Actionable Process Theories: A Unique Selling Proposition for a Science of Services

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ABSTRACT

A key objective for a science of services should be to produce *actionable process theories*. Doing so will distinguish a science of services from competing fields like management information systems, and allow a science of services to have more immediate real-world impact.

Introduction

The academic side of management information systems (MIS) has a serious problem that a science of services can solve—MIS research lacks real-world impact. To see this, answer this question: When do you think was the last time a manager in a top technology organization picked up *MIS Quarterly* or *Information Systems Research* (two of the top journals in MIS) to get ideas for improving his or her organization?

The answer: Probably never. And this is strange considering that we are currently in the midst of a revolution in both information technology and networking.

MIS researchers should be driving this revolution. Instead, they are reacting to it by merely analyzing *existing* information system—using statistical methods to finding relationships between variables.

The problem with statistical studies of existing information systems is that the systems are complex and constantly changing. Therefore, today's findings may not be statistically valid tomorrow.

I can think of no better example of this problem than the famous study by Kraut et al [9], who initially reported that spending time on the internet was positively correlated with depression, loneliness, and stress: However, several years later, Kraut reported that his follow-up studies showed that most of the bad effects had disappeared! [8] According to Kraut: "Either the Internet has changed, or people have learned to use it more constructively, or both." [3]

When studying complex, socio-technical systems, that are constantly changing, it is not sufficient to identify correlations between an independent X and some dependent variable Y. It is also important to understand the causal chain of structures and processes by which some variable X produces an observable outcome Y. The former is known as a variable theory, and the latter a process theory [10].

Classic examples of process theory in the natural world include, how malaria is spread from mosquitoes to humans, and Mendel's theory of inheritance.

Knowledge of process in the natural world allows people to develop treatments, e.g., methods for preventing malaria, or to produce novel kinds of plants and animals, e.g., hybrids and cross breeds. Similarly, knowledge of process in the "artificial" world allows researchers and developers to create technologies that improve existing information systems, or to develop new kinds of information systems.

The need for process theories in the organization sciences is well known. Mackenzie [11] wrote:

> *"We have reached the point in the organization sciences where our traditional methods of positing variables, gathering data across groups and organizations, and then linking variables by linear models using standard statistical methods is breaking down… We are left with a proliferation of competing paradigms…, little understanding of how things work in actual organizations, and generally inconclusive (or unconvincing) results from these labors. It is possible that this state of affairs is a direct consequence of how research is being done." (p. 123)*

Unfortunately, in the field of MIS this is unlikely to change. MIS is dominated by variable theories, especially in the top journals. Moreover, the tenure and promotion process is intricately linked to publishing in these top journals. Thus, MIS researchers do not have any incentive to produce process theories.

This is where a science of services (SOS) can make an impact. It can focus on creating process theories for information systems or, more generally, service systems. If the theories could somehow be written up so that they were understandable, not only to academics, but managers and other practitioners, they would be *actionable process theories*.

The remainder of this paper describes what students would need to know in order to create actionable process theories, and provides a possible example of how an actionable process theory could be used to improve an existing service system.

Actionable Process Theories in Education

What would an undergraduate or graduate student in MIS have to know in order to create actionable process theories for service systems? Recall that a process theory describes the causal chain of structures and processes by which some variable X produces an outcome Y, and that a service system consists of both people and technology. Therefore, to create an actionable process theory of an existing service system, one needs:

1. Methods for mapping the observable structure and process of socio-technological systems. Examples of such methods include *physical* (versus logical) data flow diagrams [2] and information activity maps [6].
2. Methods for mapping the structure and process within technological systems. Examples of such methods include Unified Modeling Language [7] and Object-Oriented Analysis and Design [1].
3. Methods for mapping structure and processes within people—within mental systems. The only example of such a method that I know of, that is also actionable, is the mental-space mapping technique used by conceptual blending [4] researchers.

It would be a great help to universities if there were a single methodology that combined all three kinds of methods—a kind of UML, but for socio-technological systems instead of software systems, e.g. STML.

An Example of an Actionable Process Theory

An distance organization has a problem with excessive mailing costs which are currently at $100,000 / year (actual case based on Flor [5]).

The task of a service scientist is to first represent the people, technology, information, and physical goods in the mailing process. Figure 1 depicts one way of representing this information using information activity maps [6].

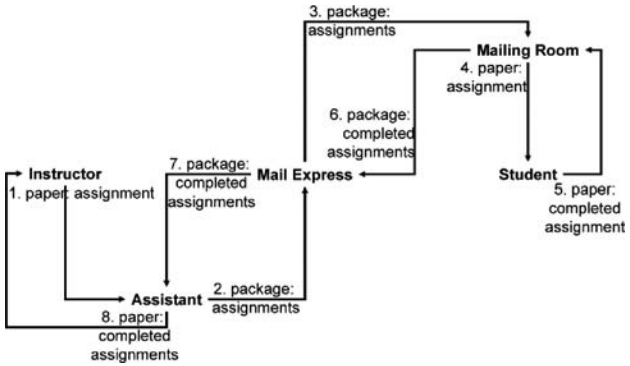

Figure 1. Information Activity Map: Step 1, Representing the Current Process

These maps are actionable. A researcher, manager, or practitioner can understand them with minimal explanation. Furthermore, the maps allow one to visually explore possible problem areas. For example, each individual agent could be driving up costs (see Figure 2).

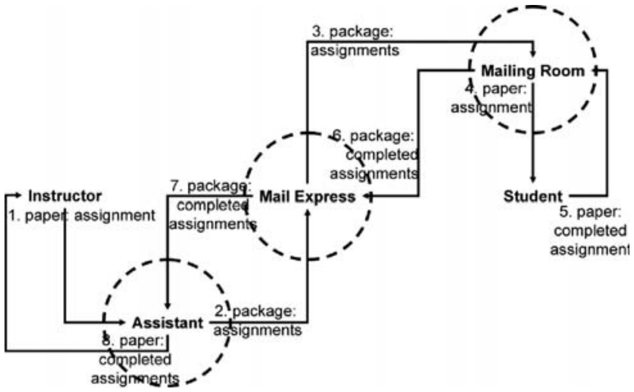

Figure 2. Information Activity Map: Step 2, Examining Possible Problem Areas

Or pairs of agents may be driving up costs (see Figure 3). Or all the intermediate agents could be driving up costs (not shown).

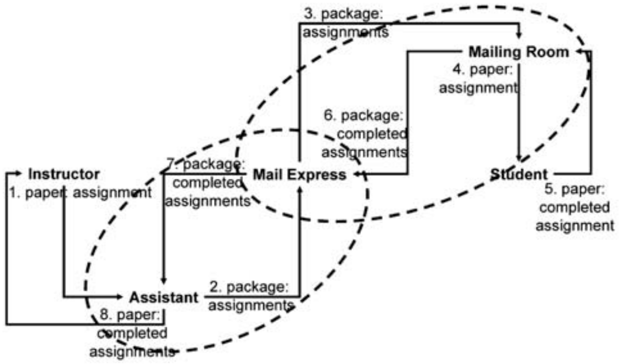

Figure 3. Information Activity Map: Step 2 (cont.), Examining Possible Problem Areas

Suppose a service scientist has a hypothesis about what agents are driving up costs. To support this hypothesis the service scientist can build a cost model in (e.g.) Microsoft Excel that assigns a cost to each arrow in the model. The costs represent media, production, and distribution costs for each information transaction (see Figure 4)

INTERACTION MATRIX:

FROM/TO	I	A	M	S
I		$ 5.85		
A	$ 2.75		$ 123.30	
M		$ 1.25		
S			$ 120.00	

SUMMARY:

SINGLE	WEEKLY	MINI	MINI-ALL	YEARLY
$ 253.15	$ 506.31	$ 3,544.15	$ 14,176.59	$ 85,059.52
			ORIGINAL	$ 85,059.52
			REDUCTION	0.00%

CONTROL PANEL:		units	comment	50%
IWAGE	$ 50.00		per hour	1.15%
AWAGE	$ 15.00		per hour	1.28%
PTIME	0.03	hours	2 minutes	0.33%
DTIME	0.08	hours	5 minutes	0.82%
CTIME	0.08	hours	5 minutes	0.25%
MTIME	0.08	hours	5 minutes	0.25%
STIME	0.08	hours	5 minutes	0.25%
RTIME	0.02	hours	1 minute	0.30%
WTIME	0.08	hours	5 minutes	0.25%
CPAGE	$ 0.01	per page	1 penny	0.16%
NPAGES	2	pages		0.16%
NSTUD	40	students		0.16%
NSITES	6	locations		47.70%
MAILXFEE	$ 20.00		overnight	47.40%
TFREQ	2		per week	50.00%
NINST	4		instructors	50.00%
WMINI	7	weeks	per mini	50.00%
NMINI	6		per year	50.00%

Figure 4. Information Activity Map: Step 3. Diagnosing Problem Areas (Cost Drivers) By Modeling Information Transaction Costs

By manipulating the variables in the control panel for this model, the service scientist can discover the cost driver. In this case, the variable is the mailing fee (see Figure 5).

INTERACTION MATRIX:

FROM/TO	I	A	M	S
I		$ 5.85		
A	$ 2.75		$ 3.30	
M		$ 1.25		
S			$ -	

SUMMARY:

SINGLE	WEEKLY	MINI	MINI-ALL	YEARLY
$ 13.15	$ 26.31	$ 184.15	$ 736.59	$ 4,419.52
			ORIGINAL	$ 85,059.52
			REDUCTION	94.80%

CONTROL PANEL:

		units	comment
IWAGE	$ 50.00		per hour
AWAGE	$ 15.00		per hour
PTIME	0.03	hours	2 minutes
DTIME	0.08	hours	5 minutes
CTIME	0.08	hours	5 minutes
MTIME	0.08	hours	5 minutes
STIME	0.08	hours	5 minutes
RTIME	0.02	hours	1 minute
WTIME	0.08	hours	5 minutes
CPAGE	$ 0.01	per page	1 penny
NPAGES	2	pages	
NSTUD	40	students	
NSITES	6	locations	
MAILXFEE	$ -		overnight
TFREQ	2		per week
NINST	4		instructors
WMINI	7	weeks	per mini
NMINI	6		per year

Figure 5. Information Activity Map: Step 3. Diagnosing Problem Areas (Cost Drivers) By Modeling Information Transaction Costs

This cost driver corresponds to the Mail Express agent in the information activity map. Thus, the service scientist knows that to drive down costs he or she must create a solution that eliminates the Mail Express agent (see Figure 6).

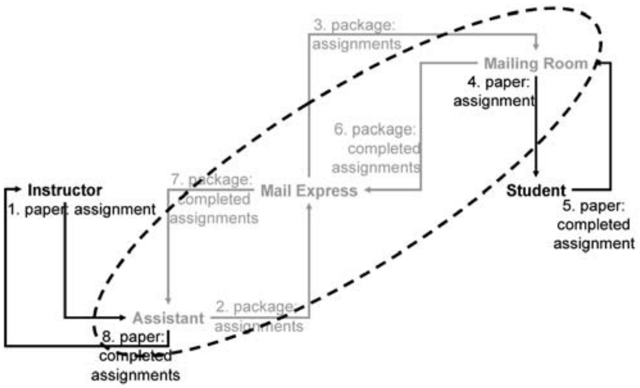

Figure 6. Information Activity Map: Step 4. Developing a treatment

A common solution is to use the web for electronic mailings. However, using the information activity map, the service scientist can find alternative solutions. Note that the arrows into and out of the Mail Express agent—the agent that is driving up costs and that must be eliminated—form a kind of functional specification for the technology (see Figure 7).

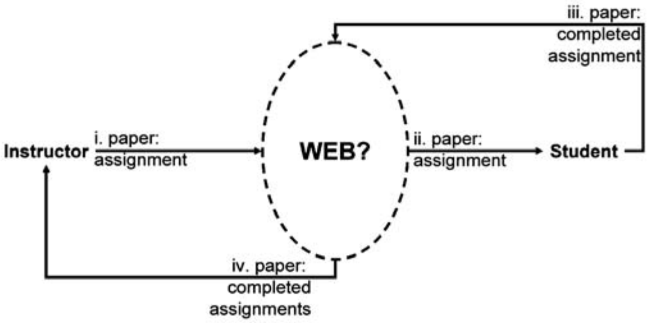

Figure 7. Information Activity Map: Step 4 (cont.). Developing a treatment through analysis of the information activity map

Given this functional specification, a "low-tech" solution like a FAX would be just as effective in driving down costs as the Web (see Figure 8), and no bridging technologies need to be purchased to convert the paper assignments to electronic form.

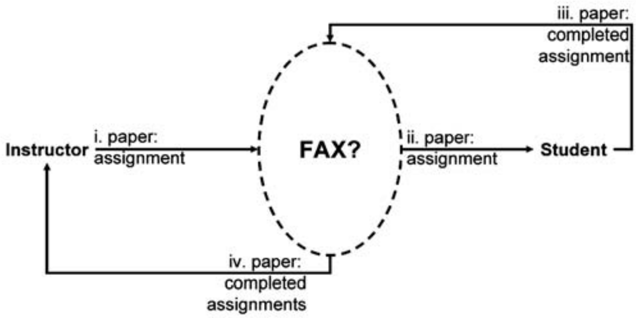

Figure 8. Information Activity Map: Step 4 (cont.). Developing a treatment through analysis of the information activity map

Summary

A science of services is a science of the artificial [12]. The systems studied are complex socio-technical systems that are constantly changing. The dynamic nature of these systems limits the value of variable theories. Instead, using process theories one can better design treatments and develop new service systems.

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