Systemic Problems in Information Technology Adoption and Use: A Systems Thinking Perspective

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Abstract
Understanding and creating the conditions under which information systems will be embraced by human organizations (thinking systems) remain a high-priority research issue. Despite numerous benefits associated with Information Technology (IT), there exist some intervening factors (systemic problems or issues) that impede technology's widespread adoption and use in organisations. Established information technology adoption models like TAM, TRA etc. view technology adoption from the users' perspective without taking a strategic perspective into account. As an alternative focus we suggest that addressing systemic problems can be a method of reducing fundamental barriers to organizational progress. This paper presents some real life examples of IT projects in organizations which experienced failures or barriers related to IT adoption processes. The issues are framed as systemic problems and are analysed from a 'systems thinking' perspective. The paper argues that some of the issues contributing to the failure/barrier cannot be easily explained by traditional user acceptance models like TAM or TAM2. The paper presents a number of systems thinking principles that can be used to analyse organizational contexts. It also provides some recommendations and suggests a new research direction based on the marriage of 'Systems Thinking' approaches and 'Adoption Model Theories'. This research will help in identifying the relationships between the determinant factors of the technology acceptance models and the concepts involved in systems thinking approaches. We believe the integration of the two approaches will facilitate improved technology adoption, organizational learning and change.

Keywords
systems perspective, systems thinking, information technology adoption models, systemic problems

INTRODUCTION AND RATIONALE
Information technology (IT) adoption in organizations has been extensively researched within the information systems field. Using IT to improve efficiency and create competitive advantage has been a major focus for organizations in the past few decades. However, adopting information technology successfully has not been without its challenges. Significant progress has been made over the last two decades in explaining and predicting user acceptance of IT at work. User acceptance models like Technology Adoption Model (TAM) (Davis 1989, Davis *et al.* 1989), Theory of Reasoned Action (TRA) (Ajzen & Fishbein 1980) and the Theory of Planned Behavior (TPB) (Ajzen 1991) have played a vital part in contributing to the organizational know how related to user acceptance of technology. TAM was later refined and extended to TAM2 (Venkatesh & Davis 2000) and the Unified Theory of Acceptance and Use of Technology (Venkatesh *et al.* 2000) to include additional key determinants of TAM's perceived usefulness and usage intention constructs, and to understand how the effects of these determinants change with increasing user experience with the target system. Information Technology, being a source of improvement in information flow, decision making, level of service and productivity gains however can sometimes face a number of potential barriers or *'systemic problems'* in its widespread adoption and use. This paper suggests a potential research area for incorporating *'systems thinking'* approaches in highlighting these concerns to facilitate technology adoption and use in different environments. The following section describes the theoretical framework of *'systems thinking and thinking systems'*. The third section discusses IT adoption failures experienced by some organizations. We present recommendations to improve IT adoption and use by periodically refining user beliefs. Finally, the paper suggests some future research directions.

SYSTEMS THINKING AND THINKING SYSTEMS
Systems thinking embodies an approach to understanding how things work, the central thesis is that the effects or outputs of any system are dependent on the interaction of its parts and that studying the parts in isolation will not provide an accurate picture of the system (Bertalanffy cited in Waldman 2007, p. 278). The concept has been

expanded and refined over time (Senge 1990, Beinhocker 1997, Ackoff 1999). While perceiving the idea of a system's functionality, one must study the multiple, cross level interactions overtime (Waldman 2007). Systems thinkers regard this as *anasynthis*, referring to make whole or put together (Aronson cited in Waldman 2007, p. 279).

An organization has a multi-layer administrative hierarchy, the outcomes or outputs of which are derived from interactions with the system composed of machines, computers and people. Systemic Problems in such systems produce unintended consequences. The application of systems thinking forces planners and strategists to focus on processes, interactions and causes of poor outcomes, rather than individual players, isolated components of a system or interim results (Waldman 2007).

According to Waldman (2007), systems thinking at the first step requires the consideration of scale or boundaries. The boundary consideration coherently defines *what* issues are to be included or excluded and *who is to be involved* with these issues (Midgley 2003). A system in one perspective or viewpoint (viz., healthcare) is a subsystem inside another (viz., the nation state) (Lazlo 1972). Systems thinkers must consider three inters: the interactions of components within a process (viz., heart surgery), the inter-relationships of processes within a system (viz., healthcare) and the inter-connections between systems and across time (Waldman 2007). For example, car's fuel burning and emission system interacts with the outside environment. The car may be able to produce the desired level of power but the undesired emissions' composition shall contribute to the environmental pollution in the long run. This recognizes that expanding the system's scale or boundary leads it to interact with the external environment, making it an open system. Expanding the boundaries of an organization makes it interact with the society. Thus, in addition to dealing with the interaction of its main stakeholders, 'systems thinking', in such a case, renders it responsibilities related to the societal issues, leading to the emergence, prioritization and integration of Corporate Social Responsibility (CSR) into organizational goals (Maon *et al.* 2008).

Thinking Systems are capable of learning, composed of purposeful thinking humans for actions that require decisions where there is no established right answer and can envision preferred outcomes in the far future. Learning implies moving from a state of lesser to a state of greater and certainly different knowledge or skill. Learning is a precursor to change and flexibility and adaptability are among the main characteristics of learning systems (Waldman 2007).

SYSTEMIC ISSUES IN IT ADOPTION AND SYSTEMS THINKING

It is widely acknowledged that organizations increasingly depend on Information Technology for the execution of a variety of operational, tactical, and strategic processes (Applegate *et al.* 2003). Despite the numerous success stories illustrating the advantages of bringing information technology into organizations, it is broadly accepted that the processes of designing, developing and implementing an Information System (IS) are cumbersome and not straightforward. Recent and older reports show that IS projects frequently fail. One of the most intriguing questions is: why do IS still fail if we know what causes a failure? The answer is that we still do not really understand the nature of IS failures. In these projects, various factors interact with each other leading to a complex amalgam that is hard to identify. If additional problems occur or if the root causes of the original problems are not effectively addressed, the problems grow worse (Devos *et al.* 2008). Not all causes of failure have an objective nature or seem to be connected with technology but tend to lean on fashion, perception, expectancy, pressure, internal or external politics and cognitive processes. Smith and Keil (2003) believe that some failures involve psychological, social and organizational issues that cannot be addressed with techniques such as the critical path method or joint application development (Smith & Keil 2003). Long lasting organizational problems are often as a result of *'systemic problems'*. We argue that systemic problems are fundamental difficulties related to motivation of staff, structural difficulties, competing stakeholders, and opposing world views that exist in organizations.

This section presents two case studies of failures/barriers experienced by organizations in information technology adoption and use. We apply a systems thinking perspective and identify some systemic issues resulting in barriers or failures. The consideration of these issues is based on systems thinking characteristics in the form of the following assumptions:

Assumptions

1. An organization is a complex thinking system.
2. An effective organization is a dynamic learning system.
3. It is essential to define the scale or boundaries of a system (organization) from a certain perspective.

4. The system(s) boundary could span up to one or more systems depending upon the interactive links (interfaces) involved in the perspective under consideration.
5. *Note:* The maximum limit of a boundary is the whole universe i.e. considering how the organization'(s') processes make a universal effect.
6. The systemic problems arise due to interventions between the processes/components/stakeholders of one or more systems interfacing with one another, depending upon the defined boundary.

Case Study1: Outsourced information systems failures in small and medium-sized enterprises (SMEs)
Some academics have already pointed out outsourcing increases risks leading to IS failures (Natovich 2003, Aubert *et al.* 2003). Devos et al. point out eight cases of IS project failures in SMEs as those enterprises tend to frequently outsource projects due to their dependency on external IT knowledge. In this case the system boundary comprises of two organizations/stakeholders i.e. the enterprise (principal) and the vendor (agent), as shown in Figure 1.

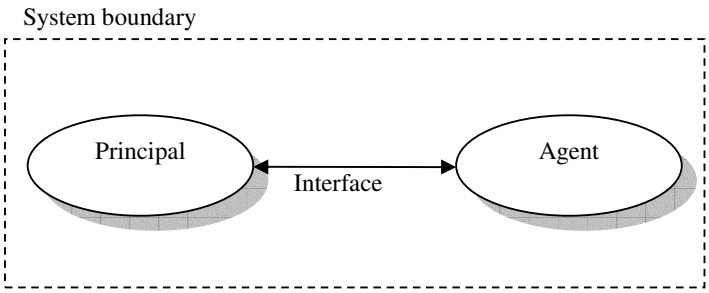

Figure 1: Systems perspective of Principal and Agent in IS adoption

Following are some major issues related to failure in such a scenario as mentioned by Devos et al. (2008).

1) Imperfections in contractual writing: The contracting parties may lack the necessary degree of rationality necessary to describe exactly the various states of nature in every ex-ante contract they draw up. The outcomes are not stated in measurable outputs and are only partly verifiable by organization members.

2) Information asymmetry: This is a typical situation for an SME (principal) and an Independent Software Vendor or ISV (agent). It is assumed that the agent often has private information about the quality of the IS that is not available to the principal. This puts the principal in a disadvantaged position. In all eight cases, the agents were found to have some private information. While in some cases, principals possessed some private information.

3) Lack of structural controls: Some of the studies indicated lack of structural controls (appropriate mechanisms including deliverables, reporting arrangements, meeting schedules etc.)

4) Vendor lock: Some studies were characterised by vendor lock (a lock-in situation in which the principal cannot get out of the relationship with the agent).

5) Lack of commitment: In three cases, the commitment (lack of oversight and engagement by executives) was found with the agents only while in the other three principals were found to have lack of commitment.

Case Study2: Barriers in Mobile Technology Adoption in Healthcare
Mobile technology offers great potential to improve the level of service, provide productivity gains and reduce costs in the healthcare sector. It can be used both for administrative and clinical applications. User groups include doctors, nurses, administrators and patients (Standing & Standing 2007). Figure 2 shows the system's boundary with all possible interactions/interfaces between its stakeholders indicated by Standing and Standing (2007).

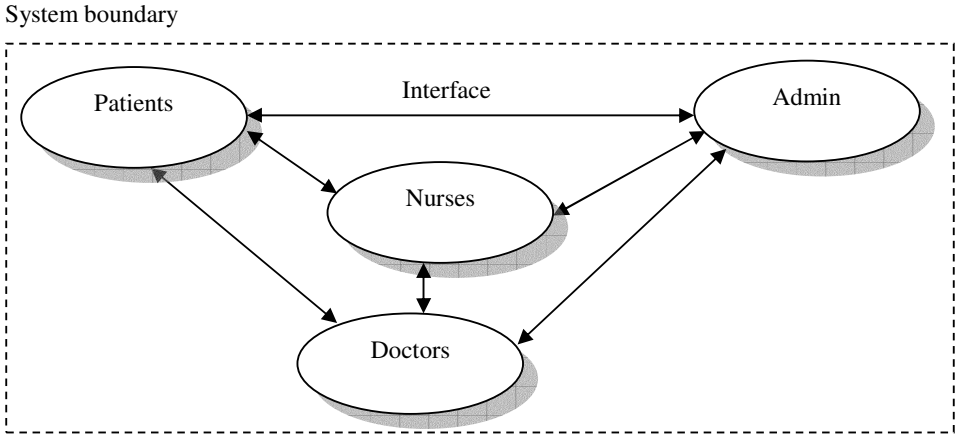

Figure 2: Systems perspective of Mobile Technology Adoption in Healthcare

They conducted a case study on a project involving 500 nurses, 600 home help personnel and 710 care aid workers. In addition to indicating the benefits, their findings also shed light on the barriers to mobile technology adoption and use as experienced by the nurses of a major health care provider. Following are some major systemic issues as indicated in their study.

1) Conservatism: The healthcare sector is highly risk-averse and lacks an innovative culture Nurses were found to be conservative and concerned about using mobile technology.

2) Lack of expertise: This lack of expertise was not only found in system users but also with the management for having poor change management skills. The nurses were not communicated a clear rationale for adoption.

3) Lack of training and support: Poor levels of support and no help desk provision lead nurses to give up using mobile devices.

4) Lack of system integration: The information systems integration challenges were evident but not insurmountable.

5) Privacy Issues: The devices were perceived as monitoring devices for the health care staff.

Note: The systemic problems indicated above do not involve all possible interfaces shown in figure 2.

ANALYSIS

Having identified the causes of failure/barrier in the above case studies, we now categorize them under the basic determinant factors of user acceptance models TAM and TAM2; the objective being whether the above systemic problems can be explained by these frameworks.

Considering TAM as a conceptual framework for the first case study, none of the above mentioned problems can be categorized under any determinant factor of the model under consideration. Using TAM2, lack of commitment, however can be categorized under experience. But in a vendor lock situation where the principal cannot get out of the relationship with the agent, application of experience to bring improvement into its system shall prove cumbersome for the principal.

Using TAM and TAM2 in the second case study, conservatism can be categorized under self-efficacy and computer anxiety while lack of training and support and lack of system integration can be addressed under facilitating conditions. Lack of expertise and privacy however, are issues not directly identified by TAM or TAM2. The project managers should have emphasized to the nurses about the achievement of improved quality of care through the use of mobile devices. The managers' assurance of a certain level of flexibility in the nurses' job could have cured the privacy issue (Standing & Standing 2007).

Although technology adoption can help developers and managers consider the key factors in adoption success they just focus on the user and do not take a strategic perspective. Researchers can only gain a limited understanding of a technology's potential success by using technology adoption frameworks such as TAM or

TAM2 and need to supplement this with a "systems" perspective that takes a more strategic view (Standing & Standing 2007).

OBSERVATION

Looking at the above case studies, it can be observed that some inter-connections in the system under consideration are actively involved in the identification of systemic problems between the processes/stakeholder than the others. The first case study is an exception as there are only two stakeholders. The second case study shows that the interface between the administration and nurses was the main indicator (hard coupling) of the systemic issues mentioned by Standing and Standing (2007). On the basis of this observation the interactions/interfaces may be categorized into two types:

***Hard Coupling*:** An interface indicating systemic issue(s).
***Soft Coupling*:** An interface free of systemic issue(s). This is an ideal condition.

RECOMMENDATIONS

The authors of this paper make the following recommendations in considering technology adoption from systems perspective.

1. Portray the entire system in the form of a figure, showing system boundary comprising of all the components/processes/stakeholders with all the possible interconnections/interfaces.
2. Categorize the interactions/interfaces into two types as listed in the above observation. The soft coupling can be shown in form of a normal interface as shown in Figure 1 & 2, while the hard coupling can be shown with a serrated or zig-zag line as shown in Figure 3.
3. Define a sub-boundary comprising of the components/processes/stakeholders and the interfaces contributing to the systemic problems, as shown in Figure 3. This will let us further zoom into the system, which will help us in further investigating about these systemic issues.
4. Identify an effective feedback mechanism leading to a healthy change or improvement into the system, consequently converting hard couplings to the soft ones.

CONCLUSION AND FUTURE WORK:

Although benefits associated with IT adoption are well known, systemic issues may tend to prevent its widespread adoption and use. Technology adoption frameworks such as TAM and TAM2 only give an understanding of technology's potential success from a single perspective at a time. They use a well-defined set of factors to determine adoption success. Systems thinking approach on the other hand, considers a system in its totality taking relationships among the factors into account from multiple stakeholders at a time. In technology adoption, there are a number of 'under the carpet problems', embedded within the relationships of system's components, which may go unidentified consequently putting hurdles in a project's success.

Further studies may be directed towards how 'systems thinking' approaches can be incorporated in technology adoption models finding the linkages between the two. These connections shall identify the relationships between the basic determinant factors of acceptance models and the steps involved in systems thinking approaches leading towards smoother technology adoption and organizational learning in the environment under consideration.

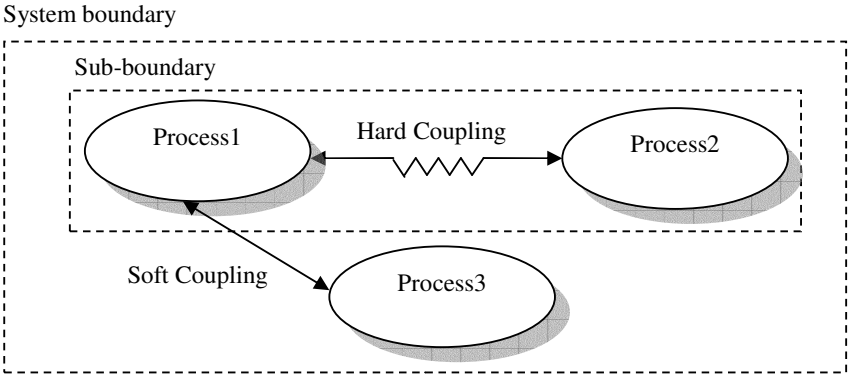

Figure 3: Hard and Soft Couplings

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