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Abstract

Those in organisations tend to adopt new technologies as a way to improve their functions, reduce cost and attain best practices. Thus, technology promoters (or vendors) work along those lines in order to convince adopters to invest in those technologies and develop their own organisations profit in return. The possible resultant 'conflicts of interest' makes the study of reasons behind IT diffusion and adoption an interesting subject. In this paper we look at IT diffusion and adoption in terms of technology (system features), organisational aspects (firm level characteristics) and inter-organisational aspects (market dynamics) in order to see who might be the real beneficiaries of technology adoption. We use ERP packages as an example of an innovation that has been widely diffused and adopted for the last 10 years. We believe that our findings can be useful to those adopting ERP packages as it gives them a wider view of the situation.

Keywords: IT diffusion and adoption, packaged software, ERP

1. Introduction

Diffusion of innovations is a complex and longitudinal process, which in the case of individual adopters, is mainly concerned with the process of decision making towards the adoption or rejection of the innovation. In the case of innovation adoption by those in organisations, once the decision to adopt has been made, implementation does not always follow directly. The complexity of the diffusion process is becoming higher as a number of individuals with different interests and agendas are part of this process.

The diffusion of technological innovations has been extensively examined in the literature as a phenomenon that is affected by the social and communication structures where it is manifested. There are various theories relate to the diffusion of innovations taking three main perspectives (Baskerville and Pries-Heje 2001). The micro perspective focusing on the internal nature of a single innovating organisation and the meso and macro perspective analysing how extra-organisational power dependencies shape the diffusion process. Other models related to the study of innovation diffusion are divided by Beynon-Davis and Williams (Beynon-Davis and Williams 2003) to rational, interpretive and knowledge based. The two latter models refer to the social construction of technology under investigation, focusing on the impact that specific groups, such as professional associations, have on the innovation decision process.

The most dominant and representative of the rational models is the diffusion of innovations theory of Rogers's (1995). Rogers (2003) defines diffusion as *the process in which an innovation is communicated through certain channels over time among the members of a social system.* His diffusion of innovation theory (DOI) has gained wide popularity in the IT field, with studies describing diffusion in terms of an S-shaped curve where early users adopt the innovation and then pass their knowledge to the later adopters.

In this paper we look at Enterprise Resource Planning (ERP) as a sociotechnical innovation, which is typically a package that is licensed for use to a client organisation. ERP packages are applications that are sold as being able to automate a wide range of processes within organisations. Moreover, their ability to facilitate the integration of processes and allowing those in organisations to tap into so called best practice functionality embedded within the software are common reasons why they are often perceived as innovative (Klaus et al. 2000; Swanson 2003). Thus, we view ERP packages as innovations and use diffusion of innovations theory to deepen our understanding of the IT diffusion.

The paper is structured as follows. In the next section we define our research framework, which our analysis is based upon. In section 3 we look at the technological aspects of ERP packages followed by the organisational and inter- organisational dynamics in sections 4 and 5 respectively. Finally we conclude the paper by summarising our findings and discuss implications as well as future research directions.

2. Aspects of IT innovation diffusion

Diffusion of innovations theory seeks to explain reasons behind individual or collective adoption of an innovation but has been criticised as not taking in to consideration the particularities of complex information technologies (Lyytinen and Damsgaard 2001). Thus, the theory has been judged as poorly equipped to understand how different groups interact in the production and provision of innovation as well as lacking attention to reinvention and consequences of innovation (Kautz and Pries-Heje 1996); (Allen 2000; Elliot and Loebbecke 2000; Papazafeiropoulou 2002). The use of other social theories such as stakeholder theory, social shaping of technology and economics of innovation theories have been proposed as supportive to DOI for the understanding of the diffusion and adoption of complex information systems phenomena.

In this paper we focus on the limitations of the DOI theories related to the assumption that the innovation will benefit the adopter (pro-innovation bias) and the conception that the change agents, diffusers or vendors in the case of ERP packages care about meeting the adopters needs and have the necessary knowledge to do so. In line with that we use traditional and contemporary models of the diffusion of innovation in order to examine the rationale behind the adoption of ERP by organizations. Our analysis is performed at three levels (technological, organizational, inter-organisational) taking also the time dimension under consideration. These levels are presented in figure 1 with the technological organisational and inter-organisational contexts having a multiple effect as they change or re-invent themselves over time.

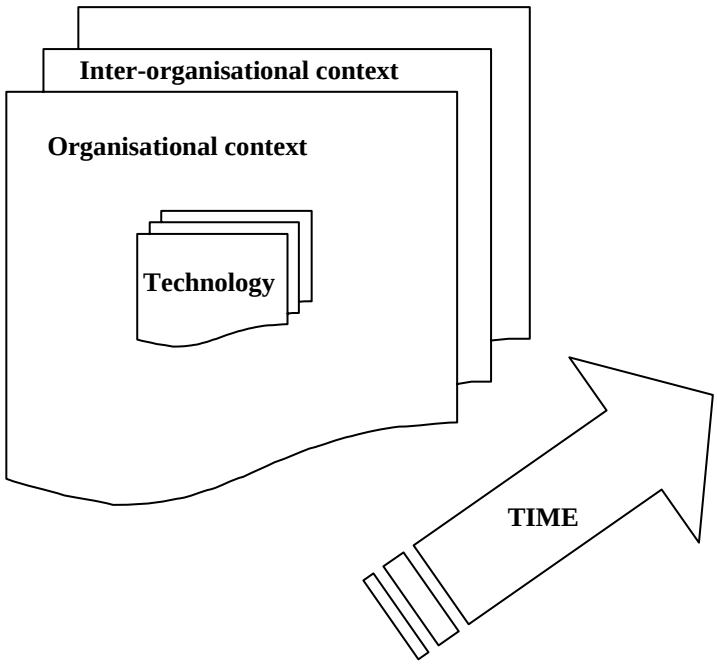

Figure 1. The technological, organizational and longitudinal contexts of IT diffusion

The theoretical assumptions used for the analysis of the levels are described below:

Technology. According to (Rogers 1995) there are certain characteristics of innovations, which explicitly affect the rate of their adoption. All innovations are not the same and there are some elements of the innovation itself that the potential users perceive as important (or not) during their decision to adopt or reject the innovation. These elements are the *perceived attributes of innovations* and can be divided to relative advantage, compatibility, complexity, trialability and observability.

- Relative advantage. The degree to which an innovation is perceived as being better than the idea it supersedes.
- Compatibility. The degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters
- Complexity. The degree to which an innovation is perceived as relatively easy to understand and use.
- Trialability. The degree to which an innovation may be experimented with on a limited basis.
- Observability. The degree to which the results as are visible to others.

Agarwal and Prasad (1997) also argue that innovation characteristics explain users' acceptance behaviour and based on Moore and Benbasat' s (1991) set of innovation attributes they extend Rogers attributes to demonstrability (the degree to which an innovation is easy to communicate to others) and image (the degree to which use of innovation enhances the individuals status in the organisation or the society in general). Finally the authors emphasise perceived voluntariness as another attribute that can be a reason for adoption as they have tested it for the user acceptance of the World Wide Web (WWW). The perceived voluntariness is the degree to which use of the innovation is perceived as being an optional

innovation-decision. In this paper we use these attributes to analyse the attributes of ERP packages as perceived by both diffusers and adopters.

Organisational context. The above attributes of innovation can be observed easier when the potential adopter is an individual user who needs to have these attributes in mind during the process of decision making towards the adoption or rejection of the innovation. In the case of innovation adoption by organisations, once the decision to adopt has been made, implementation does not always follow directly. The complexity of the diffusion process is becoming higher as a number of individuals with different interests and agendas are part of this process. In this paper we look at organizational attitudes towards ERP adoption as they shape through internal and external organisational pressures.

Inter-organisational context. Apart from the technology itself and the nature of the organisation where this is adopted there are a number of interrelated and sometimes conflicting factors that can explain the rationales behind the adoption or rejection of an innovation. These factors are mainly related to the social system where the innovation is manifested and have positive and negative effects on its adoption. These factors are defined by Rogers (2003) as:

- Communication channels (mass media or interpersonal)
- Nature of the social system (norms, degree of network interconnectedness)
- Extent of change agents' promotion efforts

Apart from Roger's model there a number of models described as interpretive by Beynon-Davis and Williams (2003) that criticise the rational account of technological diffusion and they emphasise the role of various actors and their interrelationships during the diffusion process. They argue that complex network of actors and their conflicting ideas or requirements can influence the adoption or rejection of a technology. In this paper we recognize the importance of the examination of various viewpoints related to the diffusion of technologies and we analyse the views and relationships of actors involved in the diffusion of ERP systems.

Time. One of the main critics of the diffusion research is its lack of attention and reinvention of innovations by the users (Allen, 2000). The degree to which an innovation can be reinvented in the process of its adoption and implementation depends on its flexibility and the eagerness of its adopters to customise the innovation to fit their unique situation. According to Rogers (2003) an innovation diffuses more rapidly when it can be re-invented and that its adoption is more likely to be sustained. ERP packages are by nature quite flexible and their global nature makes their customisation a necessity. In this paper we see how the changes that ERP packages undergo overtime affect the adopter organisations as well as those that plan to adopt ERP in the future.

Our understanding of IT diffusion as presented above is not far from studies looking at the micro, meso and marco levels of IT diffusion. Our research seeks to add the characteristics of the specific technology under investigation by examining the perceptions of actors related to the technology itself. The time dimension is also another aspect that we argue needs to be considered as IT innovations change rapidly as well as the users perceptions about them.

In the next section we look at the technical characteristics of ERP packages, which can give some initial 'rational' reasons for their adoption but which can also reveal other in-sights when examined further.

3. Technological aspects of ERP packages

A key argument in favour of ERP packages adoption is their *functionality* and the conception that potential adopters can find the "right" packages for their organisation without having to go through expensive custom development. This characteristic of ERP packages gives them a relative advantage over custom development helping the adopting organisation to attain economics of scale. Nevertheless, it is suggested that software packages seldom, if ever, match user requirements exactly (Gross and Ginzberg 1984; Weing 1984), while highly integrated sets of packages (such as ERP) may vary considerably in quality on a module-by-module basis (Andersson and Nilsson 1996). Thus, functionality is a technical characteristic that may be presented as advantage for ERPs packages but needs to be examined further as this is not always the case.

Another attribute of ERP packages that is promoted as advantageous over custom approaches is their lower *cost* (PriceWaterhouse 1996) (Klepper and Hartog 1992). Moreover, the costs of acquisition, implementation and usage of packages are argued to be more reliably predictable than for custom developed software (Golland 1978; Heikkila et al. 1991). Further costs arise when companies start customizing the packages to meet their specific company needs. Therefore, ERP projects might display 'cost over-run', problems normally associated with custom development (Remenyi et al. 1997). Thus, although ERP packages may be perceived as less expensive than custom development, there is evidence that this might not be the case.

Next in the list of positive ERP packages characteristics is their ability to help organisations *overcome legacy IS problems*. ERP packages have been widely cited as the 'solution' to the problems legacy IS may pose. The relative advantages of ERP packages in this respect are that they are argued to be: well structured and allow for maintenance and future development to be outsourced to a vendor (Butler 1999; Scheer and Habermann 2000); easily operated, supported and maintained due to the ability of the implementing organisation to tap into available a skills base for the software (Bingi et al. 1999; Sumner 2000; Willcocks and Sykes 2000); and well documented and organised (Golland 1978; Butler 1999). Nevertheless, we believe that to treat ERP packages as different to legacy information systems is inherently flawed. One study highlights the irony of the belief in ERP packages as the 'replacement' for legacy information systems - 41 per cent stated they were locked-in to the packages they had bought to replace 'legacy' custom built programs (PriceWaterhouse 1996). The implication of this is that although ERP packages may have diffused rapidly because of their perceived ability to relieve legacy information system problems, they may also introduce new ones.

Another conception frequently related to ERP packages adoption is their advantage of being *standardised products*. Whether it is to fit with 'industry standard' practices (Lassila and Brancheau 1999) or achieve synergy across national boundaries and product lines (Bingi et al. 1999), the allure of standardisation is a key reason for the purchase of ERP packages by managerial staff. At Dow Corning for instance, it was suggested by a Director in Europe that the SAP product would be a fast and effective way to attain global discipline and integrated common systems (Ross 1999). Thus ERP packages are thought to enable better

organisational communication through shared, standardised, systems and a belief in their ability to engender commonality. Yet, other studies of IT and standardisation suggest that standards cannot resolve problems in communication (Damsgaard and Truex III 2000). Implementing ERP packages will not necessarily reconcile communications problems or improve communications capabilities.

ERP packages are also promoted as '*tried and tested products*' as they are argued to be thoroughly designed and tested by the vendor, and in most cases, as having been installed by other organisations (Heikkila et al. 1991). For example, ERP package vendor websites contain the lists of high profile company cases that promote the benefits resulting from the implementation of their product. Yet again, there are problems with these assertions. There is the suggestion that ERP packages are 'better built' than custom developed software yet it has been suggested there is a lack of rigour in the product development processes of the packaged software industry (Carmel 1993; Carmel 1997). Additionally trialablility of ERP packages within the organisation before its actual purchase will be very difficult and costly and even if a product is seen to work at a reference site, it does not follow that it will do so in exactly the same fashion in another organisation (Light 2003), especially where various business units are globally dispersed.

Finally, ERP packages have been advertised as an easy way to face application backlogs. As ERP packages are pre-built, it has been suggested that information systems managers can expect shorter implementation timeframes and faster attainment of project objectives (PriceWaterhouse 1996; Li 1999). However, end-users still have to wait for the product to be built (Butler 1999), and when they have implemented it, they may have to wait for upgrades and maintenance activities to be performed (Gross and Ginzberg 1984). For example, those at Dell decided that the deployment cycle for the SAP package would have taken them too long. Their plan, to convert all of the company's information systems to the SAP package, was estimated to require several years to implement and thus the project was abandoned (Fan et al. 2000).

Looking at the perceived technical attributes of ERP packages over *time* we can see that ERP products undergo a programme of change overtime, what vendors might call product development. Thus, these changes to the package may impact upon those who adopt the next version of the software. The interesting point here is that what might fit for those in an organisation at one point in time, might not fit a few versions on when it becomes time to upgrade (Light 2001). Again, there is the potential for this problem to be further amplified where products are global, and consequently, so are product development efforts. Additionally, the constant reinvention of ERP packages can imply unpredictable costs resulting in projects going over-budget.

In the next section we look ERP adoption in terms of intra-organisational behaviours.

4. Organisational behaviours towards ERP adoption

When it comes to organisational adoption of an ERP package, or any other IT innovation, there are number of stands that managers take when they decide to invest in a specific technology. These stands are used to convince employees of the benefits of ERP adoption for the organisation.

It can be argued that people in organisations may choose to implement ERP packages with the explicit desire to force *change*, or use the ERP packages as the 'excuse' for change (Champy 1997). Nevertheless, this argument needs to be considered carefully when used for pronouncing the relative advantage aspects of ERP packages capabilities to drive change. ERP packages may be used to reinforce managerial control systems rather than improve everyday working life for operational staff.

Somewhat allied to the desire to implement change is the use of packages to adopt '*best practices*'. The central theme is that there are advantages to be obtained by adopting ERP packages over similar custom development because of the ability to 'buy into' the best practices, or best processes and functionality, that are written into the software (Klaus et al. 2000). However, questions have to be raised about possibility of the attainment of the perceived advantages to be gained from the adoption of standard best practices. The forerunner to ERP packages, MRP systems, were also supposed to embody best practices (Swan et al. 2000). The point here, which holds for ERP packages too, is that what may be good for one adopter may not be for another because depending on the contexts (either domestic one site, multi-site or international in nature) of which they are part of.

Purchase of packaged software can be related to the desire of the management to *'free up' the IS function* in the organisation and release of IS personnel to work on other projects. Another survey reported that 40 per cent of respondents felt that packages would allow for reductions in the in-house development team (PriceWaterhouse 1996). Therefore, many managers might interpret these findings as a way to slash the need for in-house information systems support and thus reduce their operating cost base. Potentially, there may not be a need for the requirement for a large development work force, however the market-oriented context of ERP packages clearly requires the in-house information systems function to perform new tasks (Sawyer 2001). Moreover, if customisation needs to be performed, some development work will still be necessary (Light 2001). Thus, the extent of the suggested and perceived possible reductions in the information systems function may be overstated as a reason for ERP package adoption.

Those in organisations may also argue that adopting packaged software and thus ERP is part of their *organisational policy*. Sometimes adoption is an authority decision such as at Siemens Power Corporation, where the use of ERP packages was company policy (Hirt and Swanson 1999). Moreover, the policy was more specific in that it specified a particular product (SAP). Thus, there is the potential for policies to influence ERP package adoption because of the assumption being made by policy makers that there is a product in the market that will meet organisational requirements and even more so where a particular product has been specified in advance.

Another not widely reported reason for the adoption of ERP packages is to impress other organisations. For example, a reason for the adoption of an ERP package in one study was "To be able to show the big boys" (Adam and O'Doherty 2000) and in another, it was because many other chemical companies were implementing it (Ross 1999). As one survey highlights 66 per cent of respondents agreed that "without this package we would be at a competitive disadvantage in our industry" and 50 per cent were motivated to adopt because "we were one of the first in the industry to adopt this package" (Swanson 2003: 65-66). A reason for adoption might also be that the organisation wants to obtain the kudos of being perceived as at the cutting edge (Oliver and Romm 2000). The processes and reasons for adoption are often fuelled by bullishness and ideas of being fashionable (Kieser 2003). As

(Abrahamson 1996) argues, certain social groups are active in providing ideas and in setting fashions amongst firms about what is considered to be the latest and best practice. Thus, in our case, the promotional effects of change agents, mass media to adopt, 'or die', become clear, if not necessarily sensible reasons for adoption.

Taking the *time* dimension is terms of organisational behaviour towards ERP adoption, we suggest that the changeable nature of ERP packages can contradict arguments, such as the 'freeing up' of the IS function, as customisations may be the source of a considerable workload for the existing IS department.

5. Inter-organisational dynamics of the ERP market

The environment external to the organisation has also an important role to play towards the decision for adoption or rejection. The social environment or the market dynamics are considerable forces influencing organisations behaviour towards a particular technology.

More specifically, the influence of act of selling from vendors is an obvious, but often overlooked reason, for ERP package adoption. (Oliver and Romm 2000), suggest that packages could not be a solution to organisational problems unless vendors were selling them. What this means is that those in organisations may adopt ERP packages due to an approach by a vendor. This may also include the use of, or reliance upon, vendor promotions, publications, market surveys, the Internet, and other adopters. For example 'strong ERP vendor marketing' and 'The right solution and message at the right time ' have been cited as key reasons for its adoption (Klaus et al. 2000). Therefore, those in organisations may be 'sold' the idea of ERP packages and consequently a particular product. Moreover, this selling activity may be linked with 'over adoption', where an ERP package is chosen where it was not necessarily the best choice.

Another influence of the environment in organisational decision to adopt ERP is the view that ERP packages give organisations access to a broader knowledge and skills base. As ERP packages are usually produced for a mass market and this is inevitably perceived as affording a wider availability of support, and thus relative advantage over custom developed software (where knowledge of the software is supposedly specific to the application). Problems may however, arise if a particular form of package or a specific product become very popular and this may lead to difficulties for end-users in a consumer organisation being able to obtain the skills they need. Therefore, although ERP packages may be chosen to 'buy into' a knowledge and skills base, difficulties may arise with 'successfully promoted' and widely adopted innovations. It also follows from this that problems may also emerge if a product is, or becomes, less popular which might mean that the support for the package may be hard to find. This question of popularity is not just related to the package in question but also to the propensity of those who may support the package to continue providing this.

Looking at the inter-organisational dynamics of the ERP market over *time* we can see that the provision of a large knowledge base in the ERP market can be limited as extensive need for customisation might 'use up' the custom developer base. This brings with it a similar requirement for a set of skills that may also reduce in popularity, a commonly recognised feature of the IS profession due to the need for developers to constantly reinvent themselves (Brancheau et al. 1996; Kotamraju 2002), and the supremacy of development over maintenance (Swanson and Beath 1989). Consequently, although the decision to purchase ERP packages may limit the problem of finding someone who knows about the software,

they share the problem of acquiring the skills base. For example, the lack of SAP consultants in the late 1990s/early 2000s (Sumner 2000; Willcocks and Sykes 2000), echoes the reported shortage of Assembly skills in 1994 (Bennett 1994).

In the next section we summarise and discuss our findings by looking at the three aspects of IT diffusion collectively through the time dimension.

6. Discussion

The technical characteristics (presented in section 3) that are attributed to ERP packages explain partially the rationality behind their adoption by organisations today. ERP packages seem to have relative advantages over custom developed software in terms of functionality, cost and use of standards. Additionally they are presented as compatible with existing platforms while they considered as less complex than their legacy IS. Finally, their trialability and osbervability is perceived as standard as ERP packages are presented as tried and tested products that offer visible results. Nevertheless, our analysis showed that all these attributes often can be perceptions rather than 'real' attributes. This finding leads to the tenable question of who attributes those frequently misleading characteristics to ERP packages and why? Table 1 summarises the findings of our analysis and might be helpful in answering the question.

Table 1. Aspects of ERP diffusion

	Technology	**Organisational behaviour**	**Interorganisational dynamics**
	Functionality	Change	Access to broader knowledge and skills base
	Cost	Best practices	Influence of acts of selling
	Overcome of legacy IS problems	Free up the IS function	
	Deal with applications backlog	Policy	
	Tried and tested	Bravado	
	Standardisation		
Time	Constant changes over time can reduce function and cost fit attributes	Extensive changes may use up keep company's human and technical recourses	Extensive customisation may use up the developers' base

Looking at the organisational aspects of ERP diffusion (analysed in section 4) we can argue that the acquisition of an ERP package can be related with the desire of the organisation to appear to have certain characteristics and behave in a certain way within their environment. Decision makers within the organisation can justify their decisions by using well polished reasons such as organisational policy or desire for change in order convince end users for the benefits of the package. Additionally, looking at the inter-organisational dynamics (analysed in section 5) of the ERP market, it is clear that vendors have any reason to give certain characteristics to ERP packages in order to 'sell' them. Finally the time dimension adds to the

argument that ERP adoption should be looked at as a long-term investment that may involve a number of possibly costly changes at technical, organisational or inter-organisational level.

Our analysis does not suggest that there are not ERP packages in the market today that actually meet organisational needs and benefit companies, but we do suggest that organisations should not blindly conform with 'common sense' when it comes to the adoption of an innovation. We additionally argue that looking at the 'perceived' attributes of an innovation as the diffusion of innovation theory suggests, is over-simplistic as the perception of a user organisation about an innovation does not always agree with another.

We believe that our analysis can be useful to people in organisations wider view of IT adoption and have a better understanding of the technology itself, internal organisational behaviours and interorganisational interplay. Our research can be extended in using our framework to examine the adoption of different technologies in various market settings.

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