in light of ITESM's pursuit of an aggressive transformation strategy that includes a shift towards distributed and participative teaching as well as a strong outward-looking, international approach.

Success and failure stories are told about the efforts to establish a collaborative work culture and IT literacy. In particular, the paper discusses some relationships between the deployment of an IT platform and change management of core university processes. Some lessons are drawn from ITESM's experience, concluding with the unavoidable challenge the higher education establishment faces worldwide to redefine itself as an instrument designed for the knowledge society.

Keywords

Higher Education, Latin America, asynchronous learning network, distributed learning, distributed collaboration, ITESM

[1] This article does not constitute an official statement of ITESM policies. The views expressed are those of the authors.

INTRODUCTION

Social demands for knowledge are growing in variety and complexity, but not all of these new demands are being met. When demands are met, in most cases this is a result of innovative ways of identifying and delivering information, training, certification, analysis and other knowledge services. As a general trend, these are agile, distributed, customized, high-value services. While alternative systems such as adult education centers, corporate universities and, above all, independent Internet knowledge providers are growing steadily, traditional universities are largely excluding themselves from these developments [1].

From this perspective, three likely university profiles come to mind:

- Those that believe that the university's social role will remain essentially the same as it has been since the advent of the modern age
- New universities which have been designed intentionally as knowledge service providers
- Existing universities undergoing a deliberate, intensive transformation process to respond to the new social demands

The general transformation process of the latter, which is common to all productive entities, is one of *virtualization*. [2]. In general terms, such a process amounts to anticipating and acquiring the value-delivery process capacity that a customer base requires. This flexibility and response time [3] can generally be achieved only through highly distributed, articulate work systems. Coming to terms with process design for distributed work is one of the greatest challenges traditional universities are facing [4]. As The Economist has put it, "managing the core and cloud" is the central issue for the new "knowledge factory" [5].

This paper will review how ITESM has coped with the increasing demands for distributed work over the last few years. In particular, it will analyze the relationship between advances in IT infrastructure deployment and the development of process capacity. While a number of goals have been met, some key issues still need to be studied and resolved. Since these issues appear to be common to this kind of evolution, the authors believe that some insights may be drawn which could be useful to both ITESM and other universities undergoing major transformations or intending to do so.

History and background

Founded in 1943 in Monterrey, Mexico, the Monterrey Institute of Technology, ITESM, has grown into one of the largest private universities in the Americas. With a student enrollment in August 1998 of 80.070 and a faculty of 6.200, it has a presence in 30 campuses throughout Mexico, seven foreign units in Latin America, 1.240 Virtual University receiving sites across the continent and three international high school programs (Canada, the U.S. and Spain). [Figure 1]

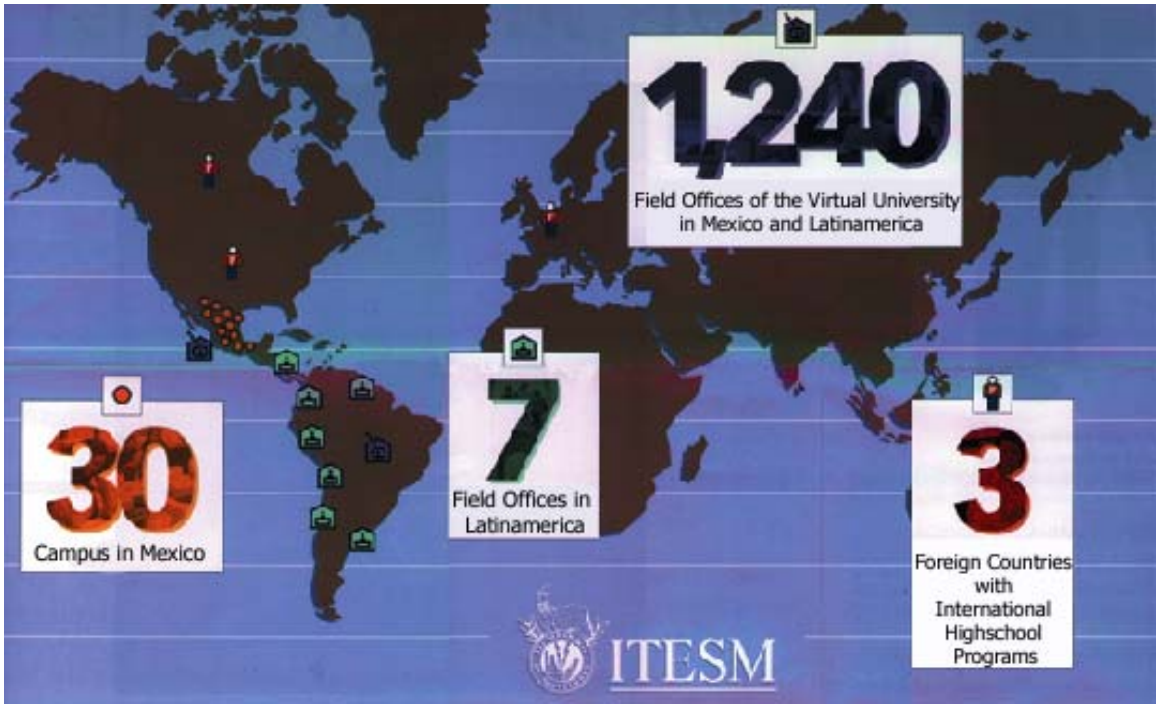

Figure 1. ITESM's international presence

This has given ITESM considerable visibility in the region, particularly through the more than 100.000 students who have graduated since the school was founded. This means that one out of every 1.000 Mexicans is an ITESM graduate, while 40% of the directors of the country's 100 largest companies and 10% of public officials are alumni.

Access to other less traditional educational markets is growing substantially, particularly thanks to the Virtual University. For example, in 1998

- close to 10.000 teachers from 20 Mexican states and 7 Latin American countries took part in a workshop to update teaching skills
- over 32.000 professionals and company employees from Mexico and Latin America were enrolled in the Virtual University's company programs
- more than 1.250 municipal public servants from 25 Mexican states and 3 Latin American countries took part in city management programs.

The rapid growth, broad geographic distribution, increasing variety of educational offerings, and the adoption of new educational models, to cite some of the causes, has placed a tremendous strain on internal response capacities (infrastructure, competencies, administration). In the following sections some of the most important development policies and how they have been implemented both in structure (computing and telecommunications) and in processes (competencies, support systems and change management) will be reviewed.

Description of the growth strategy

The institution is governed by boards made up of business people, sensitive to economic and technological trends. As a result, the boards have a significant influence on ITESM's development strategies. Two of these trends are especially relevant: the emphasis on globalization and the decision to establish a technology base for achieving performance as a continental network.

In 1996, after a broad consultation of institutional stakeholders, a new mission statement emphasizing the following was established [6]:

- Evolution of teaching systems and academic organization towards distributed formats and greater participation by students.
- Intensive use of information and telecommunications technologies
- An outward look, in terms of consulting and extension, as well as internationalization
- Unprecedented geographic expansion, particularly through Virtual University programs

Organizational structure and geographic distribution

ITESM displays a matrix structure [Figure 2]. There is an ITESM System president, who functions as maximum authority of the institution and to whom 7 administrative zone presidents report. Each administrative zone is composed of several campuses, and has an information technology director, an academic director and a finance director.

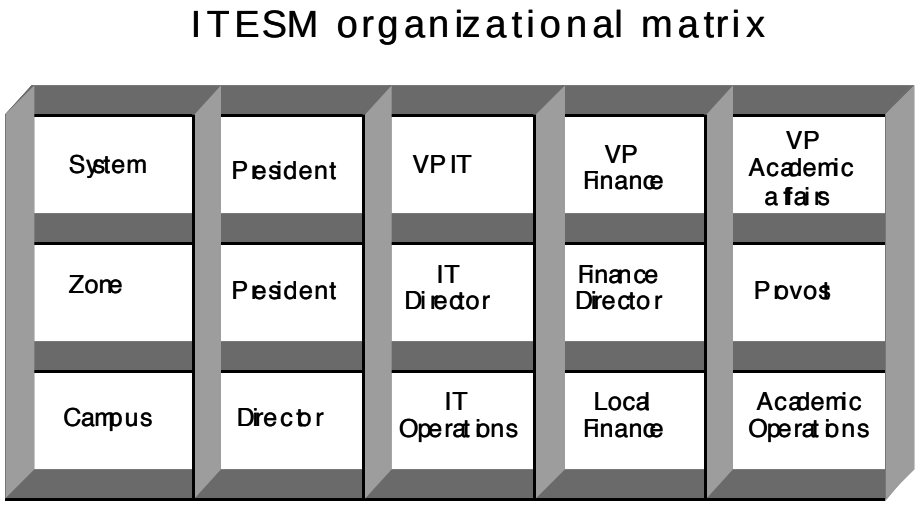

Figure 2. ITESM organizational matrix

Individual campuses reflect the same organization. The campuses are grouped into seven zones: northern, southern, central, Pacific, Monterrey (the original campus and System headquarters), Eugenio Garza Sada (high schools), and Virtual University. This means significant coverage of the greater part of the country, whose surface is similar in size to Western Europe and is characterized by two mountain ranges running from north to south and converging at an isthmus [Figure 3]. Thus, the distance and challenges for overland communication are important factors in organization interaction. A highway trip

from Campus Veracruz to Campus Querétaro, for example, takes about 8 hours of uninterrupted driving.

Figure 3. ITESM's administrative zones

The System has also a team of vice presidents responsible for specific areas such as academic affairs and finance. In 1997 a Vice Presidency for Technology Innovation and Internationalization, VITI, was created for the purpose of coordinating and standardizing efforts in information technology across the System as well as ITESM expansion abroad.

A significant cultural change took place in the operational status quo in this vice presidency's assigned areas of competence. During the years of ITESM's geographic expansion in Mexico, the need to regionalize services gave each campus in the System considerable freedom in choosing work practices, computer systems and even strategies. Recently the decision was made to carry out a System-wide standardization process to avoid dispersed energy and effort.

Implementation of these and other strategies supporting the new mission generated a series of dynamics that have been novel and at times stressful for the institution. The figure below shows the main relationships between key agents in the System.

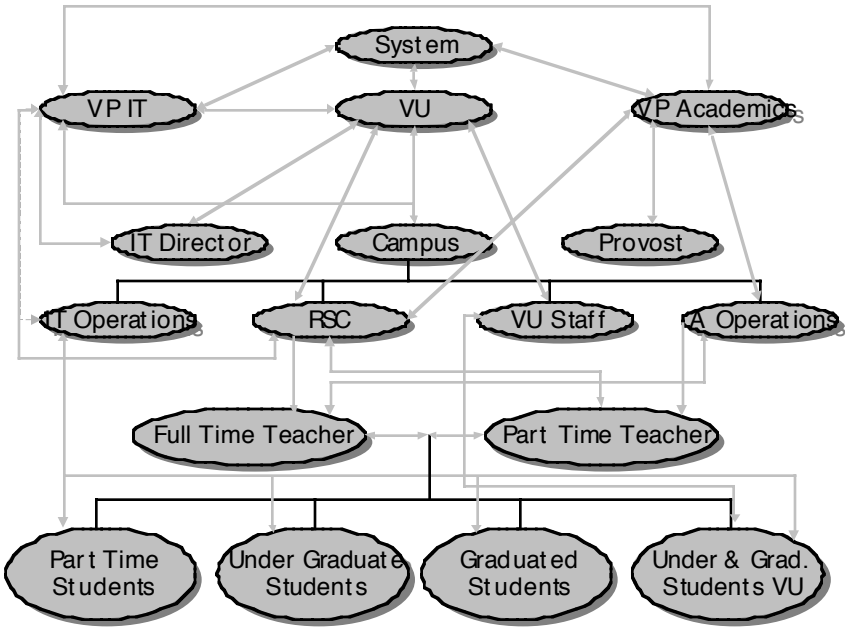

Figure 4. Relationships between key agents at ITESM

The complex organizational structure is characterized by extensive bidirectional information flows that increase the difficulty of establishing an adequate system. This is one of the most important challenges for the organization.

The next figure shows an attempt to discriminate:

1. Structured information flows (continuous lines). Structured means that agents and channels are well identified, and there is a formal procedure for such flow that includes verification and a record for future reference.
2. Unstructured information flows (dotted lines). When the above conditions are not met.

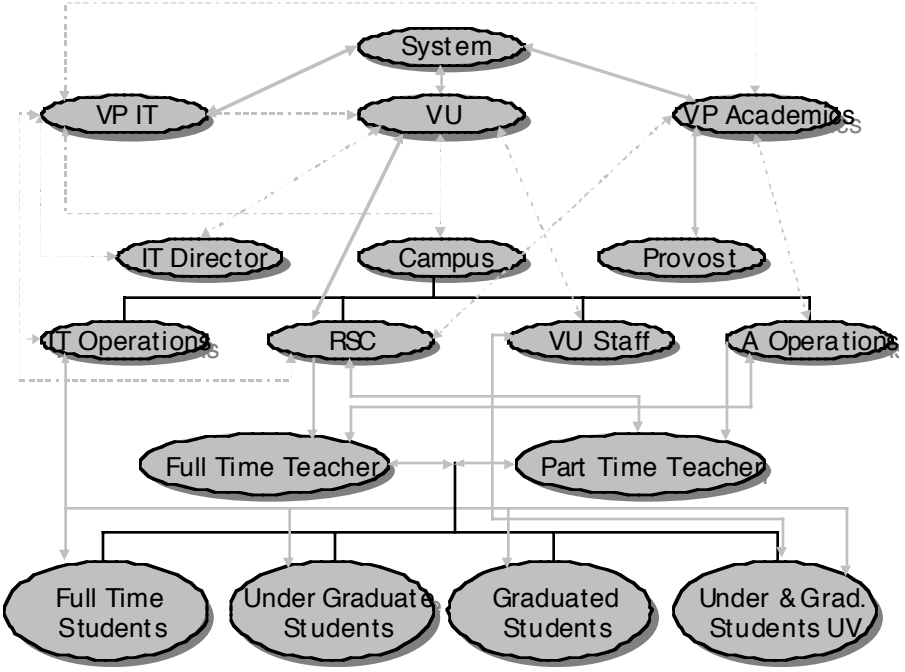

Figure 5. Structured and unstructured information flows

An effort to articulate all relevant information flows at ITESM within a knowledge management framework has not yet occurred.

EVOLUTION OF THE INFRASTRUCTURE

Evolution of ITESM's collaborative distance work systems

As mentioned earlier, ITESM's growth strategy is driven by two major trends: globalization and networking capability. In fact, the new mission has been instrumented largely through the deployment of a distance education and interaction platform. The following table summarizes the evolution of ITESM's connectivity platform.

1986	ITESM establishes connectivity to a U.S. computer network by telephone line. Access to BITNET, using IBM 4381s as servers, is negotiated successfully.
1987	First networks for student use are installed. Communication via satellite is used to help connect campuses by telephone. Connection to the Internet accomplished.
1988-1989	Some network services are made available at the Monterrey Campus. Fiber optic cable is laid. The Interactive Satellite Education System starts its first transmissions.
1990-1991	More UNIX equipment is acquired and there is an increase in the capacity of the link to the Internet. ITESM is the main RTN (National Technological Network) node. The first IBM RS/6000s arrive. Intercampus links are, the main link being the one connecting the Monterrey and State of Mexico campuses. IRC, News and Gopher

	services become available.
1991-1994	The first www server in the System begins to operate. To improve service at the Interactive Satellite Education System (the Virtual University's forerunner), a NeXT-based network is implemented in the ITESM System, using an intranet to provide news, e-mail, gopher, ftp, etc.
1996	The first Lotus Notes licenses are acquired to experiment with the product and become familiar with groupware concepts. Work is begun on the development of the ITESM System's videoconference network.
1997-1998	A significant investment in infrastructure is approved. With these funds, personal computers for more faculty, central servers for information management, and software suitable for redesigning the teaching learning process (for example, development of group work skills) can be acquired. This infrastructure is deployed in about two months and includes the growth of dedicated links between campuses, installation of 3,000 network gates for laptop connectivity, and development of arrangements for students to finance acquisition of laptops and distribution of 18,000 laptops. In addition, 60 high performance computer servers are acquired and all the services are set up.

Table 1. Milestones in ITESM's networking capability
Source: IT Office, Monterrey Campus

Over the years ITESM has emphasized the extensive internal use of IT. The institution has been a pioneer in Latin America in such technologies as data and video networks, connectivity through international data networks, data interconnection services via satellite and delivery of digital video via satellite. It is currently participating in the Internet2 effort. (See Table 1)

Until 1993 users did not see IT as friendly and they had good reasons for it. Commands were generally based on text and had to be memorized. For example, to see comments within a discussion group in text mode a user had to type *nn itesm.mty.grupo-de-discusion* without making a mistake. Key sequences (CTRL+K+E, for example) had to be used to perform actions that are done now with mouse clicks on buttons identified visually in menus. In addition, as commands and functions are named in English, many of these made little sense to Spanish speakers.

In spite of these inconveniences, IT literacy and a basic set of distance interaction competencies have been developed in most areas at the Institute. UseNet, for example, handled hundreds of thousands of users interacting and working together aroundt the world. Nevertheless, a culture of collaborative work making the most of existing IT platforms has yet to evolve.

Although a great deal of effort has been invested, getting people to work together using tools to facilitate information generation, storage, retrieval and management has still not met with success. The work culture may be a contributing factor [7]. Participants usually have heavy workloads and, as a result, are unable to establish an ongoing commitment. Frequently one person is involved in several concurrent tasks, which decreases the quantity and quality of his or her interactions. It is hard to rely on the use of non-intrusive media like bulletin boards or UseNet News, where the responsibility for making a contribution lies wholly with the user.

In the past -and this is still true although to a lesser degree- IT deployment has been driven neither by demand nor by awareness of its potential. For example, the *Coordinator* was used more as e-mail than as a tool for workflow, even though it had groupware features for establishing commitments, following up on assignments, etc.

A collective time management culture (shared agendas, etc.) has barely begun to emerge. Many users try to use electronic calendars and agendas for a while but then drop their attempts when they discover that other team members or collaborators are not using these tools. By using shared calendars, for instance, higher levels of collaboration could be reached, but so far this has happened extensively only through a hierarchical deployment; that is, if an area director is fully convinced of the benefits of a given resource, decides to incorporate it in daily work routines and begins to use it him or herself.

In the last three years, however, it has not been possible to resolve the problems and demands of academics and directors with the technology available at ITESM. Although some progress has been made, there are still lags in services.

Several resources for collaboration have been tried: e-mail, mail distribution lists, discussion groups, video conferencing, chat groups, databases for *Notes* discussion, etc. The most successful services have been those that intrude into a commonly used space like e-mail and mail distribution lists. Services that leave the responsibility of looking for information to the recipient have not yet worked satisfactorily. The main constraint seems to be the lack of a culture based on teamwork, collaboration and time management [8].

The academic environment, especially the Virtual University, has made the use of distance discussion and teamwork almost compulsory, since academic performance relies heavily on using them effectively. For students, getting a passing grade may depend on how they develop these skills. However, another key factor leading to successful use is the instructor and how he or she follows up on and manages learning. In this respect, IT resources, though important, take second place. There have been successful cases of teams and groups of students of varying sizes using a variety of interacting tools*: UseNet News, chat rooms, Hyper News, Learning Space course rooms, video conferencing,* etc. Faculty demand for services and arrangements that facilitate their academic duties cannot be met because widely used commercial products truly meeting their needs are not yet available

Current Network Configuration and Prospects for the Future

For ITESM a major challenge at present is to come to terms with the rate of growth and globalization. Establishing field offices in major cities throughout Latin America as well as maintaining the existing base of around 13,000 Virtual University receiving sites in the continent poses even larger problems than managing the 27 campuses in Mexico.

Figure 6. Distribution of field offices in Latin America

The current ITESM infrastructure, though still far from the level found in the European Union as a whole, may sustain the foundations for true collaborative work as it develops, if properly managed. This is especially relevant when the current level of investment is taken into account.

Indiscriminant handling of video or audio could create bottlenecks in network traffic. However, testing, trials and even pilot projects can be carried out if controls are applied. This constraint will force ITESM to make better use of its resources in all regards and become used to thinking in terms of optimizing current potential.

Nevertheless, ITESM still has a lead in the region, as it is taking part in the effort to develop telecommunications in Mexico and Latin America, e.g. implementation of Internet2, improvement of how satellite technology is used to reach places with interconnectivity problems, etc. ITESM can use its influence and experience, jointly with other institutions, to move Mexico ahead and improve the country's infrastructure considerably. Figure 7 shows current computing and telecommunications network configuration.

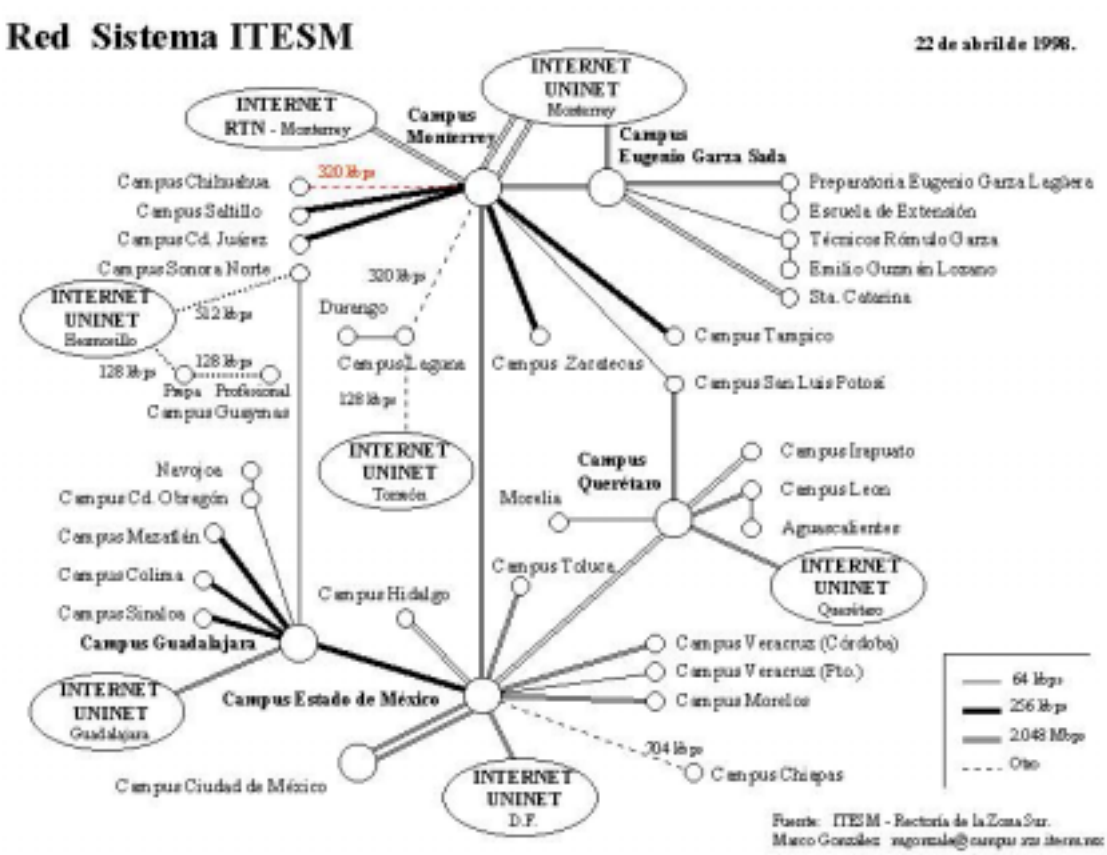

Figure 7. ITESM's network topology

As mentioned previously, ITESM is supported by a board of trustees composed of business people from the region. Through a recent change, the presidency was assumed by an aggressive businessman with strong ideas about globalization and expansion. The effects of this change in leadership are beginning to appear very rapidly throughout the organization.

EVOLUTION OF PRACTICES

Distance collaborative work circumstances and policies

During ITESM's expansion in Mexico in the 70s and 80s, each campus was given certain autonomy in recognition of the different needs in each region of the country. In 1997 ITESM's strategy called for including distributed processes designed in such a way that to achieve successful completion, each organizational entity had to carry out part of the process. To meet this need standardization was started mainly in two areas: academic affairs and information technology services. Standardization was led by the vice presidents for academic affairs and technological innovation.

ITESM's organizational structure was reconfigured to carry out tasks of this kind. Each vice president coordinates the work of a group of directors associated with the area for which he is responsible. For a better understanding of the process it is important to emphasize two implicit subprocesses. Each vice presidency coordinates the efforts of a group of regional directors and is supported by a variety of specialized directors in each area mentioned above. Thus, decisions are made by a group with common interests. Each director, in turn, is responsible for the following activities:

- Leading zone efforts in achieving common goals
- Negotiating a budget with the region's president and managing it for goal achievement
- Coordinating a staff that provides support to all campuses within the zone, in order to maximize scarce resource availability.

A need for systemic vision

In view of the tradition of independence at each campus and the challenge to be self-sufficient that some campuses must meet to survive, achieving a systemic vision at the campuses has been highly complex and costly. At present, ITESM is confronted with the need to work in a structured, integrated way to arrive at a synergy that will carry the institution to a common future. This process has sought to exchange the status quo of campus individuality for group work, which, by its very nature, has touched sensitive nerves and power centers, causing both resistance to change and errors along the way. However, the strong momentum of the process itself and determined leadership have served to smooth rough edges and make progress possible in a very short period of time.

Even though the organizational structure was defined from conception to support distributed processes, for a considerable period of time lack of actual collaborative processes and contingencies led to several deficiencies at the operational level, e.g., multiple agents with the same functions, unstructured information flows, obsolete policies and procedures, etc. Given such cultural and procedural constraints, current change has been pushed from the highest levels of the organization by bringing the different actors into the process, persuading and prodding them with economic and other kinds of incentives, and gaining their commitment in the near future. The urge to bring about change quickly has sustained the willingness to accept the risks and mishaps that might arise.

The internationalization strategy adds another element to the formula, owing to the introduction of new components to the organizational structure. This factor is complex, given the clash of different cultures in search of synergy. ITESM's expansion in Latin America brought new human resources into play who had little time to internalize ITESM's organizational culture into their different local work paradigms. In addition, a number of other variables, such as interconnection problems in data networks, infrastructure costs, legal aspects, and competence, added to the complexity of the situation.

The operation and administration of a distributed model is hard to achieve, especially when experience is limited. This has placed ITESM in a dilemma. On the one hand, it is trying to become a more participative institution while on the other, there is a need for high-level decisions that are often not easily accepted throughout the organization.

The Structure/Process Connection

It is easy to confuse the IT platform with what the organization is really looking for, namely, an improvement in the process through collaboration, teamwork and time management. This is true especially if users find IT an unfamiliar, difficult element to handle because it requires them to learn new concepts and how to use new tools. As a result the central concerns of improvement, redefinition and redesign of core university processes have been overshadowed by the focus on the effort to learn how to use the software and hardware.

In the initial phase of implementation of current strategies, two things happened that merit analysis. First, the IT platform became the most visible part of the change process. As a result, the essence of the process was often overlooked and confused with the medium; that is, there was a time when the community perceived that using IT was an end in itself. The high-sounding term *plataforma tecnológica* (technology platform) became the catchword. This reaction diverted organizational efforts for about six months until the problem was acknowledged and dealt with.

Secondly, as change gathered momentum the old way of working was seriously undermined and this caused two kinds of strong resentment. Some faculty members were able to adapt to change remarkably well. Incorporating IT into their daily operations was easy for them. For some others, this was not the case. In fact, it has been hard for them to adapt to the new paradigm, especially in their teaching duties. Change is difficult for teachers who have been teaching, without variation, the same courses for several years. This tension led, in some cases, to a distortion in the perception of the clients (the students); i.e. a good teacher is one who knows how to use the technology and is not afraid of it.

Distributed Services Management

In spite of some significant successes in academic courses, it has become clear that the process is not simple and that persuasion is not always accomplished through example. A case in point is distributed services management, a trend that, in view of how ITESM is organized, is taking root. Initial efforts centered on getting people to use *Learning Space* (the chosen *platform technological*) properly. The decision was made to create a distributed, hierarchical form of management.

Responsibilities were established at all levels: the System (through VITI) the zone administrations (information technology divisions) and the campuses (information technology divisions), which, in addition to technical operations, had to handle training, and student services. At each campus these tasks have been carried out differently. The objective has been to have contingency plans and provide easy access to services for every student in the ITESM System. This point has not been reached yet. There is still a long way to go.

Evolution of Consulting and Extension Capacity

Extension is another area that has been significantly affected by distance collaboration. Although this activity is still proportionally marginal, the volume and strategic impact are on the rise. An increasing number of faculty members are becoming involved in innovation, consulting and extension across the expanding continental territory in which ITESM has a presence. This sets new challenges for the traditional centralization of academic work: coordination of schedules, exchange of documents, long distance communication, project management and, above all, a new entrepreneurial and innovative spirit [4] [5].

Some of the R&D units with a more aggressive, innovative profile have intentionally taken on these challenges. This means platforms for collaboration as well as designs for more flexible, agile work processes, focused on the identification and return of added value, must be created. Since 1997, some initiatives have been moving systematically in this direction**.**

Training

From different quarters there has also been a parallel effort, mainly through training, to convince people of the merits of the new teaching approach, enhance their competency base and demonstrate the short-term benefits. Training has been aiming at two complementary targets: one focusing on conceptual and motivational issues and the other on technical proficiency. In like fashion, two large groups have been involved: faculty and administrative personnel.

Both conceptual and technical training have been administered by the VP for academic affairs. This initiative became a demanding and at times overwhelming training and certification process that is now a must for faculty advancement and has had an irreversible impact upon the whole community. The whole training program takes 460 hours to complete. Of these, 400 involve conceptual and motivational components and the remaining 60, technical skills.

On the technical side, mistakes have been stemming from erroneous assumptions about a general competency base. The training program was developed with the idea that everyone was literate in such basic terms and operands as *Internet, modem, hard disk, server*, etc. In fact, in many cases it was necessary to start training from scratch. Also, several hardware and software supplies were assembled and set into operation under an extremely tight schedule. As a consequence, the response capacity of the supporting platform was often insufficient to deal with the demands of both faculty and students.

On the conceptual side, training was meant to be informative, formative and persuasive. In practice, many faculty members engaged rather reluctantly in the program and have

come to terms with the initiative in many alternative ways. Perhaps the most important lessons here were the lack of a distinctive, coherent model of educational practice, failures of consistency in implementation and the poor attention given to faculty participative engagement. In fact, the very approach to handling faculty with a strong directive posture seemed contradictory to the educational participative approach that the strategy aimed at implementing. The costs of these mistakes are now apparent and more open-mindedness towards faculty participation is beginning to be displayed. Recognition of the fact that a genuine student-centered educational approach requires an overall self-management approach permeating the whole institution is beginning to emerge.

Work has also been done with collaborative or groupware tools to support the change process, enrich ideas and transmit information. These tools are beginning to be adopted naturally by some of the most innovative units.

Cultural changes

Instead of concentrating on providing services for certain specialized organizational areas, ITESM intends to make IT resources available to virtually all students, faculty and administrative personnel. The greater part of the IT budget is invested in resources for general use in an attempt to provide everyone with the updated services. Before Internet reached its current popularity worldwide, ITESM students were using it extensively. In spite of this technology deployment, and a significant lead over other institutions in the use of IT across university activities, the ITESM community is far from being techno-literate. In some organizational areas IT integration is still limited but this is changing rapidly. Currently, almost all courses make intensive use of IT for asynchronous learning tasks, communication and resource sharing.

The lack of IT culture is creating a boundary within the organization and is sometimes becoming an obstacle in itself. The problem of IT literacy and collaborative culture is becoming ever more complex as geographic expansion unfolds. Mass IT deployment is uneven in terms of infrastructure and competency support in places where ITESM now has a presence. The Virtual University's educational programs, for example, have an important byproduct: students come in contact with and are required to use IT tools as they meet the academic demands of courses. This increases the pressure on both faculty and students, especially when there are breakdowns in the supporting platform.

Change Management

Rather than following deliberate change management tactics, transformation has been led by the urge to respond to three mandatory strategic goals:

1. Redesign of the teaching learning process
2. Extensive use of IT
3. A global, systemic institutional vision

However, administrative and procedural structures did not change at the same pace and as a result, the institution has a fairly advanced networking infrastructure but an administrative apparatus and work culture that has lagged behind and is hard put to support these models. Some of the most evident lessons learned during the ongoing transformation are described below.

1. Often the way IT is used or the results of using it will reflect the strength or weakness of the processes, through the implementation of the tools chosen to support or automate such processes [9].

2. It is deceptive to believe that the successful results other institutions have had with a particular IT platform derive from IT itself rather than from a well developed culture and good process design [10]. There is a pervasive view that *plataforma tecnológica* is what technology and knowledge innovation is about. Technology is the logic of production, hence involves all production factors. If IT is introduced to support or create an ill-defined process, the organization will end up having to adapt to the tool instead of vice versa.

3. The cost of opportunity, especially in a highly competitive, fast-changing global society, affects the kind of decisions to be made. Early arrival seems to be a good reason for taking the risk of adopting innovative processes and the relevant technology platforms. A fast advance in implementing brand new processes and approaches is worth the pain and struggle of change, provided a fresh, self-critical approach capitalizes on both achievements and failures.

4. The need for a systemic vision of these complex change initiatives is fundamental for articulating an IT platform that supports both processes and change management [11]. In order to achieve that, a profound examination of how the established value scheme is challenged is a primal consideration.

The depth and complexity of the transformation processes that established universities are bound to experience, as they try to redefine their social role in response to the demands of knowledge societies, lead us to some final conclusions. These emerge from a deep conviction that universities might be in a position to help societies articulate their value base in knowledge societies, provided they do so in the first place [12]. Thus, a generic higher education development strategy may need to consider the following:

1. The fact that even if a university must necessarily deal with the challenges of extensively integrating IT capabilities, the point of departure must still be the value base and process capacities under which the institution understands its social function.

2. The warning that a university that does not adopt its own strategy - whatever it may be - to face the identity challenges a knowledge economy poses for the existing knowledge establishment will do so at the expense of survival.

3. The promise that by going through a genuine virtualization process, universities can reinvent themselves as an agile core of knowledge management processes capable of leveraging planetary consciousness.

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