

## CHAPTER 4

# DEVELOPING AN INFRASTRUCTURE FOR ONLINE LEARNING

Alan Davis  
Athabasca University

### Introduction

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In 1995, distance learners at Athabasca University (AU) were surveyed about their access to and use of computers in their learning. About 25% of those surveyed responded to the effect that they had access to a computer and to the Internet. Interested staff members considered this proportion high enough to push ahead with all sorts of computer-based learning initiatives. By 2002, the number of students with access to the World Wide Web had grown to 93%, and the pioneers were smugly standing by watching their colleagues reinvent “the online learning wheel” (Athabasca University, 2002a). It was planned that, by 2003, as a result of the implementation of an e-learning plan, AU would officially be an “online” institution (Athabasca University, 2002b). As is the case with many other institutions and organizations, much has changed in a very short time.

Online learning is now becoming ubiquitous at all levels of education, in all institutions of learning, and in the workplace. Distance education has been at the vanguard of these developments, but campus-based students are also mixing and matching their classroom and online learning in all sorts of often unanticipated ways.

Building the infrastructure for online learning requires that many factors be considered, so it is difficult to provide a straightforward checklist or recipe to follow. All educational endeavors are systems, made up of various interconnected components. In traditional universities and colleges, teachers can be unaware of all the complexities involved, but in distance education, understanding how the entire system of course development and delivery occurs,



and how these systems link to services and other components are vital aspects of ensuring effectiveness and quality.

Scientists often classify systems as “ideal” versus “non-ideal” (more commonly understood as “real”). If we apply this concept here, we can define the ideal, and then look at the deviations from ideality that manifest themselves in the real (Lu, 2002).

The *ideal* online learning and teaching system is one that is developed from scratch, without restriction on costs and staffing, and uninhibited by resistance to change from previous practices. A *real* system, however, is one where any or all of the following deviations from the ideal occur: limited resources, legacy systems that have loyal advocates, key staff who must be retrained, unworkable policies and practices that you never knew existed, inadequate governance processes, administrative systems that might or might not be made to work with the new systems, etc. Furthermore, after these deviations from the ideal are factored in, curricula, online learning technologies and approaches evolve all the time, and therefore any real system must also be able to change constantly.

In this paper, therefore, the key aspects of an ideal online learning infrastructure are described and then adjusted for real situations, and some ideas are presented on how subsequent and inevitable change can be managed.

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## Basic Thinking

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Any system is built in a context, and for any online learning endeavor, each discipline, department, faculty, institution, or company will have a mandate, a mission, specific goals, and values that have to be considered when planning and designing an ideal system. For a real system, even at this conceptual level, there will be many other internal and external environmental factors, such as competing priorities, budget constraints, professional group requirements, and so on. All of these factors must be well understood and accounted for at the outset.

All teaching and learning systems should be built on two foundations: the *needs of the intended students*, and the *learning outcomes of the course or program* (i.e., the knowledge, skills, and attributes that students want). An ideal online learning system will

be based on a plan that flows from a full understanding of these two fundamentals.

An understanding of the technological background of the intended students is crucial, including their expectations, their financial and other resources, their access to the Web or other online networks, their bandwidth limitations, and any other pertinent information about their preparedness and ability to participate equally and fully in the learning experience. In reality, of course, such a complete picture is rarely available, and a judgment call must be made on how much the system employs technologies that we know the students are familiar with and have access to, versus those that are new and unfamiliar, but are expected to become widely available. A good example is the extent to which distance students have access to high-speed connectivity. Since this access is expanding, an organization might choose to use a system that requires high bandwidth, and to provide alternative access to the online learning components (e.g., by CD-ROM) to the declining number not yet served by high speed systems. Considerations of student demographics and other factors would, of course, affect the timing of such a decision.

The clear identification of the learning outcomes of a course, a program, or a training event of any kind is useful in many ways: in the design of a learning assessment system, in determining the degree of prior learning considered necessary, and in measuring the quality of the offering. In applied and professional fields, describing the intent of the educational experience in terms of the knowledge, skills, and attributes expected of a successful completer is fairly routine, and a curriculum and associated teaching and learning system can be devised and cross-referenced with those ends clearly in mind.

In academic fields (the “real” world in this context), such outcomes are not often so well or explicitly stated. For example, all programs claim to develop critical thinking skills, but few define those skills, identify what taxonomy is used to determine the extent of their achievement, or discuss exactly how the content and program design link to them. If the ability to work in groups is an outcome, or the ability to undertake independent research from a wide range of resources, or the ability to make critical analyses of case studies, then these goals will drive the design and functionality of the online learning system needed to deliver that curriculum.

Having comprehensive and clearly stated learning outcomes, and a curriculum and associated teaching approaches that are designed to meet these outcomes, makes the task of building the ideal online learning system much easier. If well-expressed learning outcomes are not available, at least some understanding of, and linking with, good principles of teaching and learning should be in place (Chickering & Ehrmann, 1996).

Closely related to these two foundations (intended students and learning outcomes) is the size and scalability of the online learning system. Whether the program is to be delivered to a well-defined and selected cohort of students once a year, or is to be made available to all comers (as driven by mandate or a business plan predicated on growth) will have a strong impact on how the system is designed.

The real situation, of course, is much less rational. Online learning initiatives often spring from the experimentation of an individual educator or a small group of educators and technologists who sometimes have no clear idea of what benefit (if any) the experiment will bring to the learning experience, but who are well intentioned nonetheless. The addition of a new functionality, new content, or a new tool sometimes does not add value and is ignored by students, but in other cases, a simple enhancement can reap great educational and other rewards for all concerned, and sometimes in unanticipated ways. The degree to which an organization (department, faculty, company, or institution) wants to foster and allow experimentation, versus keeping tight control over a single online learning system, will be driven by its mission, mandate, core values, and financial resources. There are interesting case studies of how institutions have adopted various strategies, intentionally or not, along this centralization/decentralization spectrum [see *International Review of Research in Open and Distance Learning*, 1(2) (2001)]. The decision is a very important one, however, because it will determine how the online learning system is to be designed, developed, resourced, and governed.

Even where the student market is well understood and learning outcomes are clearly defined or prescribed, the implementation of online learning often involves a good deal of trial and error. With the best information and intentions, the results and experience rarely meet expectations, and thus the ability to adapt and refine the online learning system is crucial.

## Overall Structure and Organization

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The ideal case is based upon a good understanding of an institution or company's core business and values, of the nature of the intended student market, and of the needs of the curriculum. This understanding is expressed through the learning outcomes of the program to be developed and delivered. On this basis, an overall online learning framework can be developed. This framework will show the organization of the various components of the proposed system, and will facilitate the development of a fairly complete business plan for the endeavor. Figure 4-1 and the subsequent discussion describe one such framework for a post-secondary institution.

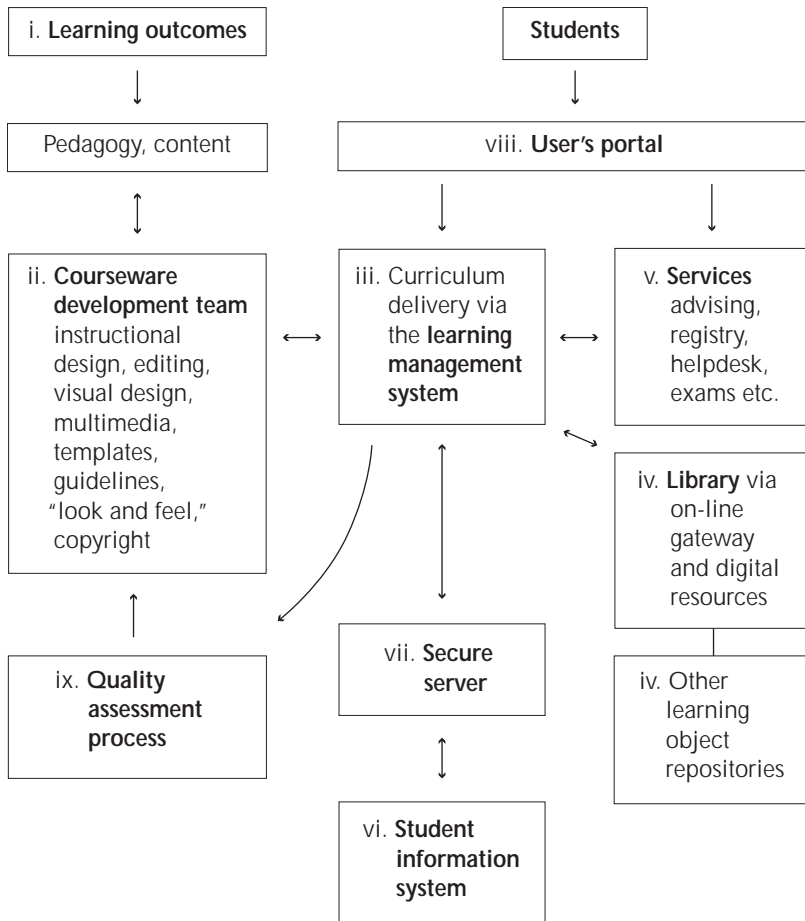
Ideally, the learning outcomes (i) are translated into course content, resources and an approach to the teaching and learning process that will enable a student to achieve those outcomes. Once these basic parameters have been thought through, the courseware development team (ii) will share the responsibility of translating the theory and intentions into courseware and online learning functions to be delivered by the learning management system (LMS) (iii), which interfaces with the library and other digital resources (iv), related services (v), and the student information system (SIS) (vi) through a secure server (vii) that can authenticate the student login.

From the students' point of view, they will connect to the LMS and the related services through a user-friendly users' portal (viii), so that, with a single login, they can have access to their courses and can be linked to all related resources and services.

Finally, to ensure ongoing improvement, an evaluation process for the effectiveness of the system, based on achievement of the learning outcomes and students' feedback is in place, in the form of an independent quality assessment process (ix), which also feeds back into the development cycle.

Aspects of the online learning infrastructure are discussed below; however, to conclude this section on overall organization, the general relationships, particularly among the units responsible for information technology support, should be considered.

Paul (1990) raised a number of important issues about the incorporation of technology into learning systems, many of which



**Figure 4-1.**  
An online learning system framework.

we still grapple with. Two in particular are intertwined and are pertinent here.

The first is the relationship between academic and administrative computing, that is, whether or not these two information technology functions should be connected, and in either case, how they can interface with each other. This relationship is a significant aspect of the centralization/decentralization issue. Although the normal structure is to have the functions separated, and often reporting through different executive officers, the online learning staff and systems need a lot of support and maintenance from the central administrative computing unit, as do key service areas, such

as student registration, the library, and other learning resources.

The second and related issue is that of centralization versus decentralization of control. Normally, the administrative computing units prefer a more centralized system to avoid duplication, ensure security, and minimize the divergence of approaches and the subsequent complexity of support. Those involved in the design and delivery of educational programming prefer a more decentralized approach, with more freedom to innovate and to choose platforms and applications that suit their specific needs and preferences. Of even greater possible political consequence is the deep desire for academic values and needs to have priority over those of the central administrative unit.

In an ideal case, it should not matter how such units are organized or linked, because the overall goals and values of the institution or company would govern people's behavior and attitudes, and everyone would accommodate each other's needs, responsibilities, and functions. In the real world of online learning, conflicting priorities and approaches quickly arise, and clear statements of roles and responsibilities, processes, and policies must be established to help balance the relative need for control/centralization and freedom/decentralization.

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## The Components of an Online Learning System

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### The Development of Courseware

Even in the initial stages of thinking about the development of an online learning program, it is wise to involve all those who are likely to be involved at any stage. To foster such involvement, the sponsors of the program can prepare a preliminary proposal laying out the objectives of the program, the intended student market, and the proposed online learning approach. This strategy gives the service units a chance to comment on matters that will affect them, and for fellow educators to comment on the proposed content and pedagogy. The proposal should also identify the composition of the development and delivery teams that will be established to undertake the project. The nature of these teams can vary widely.

The smallest “team” would be a single person, the content expert, who is also the educator, and who is also well trained to use a comprehensive Web learning platform that is already fully supported by the institution or company. This individual would just need routine support from areas such as copyright and the library. A complex team, however, involves a project manager as well as content experts, educators, instructional designers, editors, visual designers, multimedia designers, programmers, systems staff, etc., who undertake the design of a course that needs new online learning functions, connects uniquely to the other systems, and involves the creation of new multimedia digital learning objects. In either case, the preliminary proposal must provide sufficient information for all concerned to understand what their probable roles and responsibilities will be, and what direct and indirect costs are involved.

For those familiar with formal project management processes and techniques, this detailed discussion of the proposal and the project team will seem redundant, but it is surprising, in academe especially, how little attention is paid to this process. Much of it is just common sense, common courtesy, and good planning. However, depending on the size and scope of the task, some basic understanding and application of the principles of project management are also needed for online learning courseware development. The roles of team members can vary widely, but the types of positions, and the general roles they play in the team, are described further in Chapter 7 of this volume.

## The Learning Management System

Another key decision to be made at the development phase is the choice of LMS. The first question to be considered in this decision is whether to use imported proprietary software or to develop an in-house system, which may or may not also be based on freely available, imported open-source software.

Many very good and comprehensive proprietary packages are available; some come as an add-on to the SIS, and others can be interfaced with the system. Staff can be oriented to and updated on the software’s development and functionality at training events, conferences, and meetings. Assessing which of the available



proprietary options is the best fit for the needs of a particular online learning system can be an onerous task, and choices must be carefully considered, and are often made with the help of an independent evaluation source (see, for example, Edutools, 2001).

For the in-house system, many free, open-source solutions are available, which can emulate the functionality of the proprietary systems, and can be adapted in any manner needed. This approach, however, might require more initial development and different skill sets among staff to ensure the robustness of the system, to provide a higher level of on-going technical support, to prepare documentation and training, and to interface with other systems as necessary.

In the ideal case, the choice of LMS is based on the needs of the course, without consideration of costs, the availability of qualified staff, or any requirement to use existing systems. The real case, however, is often more complicated: either one is constrained to a single solution based on previous institutional or company decisions (which some would think of as ideal), or the choice is limited (as it should be) by practicalities such as the costs of adopting yet another proprietary LMS, or the human resource and other implications of building or adapting an open-source LMS. Each new solution adds considerable pressure on back-end systems, especially services such as the technical helpdesk, and the need to adapt to a new LMS can have a negative impact on a student's learning experience. Finally, there is a lock-in factor: the costs of changing systems can be very high, and, although much effort is being made to develop standards for online learning that will improve interoperability and reusability of online content, the promise has not yet been met.

## Library and Digital Resources

Linking the course or program LMS to the necessary online resources is a key element of any online system. Institutional and public libraries have been leaders in the development of systems and protocols to acquire and share resources. Many now have electronic gateways to their own holdings, to those housed elsewhere, to digital databases of journals, magazines, and government publications (including much in the way of full-text

materials), and to specially developed supplementary databases of materials selected for a particular course. In addition, learning objects will be increasingly accessible through in-house and external digital repositories.

These components are discussed in greater detail in Chapter 14, but the key point in developing the infrastructure for online learning is that the availability of such online resources should be ensured, or at least anticipated, so that the courseware is developed accordingly, the LMS is appropriately configured, and any access that the student may require is enabled.

## Learner Services

In online learning, most attention is always paid to the courseware and delivery platform. However, those who have worked in various forms of distributed learning for any length of time know only too well the vital importance of the non-academic learner supports that are needed to ensure student success and satisfaction. Depending on the enterprise involved, such supports would include technical help, educational advising, various forms of counseling, services for learners with special needs, and so on (see Chapter 15). In an ideal online learning system, these aspects would be given equal priority with and would be developed in conjunction with the curriculum. In the real situation, it is likely that such services already exist, and must be converted and enhanced for online learning, and provided with the ability to adapt and change as new options appear and learner expectations change.

## Interface with the Student Information System

Ideally, the LMS is linked to the SIS in such a manner that the right student is automatically in the right course at the right time, and that all the right student information is easily available to the right instructor and any other authorized person. This strategy avoids the need to input student names into the LMS, with the associated errors and waste of time. The instructor should be able to manipulate the student data as needed for the course (e.g., submitting and editing final marks), and to contact the students as a group, in sub-groups and individually.

All this requires clever and robust programming in the LMS, a server to authenticate student log-ins and ensure a secure interface with the SIS, and some appropriate programming in the SIS itself. This is where an integrated SIS/LMS system might seem attractive if one is building an online learning system from scratch. In many real situations, there will be more than one LMS, each of which needs to be interfaced to the SIS, and any or all of which might be composed of proprietary, imported, or home-built systems.

## The Users' Portal

As in most sophisticated online enterprises (travel, banking, shopping, etc.), the nature of the portal provided to the user (and indeed to staff in various ways) is important. Ideally, the portal should allow the learner, with one secure login, to access everything that is of interest to them: the LMS (and from there, other essential links), their grades and other applicable documentation on their student file, and related learner services and accounts. It will also allow them to customize their portal Web page to be a unique interface, showing their own preferences, and allowing them to link easily with other learners and staff, related services, and the student association.

## Quality Assessment

Most institutions and organizations will have a unit dedicated to providing a thorough and independent evaluation of any enterprise as part of the routine process of quality assurance and improvement. Ideally, the development of an e-learning system should include a plan for the independent evaluation of all aspects of the system, and especially of the degree to which it enables or enhances the achievement of the stated learning outcomes (primarily in the opinion of its users). Furthermore, such an evaluation would also provide information on the return on investment of the system, especially the unanticipated or unseen costs of implementation on back-end systems, staff attitudes, and infrastructure.

In the real situation, where a variety of systems could be in place, the tendency will be for each group to undertake its own research, which can often be biased (intentionally or not) and difficult to

compare with that of other groups unless a strict, common framework is in place. Even if only one system exists, larger corporate pressures might be applied to ensure that a project is “doomed to succeed.”

Quality assessment is an aspect of online learning in which a strong and centralized approach is preferred. The type, scope, and framework of evaluation must be independent and structured if the results are to lead to real improvements in systems, and to appropriate decisions about whether to scrap them or to build on them with new resources (see Chapter 16).

## Related Issues

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Many institutions and organizations that have shifted their core business to an online environment have noticed both predicted and unanticipated effects on all aspects of their enterprise. For online learning, some of these effects are straightforward and can be factored in early on, with systematic updates.

Back-end hardware (servers, switches, etc.) and connectivity will need to be estimated in the beginning, and then adjusted routinely as the number of users grows, the system evolves, and standards and expectations for “up-time” increase (usually to 24 hours a day, 7 days a week).

Policies related to access to servers, to security, and to the use of the online learning system need to be in place, and must balance the need for stability and security with the need to innovate (Kotter, 1996).

Technical help and helpdesk support must be in place, possibly linked to a training, orientation, and documentation function that provides support to students and staff. Since this function can be spread between the core information service units and the teaching units, clear mandates and lines of responsibility must be in place to avoid duplication of effort or gaps in support.

A host of human resource issues must be addressed. Some of them are tied to collective agreement and employment contract terms and conditions, especially those related to the service standards and expectations (which go beyond the normal working day), and to the automatic flexibility that online learning provides, not only to the student, but also to the staff in terms of the place

and time of work. New policies may be needed on attendance and on standards for being in touch with the central office for administrative matters.

Another human resource issue is the constantly shifting nature of the work that staff undertake. Many of those working in online learning have had dated training, or no official training whatever, but have learned and adapted successfully to new approaches and new technologies. There are many stories of staff who entered organizations at a junior level and worked their way into key roles in online learning quite unexpectedly, as the organization's needs and their abilities evolved. Traditional approaches to hiring, appointment, promotions, position classification, access to training and professional development, etc., must be adapted to maximize the opportunity to invest in and reward staff in such a dynamic environment, and to avoid exploiting staff who might be working well above the level for which they are paid. The long-term sustainability of the online learning system will depend to a large extent on how this new human resource environment is addressed. The online learning system itself should inspire new kinds of flexible training for staff, with inter- and intra-institutional support groups and learning communities, information links, etc.

Finally, the process for decision making and resource allocation related to online learning must be carefully considered. If new committees are to be established to provide recommendations on directions and investments, care must be taken to balance the discussion between those who know and understand a lot (but might champion one approach), central and decentralized technical staff (who directly support the online system and who often want more freedom), the central administration (who likely do not know as much, but are accountable for the success and effectiveness of the system), and the users (teachers and learners). The role of independent and thorough evaluation becomes very important in this process.

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## Change Management

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Any credible educational endeavor is dynamic in nature, responding to new knowledge, understandings, and approaches to the disciplines, to new employment market needs, to changing student

demographics, and so on. In a traditional campus or classroom environment, the expectation is that the teachers and curriculum developers will ensure this “currency,” and the same is true in online systems. However, in the online system, change is more complicated, because any change in content or approach can have a wide impact on a number of aspects of the system. Because online learning technologies evolve as quickly, and often as unexpectedly, as do the curriculum, students’ expectations and connectivity, etc., the ability to manage change effectively is important.

Assuming that the organization as whole respects and encourages change in such systems, there still remains the matter of how it is to be managed within the context of online learning. The first issue is one of balance: between constant change every time an idea or product comes into view (and so frustrating those affected, including students), and sticking with a system (for administrative ease and staff convenience) long after it has been superseded by better, proven systems.

The degree of centralization or decentralization of the system (or systems) also drives the change process. To what extent will some units be free to explore and try new systems, and to what extent should those lagging behind be forced to update their approaches? Because they relate to core aspects of an organization’s business and culture, such questions can only be answered in that context, but the following dimensions of an online system infrastructure would appear to be key factors in handling change well.

## Leadership

As in any organizational issue, effective change starts with leadership. Having the right attitude toward change and its importance and value is essential. Change should be embraced, and not seen to be just another headache to be dealt with. Kotter (1996) gives a concise explanation of why change is inevitable and crucial in modern business, and provides specific ideas on how change can be led.

## Scouting Reports

Some staff must be assigned the tasks of looking for emerging trends and ideas in online learning systems, and of providing a place for others to feed information they come across. These scouting reports need to be compiled and shared.

## Governance

A governance body is needed that not only deals with current issues related to online systems, but also provides a forum for discussion of emerging trends, organizes meetings and events for sharing and demonstration of new ideas, and revisits the vision for the online learning system regularly (perhaps once every year or two). [Note that the vision should be detailed enough to allow affected managers to adjust plans and budgets in the context of the organization's regular cycle.] The terms of reference and reporting relationship of the governance body should be commensurate with the importance of online learning to the organization.

The membership of such a body can be difficult to determine. The first impulse is to include those most intimately involved in online systems—the technical experts and educational technology champions—and their opinions are, of course, valuable. However, a more important criterion for membership is the individual's willingness to consider a wide variety of alternatives, and not stubbornly to defend their own preferred approach. In addition, users of the online systems, such as neophyte teachers, students, and user-support staff, will provide an important balance to discussions that otherwise can degenerate into purely technical banter. Finally, this body should be chaired by the highest possible level of relevant management.

## Communication

The governance body must establish a process whereby developments and ideas in online education are regularly broadcast internally through newsletters and other forums, and, where appropriate, externally through journals and conferences. In any com-

munication between the governance body and the users' community, simplicity of language is important. Furthermore, such communications must give users the opportunity to provide input to the governance body, and that body must be seen to be responding to the input; for example, by explaining seeming inconsistencies of approach.

## Pilot Projects and Evaluation

An important dimension of change is the use of pilot projects for new developments. Of course, the impacts of such projects must be evaluated before the developments proceed to wider adoption. The governance body could provide the approval for such pilots, and could have a pool of resources to allocate to approved projects. Evaluation of the pilots should be conducted at arm's length, and the results should be widely shared. In this way, the organization can receive the fullest benefit from the pilots, and the process of innovation can be seen to be open and effective.

## Resources for Change

As implied above, new ideas and approaches must be fostered, not just by words, but also by financial and in-kind resources, and they need to be coordinated by an open and widely representative governance body. The intention would be to balance the need for some control over innovation, which can diverge rapidly if separate units are left to their own devices, and the need constantly to explore and innovate in anticipation of broader change. For the employees, a balance must be struck between recognition for contributions to innovation and to ongoing operations.

## Conclusion

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In developing an infrastructure that supports excellence in online learning, the issues to be addressed are almost all the same as for any post-secondary educational enterprise: a clear understanding of the goals of the curriculum and of the characteristics and needs of the intended students; and a healthy working environment, with



committed staff, where implementation can proceed, and where constant change is understood to be the norm. Within these general areas, there are, of course, a host of technical, procedural, and policy decisions to be made, but online learning is now mature enough that such decisions need not be made haphazardly: plenty of research and information is available, and there are many successful examples of online learning systems to learn from (see *International Review of Research in Open and Distance Learning*, 1(2) (2001)). In contrast to those who were in the vanguard of this exciting educational development, new contributors can focus on getting the basic principles and goals in order before proceeding to implementation. Ultimately, as is any educational system, online learning is fundamentally a human endeavor, with the technology available to support the agreed upon principles and goals, not vice versa.

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