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Main Articles

Models of Early Adoption of ICT Innovations in Higher Education

[Melanie Bates](#), [Sue Manuel](#) and [Charles Oppenheim](#) provide an overview of some considerations for change agents attempting to introduce an innovative new information communication technology service into Higher Education institutions.

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Introduction

One of the common dilemmas faced by developers of information communication technology (ICT) initiatives is how to go about identifying potential early adopters of their service. This article outlines background research into this area and details the approaches taken within the JISC-funded Rights and Rewards in Blended Institutional Repositories Project to locate these key individuals within a Higher Education (HE) environment. The concept of an innovation is discussed and the differences between the terms innovation and invention are outlined. Models and frameworks for describing the process of introducing an innovation to an organisation are described. These suggest influential institutional factors, key characteristics of individuals, the innovation, and the organisation that affect the diffusion of an innovation. Together these features create the environment in which new innovations are explored.

This research, combined with the experience of the project team in introducing new e-learning innovations into the Higher Education environment, leads to the formulation of a strategy for an institutional framework for adoption of change.

Denning defines innovation as: 'a transformation of practice in a community' [1]. This statement carries with it the concept that a successful innovation is one that is taken up by a community with an accompanying adjustment to expected work methods and/or practices. There is an important distinction between the meaning of 'invention' and 'innovation'. Carayannis, Alexander, and Mason state that: 'Invention is the development of a new idea that has useful application. Innovation is a more complex term, referring to how an invention is brought into commercial usage.' [2]

Newell and Turner introduce the concept of the degree to which individuals will have to adjust their current practices as a result of the innovation. They state that: "Innovation means change: sometimes radical change... .., and sometimes incremental change" [3].

Theories and Models

Certain theories and models associated with the acceptance and take-up of ICT innovations have been developed in association with commercial products and business organisations. It is possible that some of the principles involved in introducing an innovative service or product will differ in the education sector. However, the following underlying principles are applicable across sectors:

- Adopter characteristics and motives for embracing innovations
- The innovation's characteristics, its benefits, costs, and associated learning curve, and
- Factors in relation to the institution, its culture and services

Some of these theories and models are presented in the following section.

Diffusion of Innovation Theory

The factors that affect the spread of innovations are described in several well-known theories. Perry states that scholars in the diffusion theory field 'define diffusion as the process through which some innovation is communicated within a social system.' Perry introduces the idea that 'time' is an important factor in the rate of diffusion. He also stresses the role of individuals and their social influence in the diffusion process [4]. An upsurge of research into diffusion in the late 1960s included practical studies looking at commercial products. These focused on innovations in business settings and were designed to provide insights into improving marketing, as well as describing product dissemination. Scholars, like Rogers, who study communication, have concentrated on more theoretical approaches. Rogers' diffusion of innovation theory incorporates 'the innovation-decision process, innovation characteristics, adopter characteristics, and opinion leadership' [4]. Rogers' theory can be divided into three main components:

1. The innovation-decision process
2. The characteristics of an innovation, and
3. Adopter characteristics

These components are presented below.

Innovation Decision Process

The 'innovation decision process' categorises the steps an individual takes from awareness of an innovation, through the formulation of an attitude to the innovation, on to the decision as to whether to implement, and finally confirmation of this approach. These five categories are [5]:

1. Knowledge
2. Persuasion
3. Decision
4. Implementation
5. Confirmation

Characteristics of Innovation

Perry states that 'Different innovations have different probabilities of adoption and hence, different adoption rates' [4]. Therefore, the characteristics of an innovation have an impact on the likelihood of acceptance and adoption, and also on the rate at which this process develops. These innovation characteristics have been classified into five criteria:

- Compatibility
- Complexity
- Observability
- Relative advantage
- Trialability

Adopter Characteristics

Rogers has defined the socio-economic characteristics of early adopters under three headings [5]:

- Socio-economic
- Personality values
- Communication behaviour

He identifies the following characteristics as being typical to early adopters:

Socio-economic

- High social status
- No relationship between early adopters' age and adoption
- Upward social mobility
- High level of education

Personality

- Ability to deal with abstract concepts
- Favourable attitude to change, risk and science
- Greater empathy
- Intelligence
- Less than average dogmatic outlook
- Less than average degree of fatalism
- Greater than average level of aspiration
- Rational outlook

Communication

- Greater degree of contact with change agents
- Greater degree of exposure to mass media communications
- Higher degree of opinion leadership
- Inter-connectedness in social networks
- More cosmopolitan outlook
- Greater degree of social participation
- Tendency to seek information about innovation, and consequently a greater degree of knowledge about innovation

The degree of interpersonal influence an early adopter possesses within the 'innovation decision process' will affect the dissemination of the innovation to others. Three issues are identified: 1) information flow, 2) opinion leadership, and 3) diffusion networks. At different stages in the diffusion of the innovation, individuals may be either leaders or followers [4]. Leaders have the ability to exert a positive influence over their contacts and to encourage the use of an innovation.

Rogers also defines five adopter categories: innovators, early adopters, early majority, late majority, and laggards [5].

Marcus's Theoretical Model of Adoption

Ankem [6] describes Marcus's theoretical model of adoption that has been derived from the diffusion of innovation theory and the social learning theory. Marcus's model highlights the importance of innovative behaviour and the phenomenon of others modelling themselves on this. Communication channels are a vital component in spreading this modelling behaviour to other potential adopters. Ankem explains how the model sets out a range of influential factors in the take-up of innovations including [6]:

- The associated 'costs' - personal and institutional
- The availability of necessary 'resources' - money, equipment, training, time, prior experience and relevant skills
- The 'value' of the innovation

This illustrates the need to bring together a mix of personal and institutional factors for optimal take-up of innovations. Those factors relating to the institutions' ability to provide the conditions conducive to the introduction and acceptance of IT innovations could be used to map out an institutional framework for adoption.

Technology Acceptance Model

The Technology Acceptance Model (TAM) is similar to diffusion theory although it places more emphasis on psychological predispositions and social influences. Thus, 'beliefs, attitudes and intentions are important factors in the adoption of computer technologies.' [7]. Bagozzi et al stress the importance of the learning process associated with using computers. Their theoretical model places computer learning within three distinct components: "attitude toward success, attitude toward failure and attitude towards the process" [7].

A combination of the diffusion of innovation theory and TAM has been used by Dimitrova and Chen to examine the effects of non-demographic characteristics on the adoption of e-government services in the United States [8]. Their findings illustrate the importance of perceived usefulness, perceived uncertainty and prior interest in the take-up of these services. They concluded that targeting early adopters of e-government services would be best achieved through mass media channels rather than interpersonal channels. This view is also expressed by Rogers, who asserts that mass media channels provide a more reliable means of alerting potential adopters to an innovation, while interpersonal channels are better for persuading individuals as to the benefits of a new idea [5].

Characteristics of Early Adopters

Chau and Hui conducted a study of early adopters of the Windows 95 operating system [9]. This user group comprised predominantly:

- Experienced microcomputer users
- Individuals displaying opinion leadership qualities
- Individuals more likely to investigate new developments
- Males

However, the authors of the study do stress the limitations of these findings, which were based on one new IT product. They caution that generalisations in respect of other products may not be appropriate. Another factor that may need to be considered is that this study was accepted for publication in 1997. It could be argued that, since this study, the proliferation of computers in the home and workplace will have had an effect on the profile of today's early adopters.

A recent study by Simon investigated the views of women on technological change within a society driven by access to information [10]. The sample included women from different backgrounds, of differing employment status, and with a variety of job roles (although almost half the

sample had a background in library or information work). Simon's investigation discovered that their attitude towards ICT largely expressed itself in both positive terms - born of practical experience - and in those of either ambivalence or outright negativity. The less positive reactions were for the most part generated by their recognition of the pervasive nature of ITC in society in juxtaposition with their own feeling of 'being left out', based either on personal experience or their identification with others subjected to such exclusion.

Identifying early adopter characteristics can provide useful information, but this data, of itself, is not helpful in directing us to early adopters. However, the literature does provide some key information on early adopter characteristics and on the conditions under which they are able to interact with new innovations. These studies have highlighted the problems associated with identifying early adopters.

Resource Stores

Morón-García has evaluated lecturers' usage of their institution's virtual learning environment (VLE) to discover [11]:

- Whether they are able to make effective use of ICT
- Whether technical support is provided to enable them to engage actively with the VLE
- Whether environmental factors affect use (the culture of the institution and department)
- Whether it is a suitable tool to use with students, and finally
- Whether the VLE delivers in terms of functionality and ease of use

Some of the barriers to use identified by individuals were:

- The time it takes to learn a new system
- Individual needs for support varied
- Provision and type of support depended, in part, on institutional strategy
- Knowing how to locate support

Early adopters did provide support for their colleagues using the VLE at a later stage. Morón-García also uncovered issues for institutions adopting innovative teaching technologies. These included: finding time in busy workloads to make use of the VLE, the intention behind the introduction of a VLE, and ensuring that ICT was an accepted part of the role of a lecturer. One necessary requirement was that the 'institutional culture supported teaching innovation' [11]. Other determinants were the ability of IT infrastructure to support use and incentives to use the VLE (funds or equipment). An additional barrier that prevents use of the VLE was insufficient confidence on the part of certain users of the system and consequent low self-esteem, thereby generating a reluctance to "show oneself up" by using it. This was especially true of individuals lacking confidence in their own ICT skills.

The following sections focus on some of the key factors for change agents and early adopters in HEIs (Higher Education Institutions). The discussions are structured around three broad classifications: early adopters, innovations, and organisations.

Early Adopter Considerations

As we have seen, the potential 'value' an innovation represents to individuals affects their decision whether to adopt it at an early stage in the diffusion process. As Denning remarks: "A transformation of practice in the community won't happen unless the new practice generates more value to the members than the old" [1]. This value can be measured with reference to the associated benefits weighed against the costs [6]. Therefore, value is closely associated with the 'need' for the new innovation. If existing products or services are perceived as being adequate for accomplishing the necessary work, there is no real driver for change. Conversely, if it becomes increasingly difficult to execute an existing task, then a stronger driver for change emerges. Additionally, where the introduction of a new task or practice occurs in this scenario, the need within the community for a new ICT product or service to cope with the added difficulty becomes all the stronger.

Early Adopter Characteristics

Understanding early adopter characteristics can aid the process of targeting their involvement in the initial stages in the diffusion of an innovation.

Initiatives for targeting early adopters within HEIs may be assisted by understanding the demographics of the group. For example:

- Are early adopters scattered across campus?
- Are there any university committees where they are more likely to be represented?
- Are they more likely to be located in certain types of departments than others?
- Are they employed within specific types of job roles?
- Is there one place, meeting, or event (other than for the next new ICT initiative), where they are typically to be found (e.g. Web Management Workshop, staff development session, research seminar)?

Factors relating to the specifics of the nature of the innovation may also impact on the process of targeting the right early adopters for an innovation. These factors can include: the complexity of the innovation, whether it comes from within or outside the institution, the levels of

expertise required to participate in the initiative, and whether the innovation is generic or specific to a certain group, or groups, of individuals.

Communication Channels

Which channels of communication provide the best means of targeting early adopters?

- Interpersonal communications - informal methods, or
- Mass media communications - formal channels

Rogers states, "Mass media channels are usually the most rapid and efficient means of informing potential adopters about the existence of an innovation - that is, to create awareness-knowledge." [5] He continues that interpersonal communications provide a more effective means of persuading individuals of the benefits of a new innovation. This is especially true of communications where individuals have a similar status (socio-economic status and education). Within HEI advertising through central mass media channels, e.g., email, notice boards, university publications, could be tested as an appropriate approach to inform potential early adopters of an ICT innovation. This could be combined with interpersonal contacts to known early adopters. The adoption rates within these two groups could then be compared and levels of trust, adopter characteristics, perceived benefits of the initiative, and any perceived barriers to adoption evaluated.

Rogers also introduces the effectiveness of 'audience segmentation' when considering methods of communicating with potential adopters [5]. Targeting by means of the type of contact, source of approach, and the content of the message would seem to offer the most appropriate means of alerting potential adopters to a new innovation. Within HEIs this could include specific mailings to departments, faculties, special interest groups or research groups.

The reasons why the new product or service is being developed will also have an influence on the method chosen to alert adopters to its presence. If the need for the product or service was identified by the intended community of users, or if members in that community are developing it, then a bottom-up approach is appropriate. If however, management is introducing the new product or service, then a top-down approach is appropriate.

Background Activities Prior to Early Adoption

If we accept that early adopters are an important component in a framework for acceptance of ICT innovations within HEIs, then being able to identify these individuals plays a pivotal role in the success of such a project. Targeting early adopters may be a critical factor for success, but how can they be located? When devising a framework for this activity, the background activities prior to the initiative set the scene. Therefore, we can assume that the need for the ICT initiative has been determined, the stakeholders identified, a steering group assembled, a budget secured and staff time allocated. The individuals engaged in the initiative, their contacts, and the approach taken to introduce the initiative to others starts the spread of the initiative.

Broadly speaking in the early phases, news of an innovation spreads through a range of communication channels, including face-to-face, email (one-to-one or one-to-many) or telephone. These initial contacts are likely to be with trusted colleagues and a high degree of control over the information imparted is assured. As the introduction of the innovation progresses, other forms of dissemination are introduced. This might be via a Web site or newsletter, through focus groups, at committees or departmental staff meetings. These approaches exploit existing communication channels and people networks, although they may also involve the creation of new networks specific to the innovation. As communications spread outwards, the originators of the initiative are less able to control which individuals receive information, and the content of the correspondence. There is also a greater potential for sceptics to be encountered. Despite this, awareness of the initiative grows, is diffused across campus, and clusters of individuals with greater awareness appear.

Sources of Information on Early Adopters

Within HEIs, a number of ICT projects may be underway at any given time. These might include formal institutional large-scale projects, which will ultimately have an impact on all employees, smaller scale departmental or team projects, or externally funded projects that can be either large- or small-scale. The latter category is a more problematic one in terms of early adopter identification. This is because there may be no existing networks and channels for communication along which news of the innovation can be spread. The time scale of the projects is also a factor when identifying early adopters, as projects with a larger timescale can be more systematic in their approach compared to short timescales that may rely more on personal social networks. Externally funded projects having team members with prior experience of setting up ICT initiatives within the local institution may achieve a more successful outcome. Prior experience affords the advantage of greater awareness of existing early adopters and an understanding of the institution's practices and cultures.

The role played by individual members of the project team, its partners and steering group within the institution might also prove to be a deciding factor in adoption. If they have a central role in the institution and the ICT initiative is broad in scope, then successful adoption may be more likely. If, however, individuals' roles are within departments and the aims of the initiative are broad, then a match to suitable early adopters via personal contacts may be more difficult. For those new to the area of ICT initiatives, or to a particular institution, the task of

identifying early adopters becomes even more difficult. One solution might be to make contact with central departments likely to have involvement in institutional ICT initiatives. Alternatively, contact with those associated with prior projects at the institution that have resulted in the successful adoption of new ICT systems or services may prove useful.

In summary, successful selection of early adopters may be dependent upon:

- Availability and use of existing directories of staff interests and expertise
- The degree of mutual acquaintance among a project's members
- Levels of experience within the project team

ICT Innovation

There are five distinct phases in the emergence of a new technology. Gartner's Hype Cycle [1] defines these phases for Emerging Technologies. The graphical model for this cycle demonstrates how a 'Technology Trigger' or product launch event sets the cycle off by generating significant press interest. This leads to the 'Peak of Inflated Expectations' phase where further publicity generates expectations at a point where the product is unlikely to be at mature enough a stage of development to satisfy them. Next comes the 'Trough of Disillusionment': having failed to live up to expectations, the product is deemed unfashionable and media interest diminishes. This is followed by the 'Slope of Enlightenment', where some organisations continue to use the technology and through its practical application discover its benefits. The final stage in the cycle is the 'Plateau of Productivity': the benefits of the technology become known and accepted since it has evolved into a stable product [12].

Gartner's Hype Cycle omits the development process prior to the 'Technology Trigger' phase. This early development stage should involve product creation, testing, and feedback efforts. These background activities are not recognised in the Gartner Hype Cycle because one of the requirements at the trigger stage is a significant degree of press interest.

As identified in the Technology Acceptance Model, the process of adopting any new tool involves a learning curve for individuals. White describes the need for learners to be creative in their approaches to learning in a rapidly changing environment. An organisation that is devoted to change is the most likely environment for a culture of learning to flourish [13]. This in turn enables learners to share experiences thus enhancing the learning process. Positive experience with technology inclines an individual towards adoption of other technologies [14].

Marcus' model asserts that potential adopters of innovation evaluate the possible 'value' that the innovation has to them [6]. This value can be measured in terms of 'cost' and 'benefit', with the value being determined by the balance of these two factors. Marcus also introduces the importance of 'resources' and 'communication'. Thus, personal and institutional factors combine to determine adoption of an IT initiative. These factors are listed below:

Personal factors

- Costs
- Effort to acquire new skills
- Time
- Resources
- Necessary skills
- Prior experience with similar innovation
- Risks of failure
- Loss of self-esteem
- Loss of social approval

Institutional factors

- Resources
- Equipment
- Finances
- Training

It could be argued that some of the factors that are classified as 'personal' are equally applicable to institutions. For example, the risk of failure is a consideration for a university committee that is approached to support a scheme. The costs in respect of time and effort are also valid considerations for the institution as a whole.

Diffusion theory defines the attributes of an innovation and these determine the likely rate of adoption. Rogers lists these attributes and describes them as follows [5]:

- A. Relative advantage
- B. Compatibility
- C. Complexity

- D. Trialability
- E. Observability

If the perceived advantage to the use of an innovation is positive there is a greater likelihood that it will be adopted rapidly. Change agents can ease this learning process for potential adopters by creating advertising materials outlining the benefits of use and to provide general information about the innovation. The perceived compatibility with existing values, experiences and needs of potential adopters is another important factor in the rate of adoption. Complex innovations that are difficult for adopters to understand will result in slow rates of adoption. Being able to participate in trials of the innovation are more likely to result in rapid rates of adoption, particularly if the testing is limited, and if the innovation can be broken down into component parts. The lifecycle of the innovation's development is thus a determinant in use and uptake. If testing, feedback and further development to meet the needs of the users are possible, then the rate of adoption will be faster than it would be if these factors were not present. The final attribute of an innovation is observability; if the results of an innovation are readily available and good networks are present for discussions on the innovation, then diffusion of the innovation is accelerated [5].

Marcus' model emphasises that communication between early adopters is not an influential factor in terms of take-up of the initiative as it is for late adopters [6]. However, we argue that communication networks are crucially important for the introduction of the new innovation to the early adopter group. By this we mean that networking activities undertaken by system developers sharing ideas, project members forming contacts with allied initiatives, and cultivating advocates within the institution, all form an important part in setting the scene for the introduction of the innovation to the early adopter group.

Additional factors to be considered include:

- The nature of the initiative - whether it is a local, national, collaborative or distributed venture
- The aspects of institutional activity that are set to gain from the innovation - these may be related to teaching and learning, research, administrative functions or a combination of these
- Pervasive political climate - this has an impact on the themes outlined above
- Rewards and incentives to engage with the innovation

The project team plays a central role in ensuring the successful linkage of early adopters and the environmental conditions outlined here.

Institutional Framework for Change Adoption

Both personal and organisational processes influence a culture of innovation. Denning lists these organisational processes as: "management values, rewards, prohibitions, encouragement of new ideas, encouragement of risk-taking, and the like" [1]. To this list we can add services, support, communication channels and staff networks. An institution with these key components in place is better placed to ensure that innovations are facilitated, encouraged, accepted and diffused across its campus. Thus, the institutional environment shapes the development of the ICT initiative, its adoption and implementation. Culture also affects the success or failure of a new ICT innovation. As Denning states: "In a culture of innovation, people will have a habit of constantly looking for ways to improve things" [1].

Organisational culture can be seen as the "values and beliefs shared by personnel in an organisation" [15]. These cultural beliefs translate into "communication and mutual understanding" and they influence the beliefs and behaviours of individuals. Martins and Terblanche state that: "Organisations use different resources and processes to guide behaviour and change". This emphasises the importance of the pervading culture within an organisation in relation to the degree of acceptance of a new innovation [15].

Martins and Terblanche have devised a model to show the influence of organisational culture on creativity and innovation [15]. They view the main determinants as being: strategy, structure, support mechanisms, behaviours that encourage innovation, and communication. The model highlights the requirement for institutions to encourage: flexibility, autonomy and co-operation at the 'structure' level; reward, recognition and resources at the 'support mechanism' level; support for risk taking, change, learning and conflict handling at the 'behaviours that encourage innovation' level; and finally open communication.

Dimitrova and Chen's conceptual framework for e-government adoption determinants [8] can be repurposed to represent broad factors that are influential for the adoption of innovation within HEI.

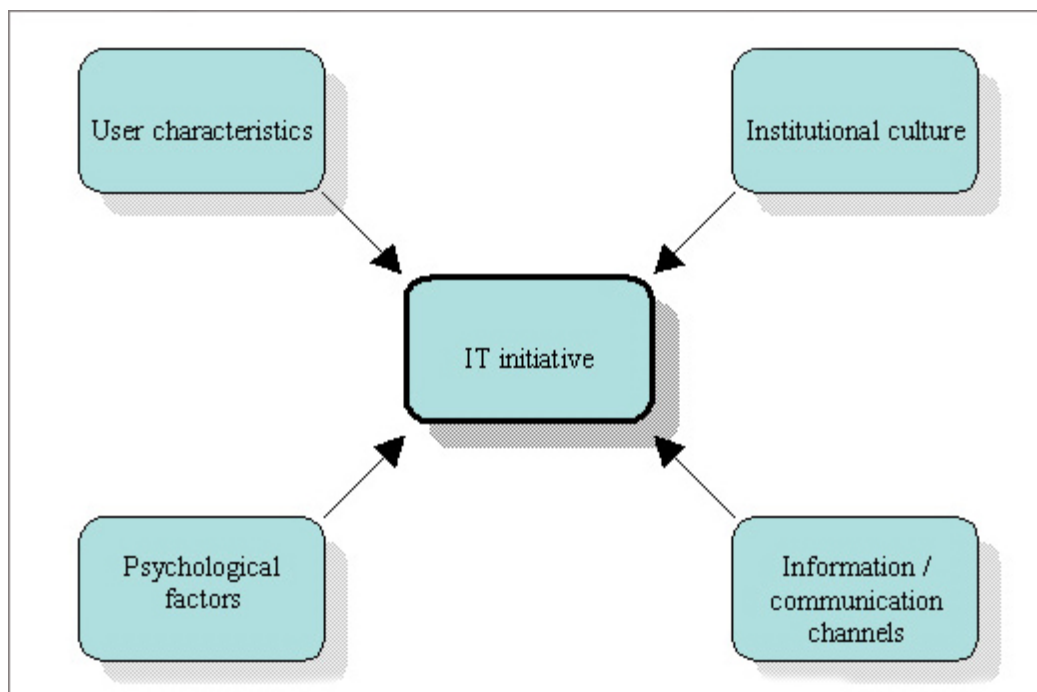


Figure 1: Broad framework for change adoption

Each of the sections illustrated in Figure 1 has a variety of conditions or factors associated with it, as do individuals and groups affected under each section. Some of these influential conditions include:

- Allocation of support staff
- Benefits
- Cost (personal)
- Drivers for change - from practitioners or the institution
- Existing solutions - these may be perceived to be good enough
- Matters relating to employment - contracts, pay, conditions or disputes
- Maturity of the technology
- Political climate
- Sufficient funding
- Sufficient numbers of practitioners willing to investigate an innovation
- Suitable environment for exploration of new innovations - trial and error, with minimal risk of loss of self-esteem

Two important determinants are 'push' and 'pull' factors. Institutional push factors might be rewards offered by an institution to encourage the adoption and use of a new innovation, or mandate to enforce adoption. Personal pull factors include the perceived need for the resource and the benefits to be gained by using it.

The institutional framework is bounded by external influences, which in turn influence decisions taken at institutional, faculty, department, and project level. The strength of the boundaries between faculties and departments, or the existence of cross-disciplinary collaborations can affect diffusion of innovations across an institution.

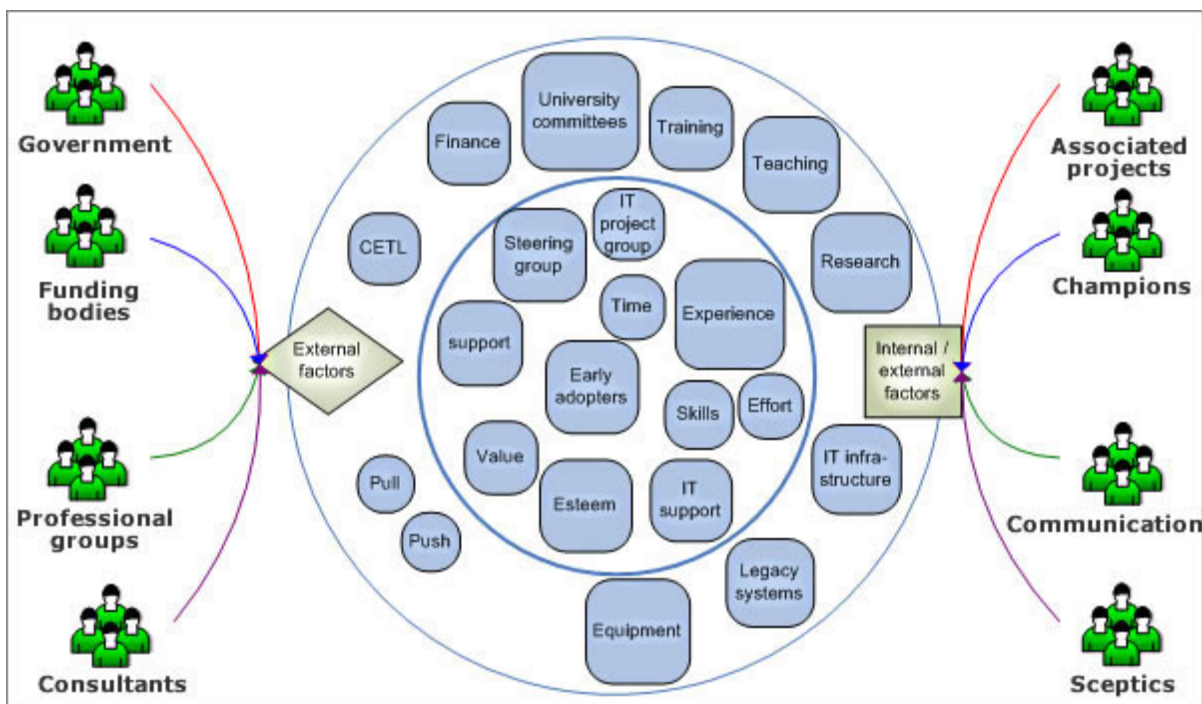


Figure 2: Institutional framework for change adoption

Figure 2 illustrates the complexity of the framework within which new innovations are situated. It provides an indication of the task change agents face when attempting to introduce a new service into an HEI setting. Having an awareness of early adopter characteristics and the most appropriate methods for targeting these individuals may give projects a head start in achieving institutional adoption for their ICT product or service.

The next section sets out some conclusions to be drawn from the [Rights and Rewards Project's](#) [16] experiences, to date, in attempting to generate interest and enthusiasm in its innovative teaching and learning repository.

Conclusion

There are numerous conditions to be met before ICT innovations can be introduced, adopted and diffused through an institution. By investigating a range of theories devised to describe and understand attitudes towards, and uptake of, ITC innovations, a number of key factors in a framework for early adoption have been identified. These key considerations are associated with early adopter characteristics, communication channels, features associated with the innovation, scale and source of the initiative, the time-scale for introduction of the new product, and a range of institutional characteristics and processes. Institutional factors include cultural values (management and personnel), communication and social networks, provision of suitable support, a safe environment for the exploration of new technologies and for creativity, as well as recognition and reward. Influences from outside the institution also have an impact on adoption of an innovation. External influences, such as the political climate and the aims of funding bodies, are broader in scope but no less important in setting the scene for new initiatives.

Mapping specific and individual factors that may have a potential impact on an innovation can assist with the process of identification and targeting of key early adopters. Broad theories and frameworks are evident, and these can be used as a starting point for individual projects. No one theory provided the solution to devising a generic framework for the adoption of an innovation. Additionally, the number of variables that can affect such a framework make it difficult to provide sufficient a degree of detail to be useful to individual projects.

What is clear is that the approach of identifying and targeting early adopters appears to be a sensible one to take. In addition, mass media channels should be used for a more comprehensive approach to potential early adopters. Utilising both of these means might ensure that potential enthusiasts are made aware of the innovation at an early stage. Furthermore, the presence of a suitable sustainable environment for the exploration of initiatives can play a crucial role in the acceptance of innovation.

*Editor's note: For sight of a diagram of the Gartner Hype Cycle see "Integration and Impact: The JISC Annual Conference", Marieke Guy, July 2005, Ariadne, [Issue 44](#).

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