The Phenomenon of Diffusion

Red Herrings and Future Promise

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Abstract: Diffusion is at the core of WG 8.6.[2] Employing Rogers' diffusion theory while in principle addressing other sorts of phenomena is an historic research problem. The applicability of Rogers' theory is discussed using the perspectives of mechanic and organic organizational settings, reaching the conclusion that Rogers' diffusion theory has only limited validity. Diffusion is defined generically as the spread of IS/IT among almost any organizational unit and its constituencies. No theory of diffusion has been developed as yet. Hence, diffusion, at best, might is an umbrella for strategy, innovation, network theory, social structural theory, and a host of other approaches to understanding change in organizational settings. Researchers need to clearly define their research scope and theory base, if we as a group are to contribute to the cumulative research, the principal prerequisite for ensuring value for practice. No doubt, in the near future, more IS/IT products, frameworks, and methods will be seen. Organizations must embark on multiple change processes that require other business, managerial, and methods approaches than are in place today while at the same time maintaining the use of well established and understood practices. These are issues that WG8.6 should address.

[2] Excellent reviews of research issues in diffusion theory and comprehensive lists of published work are found in Bayer and Melone (1989), Fichman (2000),; Moore and Benbasat (1991), and Conger (1995), and Wolfe (1994). Since this article does not include a bibliography, the reader is encouraged to review these sources.

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1. INTRODUCTION

The International Federation of Information Processing (IFIP) Working Group 8.6 uses diffusion as an umbrella in defining its goals. Contributors to WG8.6 working conferences have presented multiple views on software diffusion and Rogers' diffusion theory has been frequently used and cited (Prescott and Conger 1995; Rogers 1995). Substantial criticism has been raised with regard to research using diffusion theory a platform. It is argued that in Rogers' diffusion theory, the research scope is too narrow, the actual observed richness of human behavior is not taken into account and the theory's specification of diffusion decisions, when compared to real organizational diffusion management, render us with more questions asked than answered (Bayer and Malone 1989; Damsgaard and Lyytinen 1997; Wolfe 1994).

Of particular concern here is the difference in meaning between Rogers' diffusion theory and the diffusion as the word is defined. According to the *Concise Oxford Dictionary,* diffusion is defined as "sending forth or shedding abroad." Hence, related to our field, the semantic meaning of diffusion would include the transition among units of analysis of anything that is wholly or partially an information technology (IT) or information systems (IS) related innovation (Swanson 1994) among nations, organizations, groups, or individuals. It would also include agencies or virtual communities supporting IS/IT diffusion – run by the United Nations, governments, chartered diffusion organizations, consultants, software developers, IT departments, or local change champions. In short, diffusion includes almost anything and leaves little out.

In contrast, Rogers' diffusion theory at its core is relatively precise. Diffusion is defined as "the process by which an innovation is communicated through certain channels over time among the members of a social system" (Rogers 1995, p. 5). Somebody develops an innovation. The innovation has (user) features that can be fairly exactly described and it is clearly separated from other physical objects or abstract phenomena. The innovation is in essence without modifications, spread to people who individually decide whether or not to adopt the innovation. Information about the innovation is initially spread through channels such as professional associations and journals. Next, news about the innovation is communicated through a social network where the first adopters are key. From these prerequisites follows the division of adopters into the categories of early adopters, early majority, late majority, and laggards but also the S-shaped growth curve. Rogers' diffusion theory is heavily pro-innovation, otherwise defining some users as laggards would not be a key part of it.

An historic research problem has been using Rogers' diffusion theory while in principle addressing all other sorts of issues that may or may not be diffusion related. This paper discusses the appropriateness of employing Rogers' theory in organizational settings. Next, diffusion is put in context. The discussion section debates the future of diffusion research. The last section presents conclusions.

2. ROGERS' THEORY IN ORGANIZATIONAL SETTINGS

Contrary to popular wisdom, a thorough review of the literature documents that studies within the IS/IT field keeping true to Rogers' diffusion theory are preciously few. The classic example of research keeping true to Rogers is Brancheau and Wetherbe's (1990) study of the diffusion of spreadsheet software in the heyday of end-user computing. They found that, at the time of the study, IT departments had not yet awoken to the challenge of end-user computing. The decision to use spreadsheet software was left to the discretion of the individual user, in agreement with the prerequisite in Rogers' theory that the decision to adopt is decided at the individual level. A few users were found to be early adopters and some were found to be laggards. The finer shades of early and late majority could not be verified. Additionally, with regard to information source, early adopters were oriented toward professional associations and journals while later adopters depended upon early adopters for information about the new innovation. The cumulative adoption curve was found to be linear as well as sigmoidal.

The second research contribution keeping true to the theory is Moore and Benbasat (1991). Using a workstation as the innovation, they developed a scale for measuring the key concepts of relative advantage, compatibility, complexity, etc. The scales were confirmed using split sample research design.

These two studies strongly indicate that (at least aspects of) Rogers' diffusion theory has relevance. However, problems exist. For example, today employees, as the general rule, cannot decide what IT tools they would like to use. The compelling reason is that the present IS/IT portfolio has become so large and complex that individual adjustments cannot be tolerated. The organization, through its IT strategy, infrastructure design, and IT department, decide the end-user IS/IT portfolio and features. Individual users do not decide their workstation capabilities but must make choices in accordance with established specifications. With regard to individual attitudes and perceptions, it may be argued that Moore and Benbasat's scale has nothing to do with Rogers' diffusion theory. Faced with any IS/IT

innovation (and perhaps other types of innovation as well, provided the name of the innovation is adjusted), people may exhibit attitudes and perceptions similar to those measured by Moore and Benbasat's instrument. Hence, the instrument might have validity in many settings but may not measure aspects of a Rogersian diffusion process. A good example of how the instrument may be used is found in Karahanna, Straub, and Chervany (1999). They studied differences in beliefs among users and non-users of Windows. Although the focus of the study was before and after adoption (of Windows), the authors did not frame their study within Rogers' diffusion theory.

The problems with other research claiming to study Rogers' diffusion theory are more profound. A common approach is to divide a sample into users and non-users or early adopters and late adopters (for example, Drury and Farhoomand 1996; Premkumar and Potter 1995). The delineation is used to study dependent constructs such as information satisfaction, relative advantage, product championship, or cost. These phenomena might be of interest and might have importance but there is little connection to the core constructs of Rogers' diffusion theory. In fact, differentiating between the two categories of use and non-use is convenient but cannot be said to represent theoretical reflection. More likely than not, using a totally expected and common phenomenon such as use and non-use, which is relatively easy to measure as the independent driver, will almost by default document differences within most dependent constructs. The end result may be confusion and theoretical nonsense.

The impression that researchers pay lip service to Rogers theory and published results is strengthened through the finding that work published after 1991 addressing the issues of relative advantage, complexity, etc. frequently does not use, discuss, nor in fact cite, Moore and Benbasat's article. It may be the case that Moore and Benbasat's scale does not have validity. If so, we would expect that authors, who for all practical purposes should be aware of the scale, would discuss why it could not be employed. The lack of sincere theory building is a fundamental problem that may be general in nature within our field and not necessarily a criticism directed at Rogers' diffusion theory in particular.

In summary, four main reasons why Rogers' theory does not have high explanatory power in organizational settings are presented (Fichman, 2000). First, organizational IS/IT innovations are more complex than Rogers' diffusion theory specifies. Second, the IS/IT innovation processes unfolding in the "adopting" organization are richer and more diverse than sigmoidal. Third, the division of (future) users into the categories of early adopters, early majority, late majority, and laggards is at best unproven but more likely an introduction of social complexity, yet simplicity, that implies

semantic meaning contrary to innovation process needs. Fourth, decisions are overwhelmingly organizational rather than individual.

Keeping with the concept of adoption, an illustration of the complexity in IS/IT innovation is taking a large standard software application into use (ERP, document handling, etc.). Because of organization specific needs, applications are commonly not installed as is but changes are made beyond parameter settings or module selection. These changes may apply to the entire standard application package but may also be business area specific (marketing, production, procurement, etc.). Since off-the-shelf software applications may not totally fit expressed needs, smaller ISs are usually created as an integral part of the process "to fill the gaps." Once installed, it is quite common to find that departments, groups, and individuals do not use application features that the formal software owners and planners deem critical. Also, departments, groups and individuals more often than not create IS and non-IS shadow solutions to bridge the gap between installed software application features and the way business is actually done locally. The formal software planners and owners are oftentimes not aware of the amount and importance of non-use and local innovations. Last but not least, shadow solutions may spread from the "creators" to others who see their business value. In addition to the degree of non-communication between developers and users that the phenomenon of shadow solutions documents, severe problems may occur with regard to quality and support. These themes are illustrated in Figure 1.

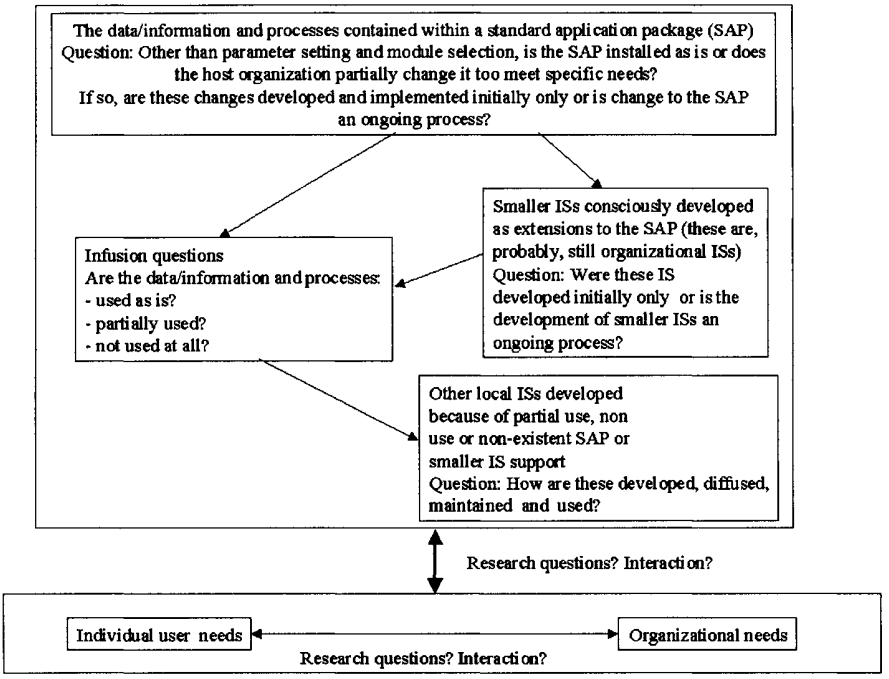

Figure 1. Process Elements in the Adoption, Development, and Use of Standardized Software Applications

It can be concluded that most processes included in Figure 1 are not Rogersian diffusion processes. For example, the main development process of adjusting a standard software application to specific organizational needs has very much in common with the well established field of systems development. Within this area, research reports on strengths and weaknesses with regard to

- phase content and sequence
- the ability of developers, managers, and users to specify present and foresee future requirements
- user participation, comparative knowledge levels, and training needs
- implementation challenges
- the role of maintenance when a system is taken into use

are abundant. Hence, stating that diffusion does not apply as the grand theory for understanding the adoption of standard software packages should not be a surprise.

In fact, traditional systems development theories, such as the waterfall model, have been supplemented and partially replaced with evolutionary development and prototyping. With regard to the adoption of standard

software applications, Cooper and Zmud (1990 - referring to an unpublished manuscript by Zmud and Apple 1989) suggested the phases of initiation, adoption, adaption, acceptance, routinization, and infusion. A generic model for IS/IT innovation consisting of the idea phase, the creation phase, and the usage phase has been suggested (Larsen 1998). Models describing the interactions between individuals and the organization when innovation is key include complex issues, phases, and reciprocal interactions (Glynn 1996). Compared with Rogers' diffusion specifications, models of the nature discussed above more richly describe the source of an organizational innovation, the complex process in its development, and the processes that occur after an innovation is taken into use. Complex innovations also may develop in the patterns of evolution, dialectic, life cycle or teleology, or their combinations (Van de Ven and Poole 1995; Robey and Boudreau, 2000).

Diffusion theory might be of partial value. For example, it may be a starting point for understanding how shadow solutions spread through an informal social network. Additionally, the concepts of trialability, complexity, etc. may assist us in understanding user beliefs, attitudes, and behaviors with regard to a new system. Knowledge about user reactions might be used in planning and implementing actions aimed at securing strengths and minimizing risks. Such actions may include the redesign of particularly negatively viewed features or additional communication with users to explain the compelling reasons why (aspects of) an IS must be accepted.

The underlying theme in the discussion so far is that the employment of any particular theory must be firmly based on a succinct description of the research setting and objective. Finding when and where Rogers' diffusion theory (or the concept of diffusion) is relevant may be a challenge in the traditional standard software application domain. Looking forward into the near future, we seem to approach a development situation characterized by a shift in focus from acquiring finished solutions to a focus on strategies, IT platforms, and tools that are change resilient. That is, rather than seeking to buy a standard software application from a particular vendor, organizations will increasingly look for IT products that allow the maximum degree of freedom for making changes with as little effort as possible. We see this change in attitude in the area of ***E***-business, but the prerequisite that software solutions are change robust will also increasingly apply to almost every aspect of hardware and software. The differences between traditional issues within systems development using components created outside the organization and traditional approaches and future innovation oriented practices are illustrated in Figure 2.

	Traditional data oriented (standard) software applications and tools	(Future) innovation oriented (standard) software applications and tools
Organizational level	•Major application development defines IT strategy •Systems development •Top down management philosophy **•Rogers' sigmoidal diffusion pattern applies, inclusing adopter categories**	•Business and IS strategy are linked •Platforms and infrastructure •Focus on application and tool ability to accommodate future change requirements •Evolutionary and prototyping developments •Processing new ideas throughout the organization (combining top-down, middle-out, and bottom-up) •Informal organization recognized as equal to the formal organization
Individual level	•User participation •Feature oriented user training **•Innovation characteristics (compatibility, etc.) related to shell (application, workstation)** **•Shadow solutions spread informally through social networks**	•Information (knowledge) focus •Idea sharing •Training oriented toward present and future interaction among business, information, and IT needs and feasibility **•Innovation characteristics (compatibility, etc.) related to innovation and business value**

Note: Issues using or that may use Rogers' diffusion theory (elements) are printed in bold.

Figure 2. Main Issues Within Traditional Software Adoption and Future Innovation Oriented Practices

It is evident that using Rogers' diffusion theory in the new setting requires even more precise argumentation than is the case in traditional settings. Also, the concept of diffusion becomes exceedingly problematic. We may study the diffusion of software applications and tools. However, each component is quite likely only a smaller piece of the organizational IS/IT infrastructure and portfolio. Organizations will be concerned with creating genuine business-value-added use of IS/IT. Hence the overall objective will be combining off-the-shelf components in ways that are tailored to the organization, otherwise organizations cannot differentiate themselves in the marketplace but converge toward look-alikes. The emerging business benefits are created through innovations large and small. The focus will be on knowledge and information and not on data processing. Diffusion theory may be applicable but it will hardly have a dominant role on the center stage.

3. THE CONCEPT OF DIFFUSION IN CONTEXT

The previous section argued that the employment of diffusion theory requires careful thinking about research setting and concept applicability. Diffusion as an umbrella term may not be a rich and timely concept for understanding how business value is created when the need for innovation

dominates. Continuous arguments about value in discussing diffusion may resemble the proverb of "the futility in flogging a dead horse to make it move."

Building on the observation that many institutions and actors may have a role in diffusion (Damsgaard and Lyytinen 1997), Fichman (2000) argued that diffusion studies may be categorized along the two axes of primary (community level) vs. secondary (adopter level) and perceived vs. objective (characterisitcs). The principle forwarded here is "reactions to an innovation or clusters of innovations." The author argues that understanding these reactions may influence the formal adoption decision process positively. Since one might infer that the IS/IT innovation is known, the principal mode of this type of research is reactionnary. The contrasting view would be that structures (for example, attitudes and beliefs) are not located in organizations or in (IS/IT) technology, but are enacted by users (Orlikowski 2000). Saying that a person is in the driver's seat indicates that reactions to existing innovations are only part of an innovation process. It is obviously true that IS/IT innovations exist in the market place but they cannot be incorporated into an organizational innovation process unless a person or group decide that a particular IS/IT should be adopted and taken into use (Larsen 1998).

A qualified answer with regard to the applicability of the concept of diffusion requires putting it into a wider context than already presented. Van de Ven and Astley (1981) forwarded the notion that organizational theories might be viewed in the two dimensions of within an organization versus within the wider environment and structural versus process approaches to theories and issues. A framework adapted for IS/IT innovation is presented in Figure 3.

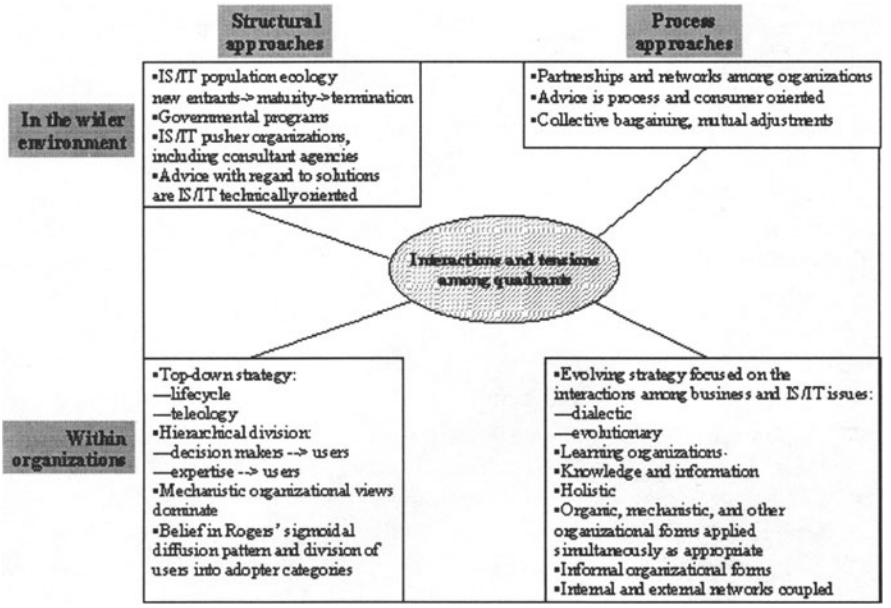

Figure 3. The Two Dimensions of Within Organizations Versus in the Wider Environment and Structural Versus Process Approaches to IS/IT Innovation. (Adapted from Van de Ven and Astely 1981, Figure 11.2, p. 431)

It would seem appropriate to observe that the concept of diffusion carries relevance within the structural approaches. Governments create programs to encourage IS/IT industry growth and increased use in the society as a whole (European Commission 1996). Universities and industry create special technology institutions mandated to educate prospective users and push novel technologies into social as well as industrial organizations (Charlton et al. 1998; Swan, Newell, and Robertson 1998). Within the organization, managers and IS/IT experts unite forces to develop and implement, for example, ***E***-business applications. Organizations use consultants extensively in the hope of learning how to harvest benefit from the latest IS/IT developments.

The troublesome aspect is the semantics of diffusion. It implies that somebody has something that others would benefit from, if only the recipient is educated and convinced about the positive aspects that would be gained. Hence, diffusion channels becomes a vital part of the diffusion "Weltanschauung" (Checkland and Scholes 1990). To a large degree, the diffusion owner decides the distribution channel mix and activity level. Ultimately, diffusion implies an elitist view with regard to innovation. Those who have transmit to those who have not. Those who know decide over

those who do not know. Those who have and know are in the driver's seat while those who have not and those who do not know are passengers.

Abiding by "diffusion thinking" might be a very efficient implementation approach provided the knowledge "diffusion recipients" possess is not required, making the core innovation right. Seemingly, this is increasingly not the case (Nonaka 1995). Top managers and IT/IS experts do not have sufficient insight into strategic IS/IT needs and requirements. To make sure that the business-IS/IT needs are satisfactorily explored and that solutions serve opportunities, many interest groups must be included in the innovation processes. This is the core concept of the process approach. It implies appropriate collaboration and the acumen to include general as well as in-depth expertise from idea birth, throughout the development process, throughout a system's usage phase, including system termination (Larsen 1998).

Obviously, the process approach does not imply a near global innovation happening and including everyone, or that we may be victims to benign human thinking; that is, true democracy means that everyone by default contributes equally. It is exceedingly difficult to believe that routine jobs will disappear, that everyone is genuinely interested in innovation and taking responsibility, that everyone from birth is equally equipped, or that the global society and its industries in the foreseeable future can afford "process" as its sovereign political foundation. Conversely, changes will occur, process is a fundamental need to ensure survival, customer value must be created, jobs as we know it will evolve, and firms must make profits (Rifkin 1995).

Hence, the process approach includes the employment of structural solutions where efficiency and certainty (with regard to, for example, production process, products, or customer segments) dominate. Wherever structural processes represent the best approach, the concept of diffusion may play a role. The prerequisite forwarded here is that, to the best of actors' ability, structure is decided as fitting the needs.

The division between organizing for flexibility and efficiency simultaneously is nothing new. The division has been extensively described with regard to organizational principles applied to research and development units versus the rest of the organization (Burns and Stalker 1994). Lawrence and Lorsch (1967) argued that production departments needed structure while the integration between production and marketing needed flexible solutions. Today, professional materials convey the impression that it is taken for granted that flexibility is needed in many business situations – although it cannot be said that theories that discuss when and where process or structure applies are in abundance.

Van de Ven and Astley point to this challenge by stating that although each of the quadrants (in Figure 3) are of importance and interest, the most fruitful research would be in investigating the interactions and tensions among them. The proposition is more relevant than ever.

4. DISCUSSION: THE FUTURE OF DIFFUSION

It may well be that our preoccupation with diffusion stems from the fact that the IS/IT industry relentlessly puts new concepts and products into the market place, as illustrated in Figure 4.

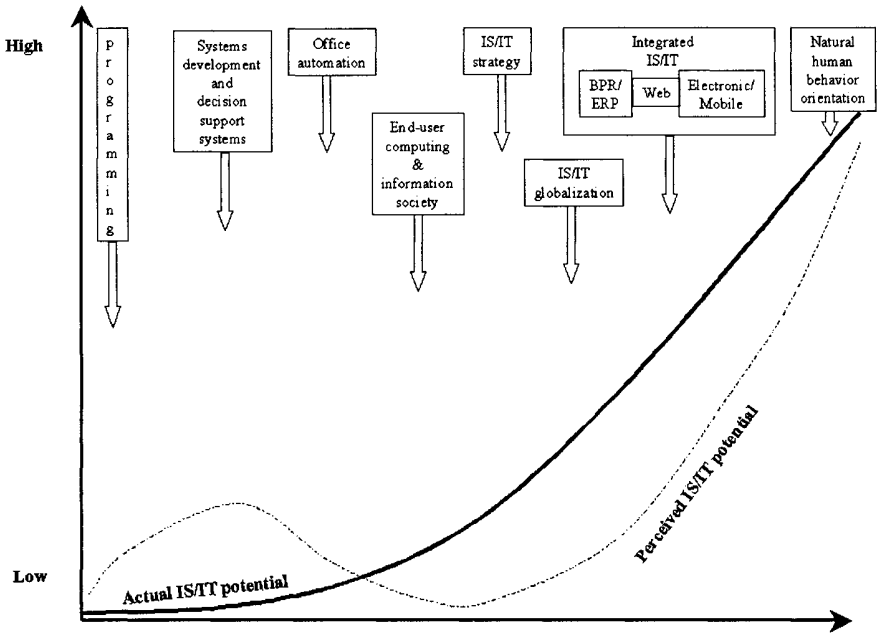

Figure 4. The Introduction of IS/IT Concepts Over Time

The present surge of integrating IS/IT across place and time may, in historic perspective, be viewed as the most active period of our field ever. The emerging technologies may soon be taken into common use. However, the solutions we see emerging today may not fully meet customer expectations. For example, the computing processing time is too long. The reason why is easy to understand. New web services require that not only data but also relatively extensive amounts of code (Java, Applets, Agents, etc.) are transmitted back and forth to make transactions work. Although

moving process bars are made part of the user interface to stall user impatience, we know for a fact that wide band transmission will be introduced to minimize waiting time but also to make true two way multimedia services happen. Another characteristic is that most web services offered today mirror yesterday's industry structure. Airlines, banks, insurance companies, or car dealers offer solutions that mirror each firm's business needs. For a customer, finding the cheapest and most convenient travel route, the best bank partner, the best fitting new car or car insurance using the web is a time consuming and frustrating process.

This is why, as Figure 4 suggests, a new main IS/IT development stage is under way: the "natural human behavior orientation." This stage has information needs, as the customer wants it as its focus. It is anticipated that the customer will ask focus on issues such as:

- I want my banking, finance, and insurance taken care of as a whole. Who are the providers? What will it cost? What additional services are offered?
- For our summer vacation, my family, consisting of two adults and two children, would like to go to Maliorca. Are there hotels or apartments available? We would like to take a variety of excursions. What kinds of excursions are available? We would like a rental car that meets certain specifications of size and type. Can the requirements be met? Who are the providers? What is the cost? What additional services are offered?
- Here are the specifications for a new car; up to two years old would beacceptable. What can car dealers offer? What is the financial deal? What do customers having this car think? What are the "customer watcher" remarks and findings?
- I want my workstation to be organized as a dashboard.
- As a researcher, I want easy access to publications, methods overviews, analysis tools, and research instrument creation

Most probably, the customer would like to service-browse sitting on the sofa using the television. The first wave of services of this nature are already offered. The argument made here is that this will be the rule and not the exception. Last but not least, the interaction will be genuinely multi-media – video presentations of place, product, and product use will be included.

We may safely expect that more IS/IT products, methods, and knowledge will be diffused than ever. There will be experimentation, success, and failure. The phenomenon of IS/IT diffusion has a rosy future. Yet, the problem is that diffusion is generic. A word that may be used for everything is not a good starting point for deep understanding. Hence, focus must be articulated: diffusing new products among industries is most likely best viewed as industrial marketing, making individual customers use a service

has very much to do with consumer marketing, and the development of new IS/IT solutions implies strategy and systems development.

It is, therefore, necessary that a group using IS/IT diffusion as its umbrella term identifies special interest groups for concrete aspects of diffusion deemed key. It may well be that subject focus and neutral information would have helped us understand the recent phenomenon of e-commerce and dot-com more objectively. If so, maybe the present situation of dot-com failure being the rule rather than being the exception could have been predicted and made less frequent. It is interesting to observe that Gartner group has introduced "hype" as the explanation for the usage development pattern for new IS/IT phenomena. Almost without exception, new IS/IT gadgets are over-valued and over-used. Because of severe failures, a painful usage reduction period must be experienced before a much smaller, stable trajectory with regard to utility emerges.

As a result, the IS/IT field is over time constantly shifted from being in the palace with the King to being in the hard place. The advent of the ***E***(lectronic-business) is giving way to the ***M***(obile-business). Everybody wants a share in it, but the ***E*** and the ***M*** might very soon be viewed as part of everyday life and not generate much interest (Earl 2000). This is an area where a group such as WG8.6 could make a contribution, that is, being the conveyor of sober views and research with regard to the societal implications, business potential, stakeholder awareness, marketing, and solution development requirements of new IS/IT products.

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