Adaptive Structuration Theory: An Impact Scale for Adaptations in Response to Website Development

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Abstract

This paper develops a scale for the impact of adaptive structuration on Web technology structures and user structures. An earlier scale of "reinvention" required comparison against "ultimate functionality" of the technology. This is not practical with a website that is continuously under development. The new scale has, in order of increasing impact on the structure, four key points: refine, extend, redesign and transform. When considering a possible change, the change should be placed independently on the impact scale for each relevant structure. Whether the changes emerge or are planned, placing each change on the scale will give an early indication of the potential impact of that change.

Keywords

adaptive structuration theory, AST, Web, technology

INTRODUCTION

The implementation and use of new technology is not a deterministic process: Technology is not simply installed and run according to predetermined methods. In practice, new technologies are adapted ("structured") by users to suit user requirements. This has been researched and explained using Gidden's "structuration theory". ((Majchrzak, Rice, Malhotra, King, & Ba, 2000) provides relevant references.) The technology is implemented, the technology is then adapted by its users.

Research also found that user structures adapt in response to the new technology. That is, both technology and user structures will adapt to each other. The adaptations may be non-deterministic (emergent) in response to perceived problems, or they may be initiated by management. Adaptations may be gradual or they may be discontinuous. (Majchrzak et al., 2000) The process of adaptation is described by "adaptive structuration theory", or AST.

AST examines the way in which technology is adapted to suit the needs of a particular organisation and the way in which the organisation adapts itself in response to the technology. These mutual, reciprocal adaptations need not be driven by the organisation. Rather, they emerge in response to the varying situations as the organisational structures impact on each other. "To date, only adaptive structuration theory (AST) offers the promise of satisfying two requirements for explanation based on an emergent perspective: recursivity and unique effects." (Contractor & Seibold, 1993)

Unexpected adaptations may make it difficult for an organisation to gain maximum benefit from new technology. Understanding of the impact of possible adaptations would improve the level of benefits to be gained, because the organisation could better recognise, guide and prepare for changes as they occurred. If change is expected and understood then there is a better chance to manage and control its effects on the organisation.

This paper develops a suitable scale for adaptive structurations. Use of the scale will help understanding and management of developing website technologies.

LITERATURE REVIEW

A decade ago, Nagasundarum & Bostrom wrote: "Radical and discontinuous change is the order of the day in the 1990s." They saw that corporations, large and small, were using methods such as TQM (total quality management) and BPR (business process redesign) in an attempt to create new organisational forms that would enable success. To stay ahead in the highly competitive market environment, organisations also needed a steady stream of new products and new services. (Nagasundaram & Bostrom, 1994/1995)

Today, there is a need for more than new products and services. To be successful, an organisation may need to implement new business processes within the new business and market environment of the World Wide Web. At the same time the increased communication abilities of the Web allow, or even force, new organisational forms. The Web may be used to introduce any or all of new organisational structures, new products and new services.

In 1988 Leonard-Barton wrote: "New production technologies are known to be competitive weapons, but their implementation is at least as challenging a managerial problem as their invention." Further, "The initial implementation stage is particularly crucial. … It is argued that technology transfer requires continuous, ongoing dedication to the process of change and the conscious management of mutual adaptation because the technology will never exactly fit the user environment." (Leonard-Barton, 1988)

In 1994, DeSanctis & Poole wrote that, "Adaptive Structuration Theory (AST) is rapidly becoming an important theoretical paradigm for comprehending the impacts of advanced information technologies." (DeSanctis & Poole, 1994) In 2002 that statement was considered sufficiently current to be quoted in a research article (Salisbury, Chin, Gopal, & Newsted, 2002). "It is suggested that further research is undertaken into the 'adaptive structuration' theory." (Kim, 2000) Majchrzak et al continued the research with a major advance in our understanding of the adaptation process (Majchrzak et al., 2000). This paper extends the AST model as described in Majchrzak et al.

Adapting to New Technology

Previous AST research has investigated implementation of various technologies, including GDSS (group decision support systems) and CT (collaborative technology). These technologies each offer a specific application that will be used by a clearly defined and tightly restricted group of users. The Web, in contrast, provides a very broad range of technology options and potential users.

GDSS and CT are applications of technology that are specifically aimed at changing inter-personal communication processes. The Web enables communication between individuals, organisations and systems. Theories developed for GDSS and CT may equally be applied to Web technologies. This paper takes AST (adaptive structuration theory) as developed after study of GDSS, CT and other technologies and applies a key aspect of that theory to implementation of an organisational website.

In 2000, Majchrzak et al reported a study of a virtual work team using a CT (collaborative technology) application throughout a ten month project (Majchrzak et al., 2000). As the project progressed, the team adapted both its own structures and those of the CT. In order to improve our understanding of the adaptation process, Majchrzak et al addressed four research questions. Selected questions and results are outlined below.

"(3) After the initial adaptation to achieve alignment, does the workgroup experience the need for further adaptations?" The research by Majchrzak et al found that their study group did experience the need for adaptations as the project progressed. The adaptations were not, however, a series of changes that converged on a suitable set of structures; The changes were in response to changing task requirements. The initial adaptations may have suited the initial task but the developing task necessitated new adaptations.

"(4) What is the nature of these adaptations: are they discontinuous, responding to windows of opportunities, or are they continuous, gradually closing misalignments?" Majchrzak et al found that the adaptations were discontinuous. They were not, however, responding to windows of opportunity. Rather, there were sporadic changes in response to discrepant events that were seen as being problems. There were no clear windows for adaptation. Discrepant events were almost continuous and resolution could take any time from minutes to weeks.

Discrepant events take varying levels of effort to resolve. For any discrepant event there could be a choice of several adaptations, each providing resolution but each with a different impact. How do we manage the adaptation process? This paper develops a simple analysis to evaluate the potential adaptations.

WEB-BASED CASE STUDY

To explain and demonstrate adaptations related to Web-based technology, I will use a particular case study organisation. It is a small organisation with clear objectives. Its current operations are strongly based on provision of physical services at a fixed location. It is developing a website, although the purpose and method of operation of the website are still not clear. Development will involve adaptation of Web structures, it may also lead to adaptation of the structures of the organisation itself.

"The Club" provides a meeting place for business people:

> "[The Club] is the leading business and professional persons' Club in [the City]. We offer the privacy and warm ambience that only a private Club can provide. The Club is a place to build long-term friendships and business relationships founded on high ethical standards. We provide a slightly conservative Club culture, modern but with a respect for traditional values. We are a Club of non-political character, for the interaction, enjoyment, entertainment and comfort of our Members and their guests. We encourage Membership from metropolitan and country areas throughout [the State]." (from the Club's website, October 2002)

This is a traditional "community" with a fixed physical focus and a common purpose. The physical focus is the Club-owned premises in the city centre, which provide the main benefits for members. The premises include a restaurant, cafe, meeting and function rooms, squash courts and a gym. The "members" of the Club are equivalent to "customers" of other forms of commercial organisation.

The Club provides a neatly bounded environment for initial development of the model for AST (adaptive structuration theory). This paper provides the groundwork, by examining one aspect of the AST model: a scale for the adaptations which may occur. Subsequent research will study other organisations in order to strengthen or modify the current model.

LEVELS OF ADAPTATION

Technology and the organisation adapt in response to each other; this is the "adaptive" part of adaptive structuration theory. "Structuration" refers to the changes, where the structures of the technology and of the organisation are adapted (changed) as a result of the technology-organisation interaction.

Adaptation as Reinvention

Using the language of Scott et al, implementation of a website requires "reinvention" of the Web technology. Reinvention is simply a more descriptive word for the process of adaptation. It is "the degree to which an innovation is changed or modified by a user in the process of its adoption and implementation." ((Rogers, 1995) quoted in (Scott, Quinn, Timmerman, & Garrett, 1998)) Reinvention "appears to be the norm for many innovations." (Scott et al., 1998)

The Club website has, to now, been through four stages of reinvention. Stages one and two used the same underlying technologies but the visible features were slightly adapted between stages. Several major but incomplete features of stage one were removed from stage two. Stage three involved completely new underlying technologies (a complete rewrite using a new development package) but the visible features were largely unchanged. Stage four involved another complete rewrite that maintained existing visible features, but the appearance of some features was changed and new features were added.

The technologies of the Web are as much opportunities as applications. The Web provides the opportunity for improved communication, both within and without the organisation. It is left to the organisation to determine the ways in which this improved communication may be used to benefit the organisation. The underlying Web technologies may be relatively stable but the visible applications may vary enormously.

The Club aim is for a website that supports and enhances but does not replace existing Club functions. Online payment of Club accounts (that is, payment by members to the Club) is a completely feasible application of Web technologies. It has not been implemented. The opportunity is there but the Club has chosen not to use it. Instead, the Club has chosen to provide online information on payment options, including the option of direct bank-to-bank payment that is managed through the websites of members' banks.

"A technical system transferred from a development site to a user site always encounters differences in context: equipment, operators' skills, and performance rewards all may differ." (Leonard-Barton & Sinha, 1993) The Web is a technical system: Its basis is technology even though (as indicated by both common sense and by AST) it operates in, affects and is affected by a sociotechnical system.

The Web is a technical system that is under constant development. The "development site" is world-wide, in numerous research, development, commercial, industrial and personal work areas. At some point, an organisation elects to implement some application of Web technology. At that point, the Web-under-development may be stabilised and adapted to the context of an operating organisational environment.

Even then, when Web technologies have been selected and a website is being developed, there is adaptation. The site may be implemented in stages, with each new stage bringing its own adaptations. The fully implemented website may be rewritten in response to new Web technologies or new management requirements. For as long as it exists, a website is likely to be in a constant state of reinvention. At the very least, a website will reflect changing business requirements by undergoing a process of incremental change.

The Club has developed its website and then reinvented it twice. Redevelopment from stage two to stage three did use new technology. The key reason for redevelopment was to satisfy the management requirement for better control and reduced cost of the development process. Stage four redevelopment again used new technology but this stage had an underlying reason based on management requirements, to reintroduce the facility for Club staff to update variable data on the website.

A Scale for Reinvention

Leonard-Barton & Sinha provide a quantitative set of measures for the level of technology reinvention. System adaptation is calculated from (1) a system's initial functionality, defined as the percentage of its ultimate functionality that is available at the time of the pilot test, and (2) the change in its functionality between the pilot test and general release into the production environment. The organisational adaptation is measured as a function of changes: user retraining, procedural changes, reward system changes, and equipment changes. (Leonard-Barton & Sinha, 1993)

Using these quantitative measures, the Club website has had only a low level of reinvention. Stage one created a pilot site, stage two moved the pilot site into production, stages three and four changed the production site. If stage four, the current website, reflects ultimate functionality then almost all features of the ultimate site were available in the pilot version.

A difficulty with the application of this quantitative measure is the way in which the Club website is being developed: There is no "ultimate" organisational website, the website will continue to develop for as long as it exists. So far, for example, the site offers largely one-way communication from the Club to its members and other Web surfers. A potential development is to build a Club-based online community, with computer mediated multi-directional communication between Club members. This will involve a major reinvention of the website, if and when it occurs.

The Web is new and developing technology. An organisational website reflects the unique features of each organisation, so each organisational website is unique. In order to maintain that uniqueness and to take advantage of technology developments, the Club website is expected to be under continual development. The newness of the Web also means that most Club managers are not aware of its full potential, so website development reflects lessons learnt along the way. As managers see what can be done, they are able to visualise further improvements.

All of this means that "ultimate functionality" is a moving target. AST predicts this difficulty. As stated in the previous section, "Adaptations will continue to occur but at irregular intervals." In the decade since Leonard-Barton & Sinha developed their measures of reinvention our understanding of adaptive structuration has improved. Web technology is unlikely to have a measurable "ultimate functionality". The developing and learning nature of Web technologies are unlikely to provide a clear end-point against which to measure the level of technology reinvention.

Similarly, organisational adaptation is not subject to absolute quantitative measurement. In qualitative terms, however, the Club has made some simple procedural changes and provided informal training. The website is seen as an extra means of communicating with Club members, but it does not replace the existing mail and voice communications. The level of reinvention is low.

Yet the website development has lead to adaptations in a related area: email communications. The developers of stage four of the Club website have also improved the quality of email design. They have taken design work from the website and applied it to email bulletins to members. The Web redevelopment resulted in adaptations to a user structure, the development work group. This in turn resulted in adaptations to a related technology, the use of regular emails to Club members. The change from early email formats to the current email bulletins represents a high level of technology reinvention.

From the above discussion, the key points of reinvention are:

- Reinvention is the level of change as a new technology is implemented
- A website will be in a constant state of reinvention
- An absolute measure of the level of reinvention is impractical and perhaps even impossible
- Implementation of one technology may lead to reinvention of another

The concept of reinvention provides one way of measuring the level of adaptation as a new technology is implemented within an organisation. A more viable alternative is to adapt terms from creativity research, to measure the changes in terms of adaptation and innovation.

A Two-Point Scale

For individuals, adaptive behaviour may take the form of either adaptation or innovation. This relates to the form of change that will be attempted as a first response to a problem within a system. The following description is based on Kirton's research on creativity ((Kirton, 1987) as described in (Nagasundaram & Bostrom, 1994/1995)).

Some individuals, when confronted with a problem, turn to conventional rules, practices and perceptions of the group to which they belong. These adaptors drive their ideas towards a solution that is based on the established procedures. When established procedures provide no answers, adaptors will attempt to adapt or stretch a conventional response until it provides an effective solution. This characteristic behaviour is adaptation.

Innovation, on the other hand, is the characteristic behaviour of individuals who initially look for non-conventional solutions. An innovator confronted with a problem will attempt to reorganize or restructure the problem, and to approach it in a new light. The innovator will be free of the customary perceptions or presuppositions which would be the starting-point for adaptors.

Innovators are likely to produce answers which are less predictable and thereby sometimes less acceptable to the group. Neither of the two styles is necessarily superior. Specific contexts demand one style rather than the other and organizations typically experience various contexts at various times.

Within AST, adaptive structuration may result from either adaptation or innovation, applied to any of the relevant structures. Alternatively, structural changes may be placed on a scale with adaptation and innovation as the extremes of the scale. This will provide a measure, or an indication, of the extent and type of the adaptive structuration that is occurring.

At the Club, structural changes have varied from adaptation to innovation, with most being at the adaptation end of the scale. Even the initial decision to implement an organisational website was adaptation rather than innovation. The site was seen as being an extra means of communication with Club members. There were no expectations that existing means of communication would be affected. There were no expectations of more than minor changes to existing organisational structures.

Stages one and two of the Club website were straight adaptations of existing information into an electronic form. For example, the Club arranges occasional sports challenges between members. There are four sports which are each played once or twice a year, each sport was given its own Web page for announcements and challenges. Since the challenges were very irregular, each sports page was almost static. This matched the rare mentions of each sport in the printed newsletters: a one-for-one adaptation of existing structures.

When I redeveloped the website (stage three) my effort included rationalisation of the page structure. Sports notices (for example) were amalgamated onto one Web page, to increase the apparent level of activity and hence interest in the sports notices. This was an innovative change, it could be said that I was, as described above, "free of the customary perceptions or presuppositions" that had resulted in separate Web pages for each sport. In absolute terms, however, this change was hardly innovative and far closer to simple adaptation, "a solution that is based on the established procedures". It was equivalent to moving all sports results onto one page of a printed newsletter.

Since "adaptation" seeks to work with existing procedures it will have minimum impact on existing structures. This is simply an inverted view of the definition of adaptation. Innovation, however, will have a more noticeable impact: The innovator is willing to change existing structures in order to find a solution.

We now have a very simple scale for structural changes in response to new technology. As shown in Figure 1, changes may be either adaptations or innovations, and innovations will have a higher impact on existing structures than will adaptations.

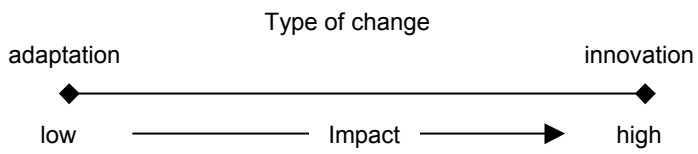

Figure 1 Impact of a Change on Related Structures

So far, there are only two clear points on the scale of impact of change. The next section will define intermediate points.

Varying Levels of Innovation

Kirton's findings have further application to AST, when considering the types of modification that may be introduced. Kirton discussed elements and context. In the following paragraphs, I relate Kirton's ideas to the concepts of AST.

Structures are the rules and resources used to generate and support a system. A system, in this sense, is a social group or organisation that acts in such a way that there are observable and consistent patterns of inter-personal relations. As defined within the AST model, structure has two parts. First is the spirit, or generally accepted objectives and attitudes promoted by the structure. The second part consists of the specific structural features that implement the spirit promoted by the structure or the system. (Gopal et al., 1992-1993)

In Kirton's analysis a new idea, a solution to a problem, may affect either the "elements" of the paradigm (or system) or the "context" of the paradigm. The elements are the ideas that form the basis of the paradigm, this has a direct correlation to the spirit of the structure that is one aspect of AST. The context, on the other hand, is the relationship of ideas within the paradigm. Altering the relationship of ideas is equivalent to changing the features of the relevant structure.

Thus Kirton's description of the way in which systems may be adapted is related directly to the way in which adaptive structuration may apply to the spirit and the features of a structure. This parallel leads to four possible categories of adaptive structuration: Refine, Transform, Extend and Redesign. These are summarised in Table 1 (below). An adaptor will prefer the first of these, Refine. An innovator will prefer ideas that result in Transform, Extend or Redesign.

Table 1 Grouping by Adaptation and Innovation

Spirit of the structure	New ideas	Redesign (paradigm modifying, innovation)	Transform (paradigm modifying, innovation)
	Old ideas	Refine (paradigm preserving, adaptation)	Extend (paradigm modifying, innovation)
		Old features	New features
		Features of the structure	

Use of Table 1 indicates that Club website development has included a number of innovative adaptations. The table allows adaptations and potential adaptations to be grouped, by impact on features and spirit of the structures.

Stages one and two were definitely "old ideas". The spirit of the technology was being maintained, only the technology was changing. That is, the new technology of the Web was being used but the purpose was the same as for the old paper and voice technologies: to communicate with Club members. There were new features in use, technology features that were available with the Web but not with voice or paper. This places the initial development into the "extend (paradigm modifying, innovation)" quadrant.

The Club sports notices described earlier could be seen as being "redesign (paradigm modifying, innovation)". Old features of the technology were still used. Pages were linked in an hierarchical tree structure: This was a direct copy from the older, hardcopy newsletter. In both newsletter and initial website, the tree structure was implemented as a "sports report" page which included a number of notices and reports grouped by sport. The sports report page was within (or linked under) a newsletter, which in turn was under Club publications. By the third stage of website implementation, however, the idea was new: Rather than report on each sport on its own, information was grouped by type. So "coming event notices" for all sports were in one part of the tree structure and "event reports" for all sports were in a separate part of the tree structure. Relative to the simple adaptation of codifying information to be presented on a website, this was an innovation.

The examples so far have involved adaptations of the technology structure. A key understanding within AST is that user structures may also adapt. For each adaptation we will need to consider the position within Table 1 for each of the structures. An adaptation that simply "refines" the website technology, for example, may "refine" or it may "transform" the user structures.

Changes to the organisation and work groups of the Club have, so far, been minimal. There have been some small changes to internal processes to ensure that the website is updated with new information. These changes are very clearly on the adaptation end of the adaptation-innovation scale: Old ideas were maintained and old features were slightly rearranged. This is a paradigm preserving adaptation, in the "refine" quadrant of Table 1.

A current proposal for the website is that it should support a "virtual community". The Club is a physical community, a group of members who communicate through the physical means of meetings and newsletters. A virtual community would use the Web to support computer-mediated communication, through electronic bulletin boards and chat rooms. This adaptation of the website would involve new ideas for the Club in its use of the Web. It would require a new technology spirit and use of new Web technology features. As such it would be a technology structure innovation, well up towards the innovation end of the adaptation-innovation scale. In terms of Table 1 it would "transform" the website.

The same change, to build a virtual community of Club members, would also require innovation in changes to the user structures. The present spirit of each Club structure is built on the concept of the Club as a "community", an environment for meeting and exchanging ideas. At present the Club is a "physical" community. Extending the Club into a virtual community would maintain the old idea (as stated in the Club website) of providing "a place to build long-term friendships and business relationships…" To communicate through the website with Club members, staff and management would need to adopt new features in their regular operations, new means of performing the task of communication. The organisation structures would need to "extend", to use new features to support old ideas in paradigm modifying innovations.

This section has developed the idea that the level of structural adaptation may range from adaptation through varying levels of innovation:

- Adaptation: Refinement of the existing spirit or features of the technology
- Innovation: Changes to the spirit of the technology (redesign), to the features of the technology (extension) or to both (transformation)
- The adaptation-innovation categories apply to all structures, including technology, work group and organisation
- A single adaptation may fit in different categories, depending on the structure being considered

Two More Points on the Scale

The adaptation-innovation scale has been presented as a matrix, this is the obvious format for a scale based on two simple dimensions. In terms of visualising overall impact, however, the matrix view is inadequate.

A simple adaptation – refinement of old ideas and old features – will have minimal impact on both technology and user structures. Compare this to an innovation where both ideas and features are to be transformed: Due to the scope of the change, the "transform" innovation will have more impact than the "refine" adaptation. In AST terms, transformation will involve changes to both spirit and features, refinement will involve neither. On a simple scale, refinement will be at the low end of the impact scale, transformation at the high end.

Between the extremes of the scale we can place "redesign" and "extend". The first involves modification of the spirit, the second modifies the features. A change to the spirit, to the underlying purpose of a structure, will have a major impact on that structure. A change to the features, to the way in which the purpose is implemented, will have less impact: The underlying purpose is intact, only the way in which it works will change.

Changing either spirit (ideas, underlying purpose) or features will have an impact on the structure. The impact will be greater than that of an adaptation, a change which affects neither spirit nor features. On the scale of potential impact, "redesign" will have more potential impact than "extend". Neither of these will have the impact of "transform", where both spirit and features will be changed. The resulting scale of impact due to adaptive structuration is shown in Figure 2.

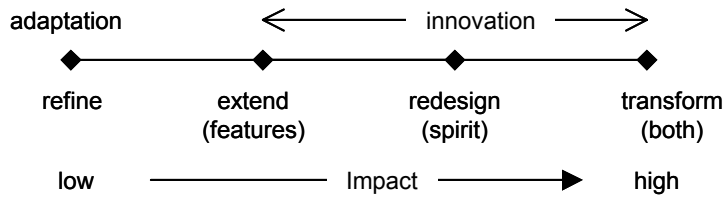

Figure 2 Adaptive Structuration Scale of Impact

SUMMARY

This paper develops a scale for the impact of adaptive structuration on technology and user structures. In particular, the paper develops a scale suitable for use when the new technology is the Web. An organisational website is constantly developing, it is in a constant state of reinvention or (at least) incremental change. This

lack of a clear endpoint makes a previously published scale of reinvention almost impossible to apply. A new scale of potential impact is developed and shown in Figure 2.

Although this paper does not discuss creativity theory in detail, the new scale is based on ideas from that area of knowledge. There are four key points on the scale. In order of increasing impact on the structure, the points are: refine, extend, redesign and transform. Whether the changes emerge or are planned, placing each change on the scale will give an early indication of the potential impact of that change.

Adaptive structuration theory deals with the affect of one structure on others. In particular, AST examines the reciprocal impacts of the technology structure on user structures. When using the new scale of impact due to a change, a change in one structure may have the same or different impact on another structure. When considering a possible change, the change should be placed independently on the impact scale for each relevant structure.

This paper has expanded one part of the AST model in order to apply it to and understand the more complex situation of the implementation of an organisational website. Parallel and future research will study and adapt other aspects of the AST model.

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