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THE CASE FOR A HOLISTIC THEORY: SOCIOTECHNICAL ACCEPTANCE AND DETERMINISM

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Abstract

The purpose of this article is to present two existing information systems (IS) theories and the notion that they are not mutually exclusive as accepted presently, but are actually two parts of a larger reality when viewed holistically. The study explores the question of whether technology (i.e., Information Technology specifically) is an enabler for change (as accepted in sociotechnical theory) in business processes or is it a driver of that change (as proposed by technological determinism)? It argues that theory of determinism and the theory of sociotechnical change are not mutually exclusive but that the theories are part of the evolution of the relationship between technology and business processes. Specifically, information technology starts out as a tool to facilitate work processes, but then develops to a "point of optimization" and, from that point on, it dictates changes in business processes. Examples and cases are used to strengthen this thesis.

Keywords: Sociotechnical, deterministic, holistic theory, drivers/enablers

Introduction

Information Technology (IT) is changing the way people work and the way society's major organizations are structured (Scott Morton, 1991; Andrews and Stalick, 1997). IT has the ability to alter work fundamentally (Scott Morton, 1991) and there are numerous examples in both practitioner and academic literature of how work (processes) are being altered because of advances in technology (Barlow, 1997). If one considers the role of IT in organizations then one can come up with the predominant argument that information technology is an enabler of business processes or it supports an organization. In the present scenario where information technology is so pervasive in all aspects of business functioning as well as in personal life, it would be a valid argument that business processes as we know them today cannot function without IT. One would like to make a shift in the argument that IT is in fact a necessity or core component of any work process. This is, at times, on account of automation and at other times due to other reasons like competitive advantage. The question as to whether IT is an enabler or a driver is still a point of debate among MIS experts. When is IT an enabler and when is it an imperative? This may be a difficult question to answer when the impact of IT on organization design parameters cannot be answered with certainty. For example, Markus and Robey (1988) state that "... empirical research has generated contradictory findings on almost every dimension of hypothesized computer impact. Information systems have been found both to enrich and routinize jobs, both centralize and decentralize authority, and produce no changes where changes were expected."

We attempt to resolve the dilemma of IT as an imperative or an enabler in this paper by incorporating both viewpoints in a unified framework for evolution of the relationship between work processes and information technology. In other words, the two existing theories are not mutually exclusive, but are two parts of a larger whole. We propose that the relationship goes through an evolution:

1. In the first stage IT is an outcome of a work process. IT evolves due to the needs of the business process primarily automation aimed at fulfilling the goals of efficiency.

2. In the second stage IT is used as an enabler in altering the work process(es). This is the primary viewpoint supported by the sociotechnical perspective. IT at this point primarily serves as a competitive weapon to support redesigned work processes.
3. In the last stage, IT becomes the driver of the work processes. Work processes get designed/defined in ways driven/dictated/demanded by IT. The focus is primarily on effectiveness.

There seems to be some confusion about the meaning of the phrase "holistic view." Two theories ((1) determinism and (2) sociotechnical acceptance) have been presented in prior literature and treated as two distinct, particular, separate theories that are mutually exclusive. This treatise presents these two theories, not as two separate entities, but as two parts of a whole. This is the "holistic view." There have been attempts in other disciplines to create a holistic view: a holistic view of philosophy that includes theories presented by Aristotle, Socrates, Plato, etc. Holistic medicine suggests that the entire body should be treated as a whole system as opposed to the treatment of just a "part" or component of the body. In that same spirit, we suggest that MIS researchers step back and view sociotechnical acceptance as the first part of a larger theory and determinism as the second part of that large picture.

Existing Theories and the Debate

We start the discussion with two existing information systems (IS) theories which have long been considered as mutually exclusive and argue that they are actually two parts of a larger reality when viewed holistically. As early as 1958, Leavitt and Whisler presented the notion that technology causes changes in organizational design (also, Lucas and Baroudi, 1994). Since that time, there has been a stream of research discussing this notion. (See, for example, Markus and Robey 1988; Simon 1977; and Pfeffer, 1982.). Markus and Robey used the term "technological imperative" and "deterministic" to refer to these studies that theorize about the impact of technology (Markus and Robey, 1988) and argue that technology is the cause of change. The mainstream literature has taken the direction of dismissing the technological determinists in favor of the theory that consistent preferences lead to choices and "information technology is the dependent variable in the organizational imperative, caused by the organization's information processing needs and manager's choices about how to satisfy them" (Markus and Robey, 1988; Pfeffer, 1982). The Markus and Robey theory views IT as an enabler and has a large body of academic and practitioner literature supporting the idea. The study by Markus and Robey (1988), "concluded that very few good theories about the role of information technology in organizational change exist, although there is the potential for more."

But technology determinism or IT determinism is important and should not be summarily dismissed. In our opinion, in today's technology driven world IT determinism is more important than ever. There are more and more examples of IT determinism, the biggest being the Internet-driven economy. At a micro level, an example of how technology defines work processes can be seen in the area of call center management (argument is based on the call center solutions that exist in the market currently and marketed by one of the authors). The computer and telephone technologies have been integrated to define work processes for call centers. Almost all call centers are based on the same basic set of work processes, primarily driven by the technology. This makes the setup highly portable since the technology can be ported much easily into different contexts like different countries. A call center organization can be built to follow the work processes dictated by the technology. As a result, many call centers have shifted to countries like India resulting in significant cost savings.

We posit the argument that determinism evolves from the socio-technical role of technology. IT starts out as at tool to facilitate work processes, but then develops to a "point of optimization" and, from that point on, dictates changes in work processes. Two new concepts emerge in this study: (1) the notion that these two theories are actually each a portion of a larger reality, and (2) that there is a point of optimization in the life cycle of technologies. Evidence is provided to support this argument. For example, in 1991 Scott Morton published a widely-accepted idea that states, "There appear to be three distinct stages that organizations are going through as they attempt to respond to their changing environments: automate, informate, and transformation." Scott Morton's three stages support the notion of a sociotechnical acceptance followed by determinism. A practical example is that of email. Email started as a support tool and enabled organizational actors to communicate fast, at a lower cost, and asynchronously. Email has become so widely accepted that it is a business necessity today due to its inherent benefits (though a part of the reason may also be attributed to its social acceptance as a means of communication). The amount of information that flows through email in the current business environment cannot flow through papers. It is convenient and at the same time the information it contains can be manipulated using computers. Now email is at the center of most business processes that are designed to contact customers, business partners, and employees within the organization.

Technology and Work Process: Relationship Evolution

We now present the framework for evolution of relationship between the work processes and information technology as a three-stage process. A work process is defined as a series of activities to satisfy a goal/objective. Each activity is characterized by inputs, act, and output. The characteristics defined for the input are what the inputs are, who provides them, where and when. The act is characterized by who performs the act, what is the act, when is it performed, where is it performed, and how is it performed. The output is characterized by what output is produced, where is it produced, when is it produced, and who receives the output. IT can impact a work process through a change in any of the aspects of the activities.

Stage 1: Technology as the Outcome and Work Processes as the Driver

In the very beginning a work process acts as the driver to cause the creation of a technology that will allow the task to be performed more effectively and/or more efficiently. This is the first stage in the evolutionary life of the technology and the work process is the driver and the technology is the outcome. It should be pointed out that this "stage" is actually a point in time represented by the creation of the particular technology. This stage is supported by Taylorism (Scott Morton, 1991; Taylor, 1911). A need or opportunity is recognized that leads to the creation of a technology. In this first stage, the role of technology is that of the outcome, the application of the technology moves from an application to the basic technology. The benefit of this stage is efficiency and automation (Scott Morton, 1991). In Scott Morton's (1991) terminology this stage may be termed as 'automate.' In this stage, usually, manual operations are replaced by machine actions under computer control. An example of work process-driving technology is that of hand-held pen scanners (e.g., Cpen brand of scanners) that are aimed at enabling researchers and people who read volumes of printed text to scan the lines as they read the text and download these lines directly into a computer. This technology (pen scanners) is purely driven by the efficiency considerations of reading the text and then transferring it to the computer through typing, reading and then typing, remembering and typing, and/or recording and transcribing.

Stage 2: Technology as the Enabler

After the technology there is a period of acceptance/adoption. As the technology is adopted and accepted, it becomes an enabler (Dunbar, 1994). The term enabler is used to signify the use of IT to enable, that is, allow, users to change their work processes. The change can be in the ways that were intended when the technology was invented or in ways that are extensions beyond the original intended use. In our example of the pen-based scanners the original use of the scanner to scan research paper may still be there but other work processes may be changed. Some of the pen scanners have evolved so that they have a voice output and can run various software. With the help of OCR (Optical Character Recognition) and ICR (Intelligent Character Recognition) software the scanners can read the read text and convert it to voice. These scanners then can be used by visually impaired people to read normal text.

When any technology is first introduced, there is a certain level of resistance to its adoption. The reasons for this resistance may come from various sources such as cost of the technology, cognitive demands places by technology in its use, availability, etc. It takes some time for the resistance to the technology to dissipate and, during this time, the technology is used only when chosen (Davenport, 1993; Coventry, 1995; Tapscott and Caston, 1993). Many times cultural change is required because work and thought processes must be changed—technical and cultural issues must be addressed (Business Editors, 1999; Schantz, 1999). The whole process of acceptance of the technology through its use in original intended ways by a wide mass is the second stage of the evolution and is supported by the sociotechnical theory and the emergent perspective.

The sociotechnical view assumes that the impact of information systems can be managed by attending the social as well as technical concerns (Bjorn-Anderson, et al., 1986; Markus and Robey 1988; Mumford and Weil, 1979). The emergent perspective is one of uses and consequences of IT that emerges unpredictably from complex social interactions (Markus and Robey, 1988). In this stage, people/organizations are choosing to use a new technology. The work processes are being enhanced (performed more efficiently and/or more effectively) through the use of the technology and the technology is enabling changes.

In the sociotechnical perspective—the enabler stage, the usage of technology is still a function of the social choices and the technical circumstances. In this stage, there is a lateral movement between the basic and application use of the technology. This stage corresponds to Scott Morton's (1991) stage titled "informate." This term describes what happens when automated processes yield information as a by-product. In this stage, benefits are seen that surpass the original purpose of creating the technology—new skills and information are developed such that new market opportunities open up. In the current environment the Internet provides a prime example of mass use and extension of an IT (Evans and Wurster, 1999). It is a powerful driver of growth and job creation (Kennedy, 1996). The Internet existed for years before it "exploded" and became a way of life. It is

estimated that by 2005, approximately a billion people will have direct access to the Internet (Evans and Wurster, 1999). People and organizations initially moved slowly in choosing to use the Internet, partially because of the element of distrust (Evans and Wurster, 1997). However, now the Internet is widely accepted and uses exist that transcend the original purpose (Dyson, 1997).

Stage 3: Technology as the Driver and Work Processes as the Outcome

The third stage in our framework is the stage of 'determinism' where the IT becomes the driver of the work process. The evolution of IT can be illustrated through the graph in figure 1. This end stage is characterized by a more or less universal acceptance of the technology and its presence in most work processes that it was invented to support.

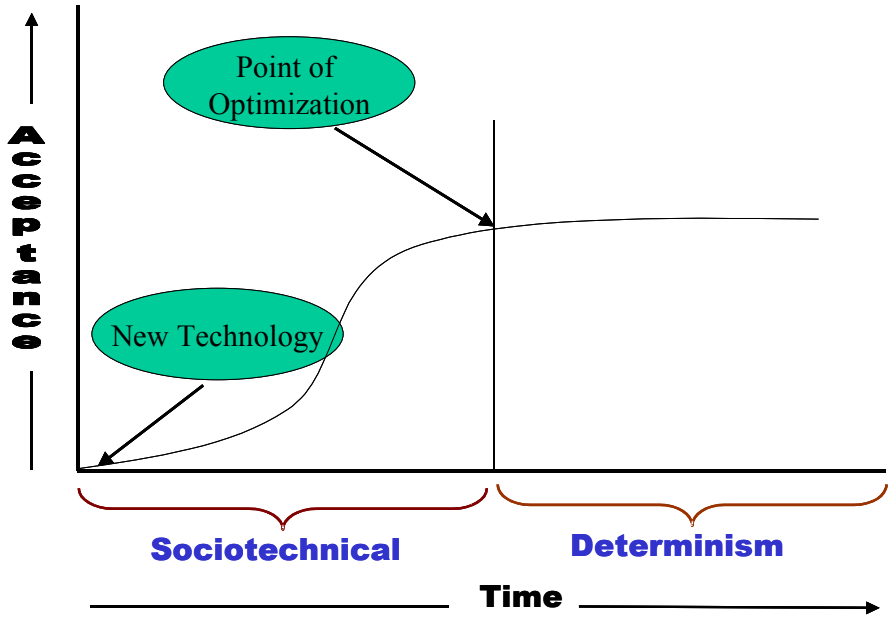

Figure 1. Evolution of Technology

We previously presented the example of call centers to illustrate this point. We build another argument by continuing on our examples of pen-based scanners and hypothesizing a direction of evolution. There is some potential in using these scanners for visually impaired people. Assuming that these scanners get into wide spread use and the print medium stays strong then the work process related to printing may change to conform to the technology of pen-based scanners. Whether this will happen on a mass scale can be debated but some of the possibilities of changes are as follows: changing the layout of pages such that they are easily read by these scanners, improving the quality of reflectivity of the pages so that they can be read easily by these scanners, government mandating the provision of these scanners as part of accessibility initiative, etc.

In the technological determinism stage not only does the technology drive changes in work processes but it also evolves without the work process driver. The users work on technology in a visionary mode and not based on solving some existing problem, need or issues but use the technology in innovative ways. In our case of the pen-based scanners, the current capability of the scanners may be sufficient for scanning tasks at hand but the improvements are being made to these scanners to build in the PDA (personal digital assistant) functionality, with the vision that if someone carries them around then it may be good functionality to have. The technology grows simply because someone realizes the opportunity to build it "bigger and better." At this stage, the technology has been widely accepted, resistance to usage is low/negligible, and the technology becomes the driver in changing work processes. In this stage, the technology is moving from the basic to the application development. The stage presented by Scott Morton (1991) as "transformate." "The concept of transformation includes the broad view of quality but goes beyond this to address the unique opportunities presented by the environment." Technologies cause changes in the way people work, in organizational structure, and in the methods corporations will use to compete in the future (Scott Morton, 1991). Another idea supporting determinism is the idea that IT enables transformation and was pioneered by application software vendors like SAP. Here the technology is implemented and then the work processes are changed to fit the application. Benefits can be derived from such an approach. It should be pointed out that the primary reason such a approach works is because the technology embodies in its functioning the best work processes available at that point of time.

One popular consulting firm has boasted that they will "build the business processes of the electronic revolution—designing the marketplace, changing its work processes, retraining its work force" (Lenzner and Gordon, 1999). Such an idea is only possible when the technology has moved beyond its original purpose. For example, some software application programs are so powerful that they fundamentally change the way businesses, and lives, are run (Bray, 1997). Lotus 1-2-3 started out as a spreadsheet to make the work process of bookkeeping/accounting more efficient. However, in the 1990s work processes are being streamlined by utilizing Lotus Notes, a groupware software (Bray, 1997). Lotus Notes is an example of the evolutionary life of a technology—Lotus 1-2-3 was created as the outcome of a work process driver, Lotus Notes evolved because it was "possible" to make it bigger and better. Lotus Notes was originally marketed in 1989, sales were slow due to social resistance, and then as it gained acceptance, it also began to act as the driver to change work processes (Bray, 1997).

It is widely accepted that IT reshapes work (Scott Morton, 1991). Examining the example of nurses' need to create, store, and retrieve patient records and charts, at this stage the nurses are using a decentralized nursing station called a DocuCart (Demarco, 1994). Nurses are no longer tied to their traditional stations doing paper work, the DocuCart is a rolling cart that is a combination supply cart, medication dispensing cart, and electronic documentation system equipped with a computer that uses handwriting recognition, a standard keyboard, or a keyboard that appears on the computer screen. Notes can be taken in a patient's room and instantly printed for patient charts and the DocuCart will soon have the capability to access lab results, medical records, and other information from the hospital's mainframe computer. This system has been developed because of the advances in computer, information, and wireless communications technology (Demarco, 1994).

Table 1 summarizes the evolutionary framework.

Table 1. The Evolutionary Life of a Technology

ROLE OF TECHNOLOGY	THEORY	BENEFITS
OUTCOME	TAYLORISM	AUTOMATE (EFFICIENCY)
ENABLER	SOCIO-TECHNICAL, REENGINEERING, AND EMERGENT	INFORMATE
DRIVER	TECHNOLOGICAL DETERMINISM	TRANSFORMATE (EFFECTIVENESS)

Conclusion

The case has been presented to support the idea that the theory of sociotechnical acceptance and the theory of determinism represent two parts of a larger reality. The need or opportunity to change work processes (make them more efficient/effective) drives the creation of new technology. With all new technology, there is a period of resistance/adoption/acceptance. During this period (sociotechnical acceptance), technology is adopted gradually until it reaches a "point of optimization" (i.e., a point where the technology is no longer meeting any mass resistance). At this point of optimization, the technology has been adopted so widely that acceptance is commonplace and non-acceptance will most likely result in an organization's inability to compete effectively. At this stage, the technology begins to act as the causal factor in changing work processes—organizations must accept the technology in order to compete or possibly even to survive. This is the stage of determinism. Technology becomes a driver changing work processes.

It is customary to support new concepts with cases/anecdotal evidence initially. The concept presented here can be supported by technological innovations that extend beyond the realm of information technology. For example, there was a period of social acceptance (when the technology was an enabler of change) followed by a period of determinism (when the technology caused change) with the steam engine, the telephone, etc. Future work on this theory would involve a search for empirical validation.

The evolutionary framework presented here builds a bridge to the technological determinism from the sociotechnical perspective. In our opinion this framework would bring in new insights for further theoretical and applied research in this area. In a practical application, organization strategy should look to this holistic theory when considering new endeavors. When an endeavor depends largely on a relatively new technology (that is still in the stage of acceptance), success might be difficult to achieve. Internet banking is an example of such a phenomenon. The internet was still in a stage of acceptance in the 1990s, with users wary of security issues. The concept of internet banking might have been a successful one if the endeavor had been initiated in the final stage of this "larger reality" rather than during the stage of acceptance. In other words, the idea was not the problem; rather the problem was the timing.

References

Andrews, Dorine C. and Susan Stalick, "Avoiding Morning-After Syndrome: Transforming Your Organization Without Regrets," *National Productivity Review* (16), Autumn 1997, pp. 5-14.

Barlow, John Perry, "The Best of All Possible Worlds," *Association for Computing Machinery* (40), February 1997, pp. 68-74.

Bjorn-Anderson, N., K. Eason, and Daniel Robey, *Managing Computer Impact: An International Study of Management and Organization*, Ablex, Norwood, New Jersey, 1986.

Bray, Hiawatha, "The Big Bang in 'Groupware' Boom was Notes," *Boston Globe*, (1:5), July 13, 1997, p. F.

Business Editors/High-Tech Writers TAWPI 99, "Colonel Terry Balven, USAF, Named Keynote at TAWPI Work Process/99 in Denver," *Business Wire,* (1) July 30, 1999.

Coventry, "Xerox: Xerox Announces 'No New Products'—Knowledge Initiative to Generate 50% of Revenue," *M2 Presswire*, (1), April 27, 1999.

Davenport, Thomas H., *Process Innovation: Reengineering Work Through Information Technology,* Harvard Business School Press, Boston. Massachusetts, 1993.

Demarco, Anthony, "Will Wireless Comm Change the Work Process?" *Facilities Design & Management,* (13), September 1994, p. 62.

Dunbar, Carolyn, "MultiCare Health System Saves Millions of Dollars Through Redesigned Care," *Health Management Technology*, (15), July 1994, p. 22.

Dyson, Dyson, "Release 2.0: A Design for Living in the Digital Age" New York: Broadway Books, 1997).

Dyson, Esther, "Education and Jobs in the Digital World," *Association for Computing Machinery, (*40), February 1997, pp. 35-36.

Evans, Philip B. and Thomas S. Wurster, "Strategy and the New Economics of Information," *Harvard Business Review,* (75), September-October 1997.

Evans, Philip, "Strategy and the New Economics of Information," *Financial Times*, Feb. 8, 1999, p. 2.

Evans, Philip and Thomas S. Wurster, "How the New Economics of Information Transforms Strategy," *Harvard Business School Publishing: Ideas at Work* (Sept. 27, 1999). http://www.hbsp.harvard.edu/ideasatwork/evans_wurster.html.

Kennedy, Mike, "The Five-Layer Hierarchy," *Financial Post*, June 1, 1996, p. 27.

Kuhn, Thomas S. , *The Structure of Scientific Revolutions, Second Edition,* The University of Chicago Press, Chicago, Illinois, 1970.

Leavitt, Harold J., and Thomas L. Whisler, "Management in the 1980's," *Harvard Business Review,* November-December, 1988.

Lenzner, Robert and Joanne Gordon, "The Messiahs of the Network," *Forbes* 163 (March 8, 1999): 98-104.

Lucas, Henry C. Jr., and Jack Baroudi, "The Role of Information Technology in Organization Design," *Journal of Management Information Systems* 10 (Spring 1994): 9.

Markus, Lynne M., and Daniel Robey, "Information Technology and Organizational Change: Causal Structure," *Management Science* 34 (May 1988): 583.

Morton, Michael Scott S., editor, *The Corporation of the 1990s,* Oxford University Press, New York, New York, 1991.

Mumford, E., and M. Weir, *Computer Systems in Work Design—The ETHICS Method*, Wiley, New York, New York, 1979.

Pfeffer, J., *Organizations and Organization Theory*, Pitman, Marshfield, Massachusetts, 1982.

Schantz, Herb, "Government: Aim High," *Inform* (13), July 1999, p. 9.

Simon, H. A., *The New Science of Management Decision*, Prentice-Hall, Englewood Cliffs, New Jersey, 1977.

Tapscott, Don, and Art Caston, *Paradigm Shift: The New Promise of Information Technology,* McGraw-Hill*,* New York, New York, 1993.

Taylor, Frederick W., *Shop Management,* New York, 1911.