Exploring the Linkages between Information Systems Capabilities and Business Variables

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1. Introduction

The first phase of information systems development is planning, which involves understanding what information system applications need to be developed in response to emerging problems or opportunities, and why. The latter question ("why?") has to do with determining the expected business benefits of an information systems project. This is perhaps the only phase of the systems development life cycle in which top managers – particularly those with financial expertise and responsibility – get closely involved. Top managers are sometimes cynical of the stated business impacts of a proposed systems project, and justifiably so: Business and technology are distinct realms, with different languages and mindsets. The business executive talks the language of the bottom line, revenue, cost, production, customer satisfaction, etc., while the systems/technology expert is concerned with automation, computerization, systematization, and the like. Existing applications of information systems have demonstrated that the above two realms are in fact related (Neumann, 1994), but there is no explicit map showing the topographical connections among them. Explicating the linkages between business-related and information systems features is the purpose of this paper. A manager unsure of the business outcomes of a proposed information systems project will be able to use this map to more easily consider those expected impacts.

2. Business Variables

The business variables chosen to illustrate the methodology proposed are listed in Figure 1. The arrows indicate producer/product relationships, with "+" denoting a direct (positive) relationship, and "–" an inverse (negative) one. For instance, customer value is directly related to customer benefit while inversely related to customer cost. Below each variable is indicated the

mathematical (or logical) operation using which the variable is computable in terms of lower-level variables. For instance, Revenue = Price × Sales Volume. As far as the use of information systems for strategic purposes is concerned, the heart of the diagram is the portion below customer value. Customer value is defined (Gale, 1994) as the ratio of all benefits gained by a customer from a purchased product (service) to all costs paid for obtaining it:

$$\text{Value} = \frac{\Sigma \text{ Benefit}}{\Sigma \text{ Cost}}$$

Hence value is maximized for a customer when benefits are maximized and costs are minimized.

What constitutes value to the customer varies from industry to industry. However, there are some generally accepted customer values that are common to most, if not all, industries. Defined as benefits are:

- FUNCTIONALITY: The functionality of a product is the extent to which it solves the customer's problem.
- QUALITY: The quality of a product is how effectively it solves the customer's problem.
- VARIETY: The variety of a product is the number of models in which it is offered.
- CUSTOMIZABILITY: The customizability of a product is the extent to which it can be tailor-made to the customer's unique requirements .
- RELIABILITY: The reliability of a product is the extent to which the customer can count on it being available and working when needed.
- TRANSACTION EXPERIENCE: The transaction experience in purchasing a product is the satisfaction experienced by the customer in the *process* of purchasing that product; it includes their experience in modifying an order, making payments, etc.)

Defined as costs are:

- PRICE: The price of a product is the total direct monetary cost paid in acquiring and maintaining it.
- TIME: It refers to the duration of various activities performed by the customer in acquiring the product, such as sourcing, ordering, receiving the product, and processing payment. The longer the duration of these activities, the higher the opportunity cost to the customer.

3. Information Systems Capabilities

There are fundamentally distinct capabilities of information systems that make them desirable to be developed and deployed in an organization. Three of the most popular such capabilities are:

A. SYSTEMATIC: This means work is done based on predefined rules and procedures independent of the judgement of the person performing the work.
B. ELECTRONIC: This means work is done using an electronic (vs. purely manual or mechanical) medium.
C. AUTOMATIC: This means work is delegated to a machine running on a set of instructions comparable to those otherwise followed by human workers.

4. Systems/Business Linkages

In this section, each of the above capabilities is discussed in terms of its linkage to one or several business variables. This is accomplished by introducing a set of intermediate variables called “process variables”, each of which describes an aspect of work. Process variables

intermediate between systems capability and business variables by identifying the manner in which systems affect work to produce business impacts. The process variables are underlined.

4.A. The Systematic Capability

One of the most significant impacts of information systems is to make operations more systematic. As defined earlier, this means work is done based on predefined rules and procedures independent of the judgement of the person performing the work. This may impact business in terms of:

Product/Service Quality:

- When a task is performed in the same way regardless of the judgement of the person performing the work, this generates <u>consistency</u>, which assures product quality. For instance, the French fries produced at a fast food chain (such as McDonald's) are of a predictable, consistent quality regardless of which store they are purchased at. This is because of systematic procedures pertaining to how the potatoes are cut, how long they are dipped in boiling oil, the temperature of the boiling oil, etc.
- A special case of the above is where the task is performed not internally by an employee but externally by a customer. For instance, some retailers (such as supermarkets) have delegated to the customer the tasks of selecting the type of payment (credit card, ATM card, etc.), of swiping the card through a scanner, and of maintaining a dialogue with a machine ("press OK if …"). What could otherwise be an intimidating experience (things going wrong interacting with a machine while other customers are waiting) becomes a routine and surprise-free interaction, producing quality service. Even if the user-interface of the machine

is not designed optimally, the consistency inherent in using it creates the feeling of familiarity and user-friendliness over time.

4.B. The Electronic Capability

Another significant impact of information systems is achieved when an electronic (vs. purely manual or mechanical) medium is used to perform work. This may impact business in terms of:

Production Volume

- The electronic medium allows work to be performed at a faster speed than is possible manually. This is a well-known attribute of the electronic medium and needs little elaboration. In fact, it was one of the two desirable attributes of the computer that gave rise to its invention – the other being accuracy (Augarten, 1984). The electronic medium is much faster than its manual counterpart in capturing, storing, calculating, retrieving data. When work is performed faster, more of it can be performed per unit of time, hence boosting production volume.
- The electronic medium provides a higher level of data sharing and hence accessibility. A manual database (a file cabinet) can be accessed from only one location. An electronic database can be accessed from any node on a network. With data becoming accessible anywhere and anytime, it is possible to perform work anywhere and anytime, hence increasing production volume.

Product Quality

The electronic medium allows work to be performed at a high level of flexibility. This can be seen clearly in the contrast between the typewriter and the word-processor. Making a change in the middle of a typewritten document is a nightmare as it affects the rest of the document.

Confronted with a certain deadline, the worker does not have the luxury of modifying and improving it until very close to that deadline. In contrast, a word-processed document can be refined up to its production deadline. This flexibility is afforded by the electronic medium acting literally as a virtual storage medium (intermediary) between input (typing) and output (printing). The flexibility inherent in word-processing paved the way to all sorts of sophisticated design instruments that are used today, such as in designing buildings, furniture, toys, etc.

Product Variety

The flexibility to modify work in progress also contributes to product variety. In a manual design environment, producing a new model of a product involves creating the blueprint from scratch. Even if the new model is slightly different from the old one, the entire blueprint needs to be redrawn, including the parts that were not subject to modification. Given deadlines and time-constraints, this is not always feasible. In an electronic design environment, by contrast, producing a new model of a product often involves modifying an existing blueprint. If the new model is based on the old one, only the required changes need to be entered to create the blueprint of the new model, making stringent design deadlines more realistic to meet.

Price

As pointed out earlier, the electronic medium allows work to be performed at a faster speed than is possible manually. Speed together with flexibility allow for the optimization of price. Each variable appearing in Figure 1 is either to be maximized or minimized, with the exception of price. This is because of the complex, dual impact of price on revenue. On the one hand, price is directly related to revenue, as in the *revenue = price × sales volume* formula. On the other hand, price is inversely related to revenue because it is inversely related to sales volume:

Price ..... – ..... ▶ Sales Volume,

and sales volume is directly related to revenue:

Sales Volume ——— + ———▶ Revenue.

Because of the dual impact of price on revenue, price is neither to be maximized nor minimized, but optimized. Combining speed and flexibility, information systems have allowed for dynamic pricing based on the constantly changing relationship between supply and demand. This is common in the airline industry and is referred to as "yield management system." (Davis, 1994)

4.C. The Automatic Capability

The third significant impact of information systems is achieved through automation: Work delegated to a machine running on a set of instructions comparable to those otherwise followed by human workers. Automation may impact business in terms of:

Labor Cost

To the extent that automation makes computers *replace* manual work, work becomes labor-free and labor cost is eliminated. This applies to both physical work (robots replacing workers in a plant) as well as mental work (computer programs performing tedious, high-volume calculations in an office). Of course, no matter how extensive automation takes its root in an organization, humans are always needed to oversee that the machine is doing its job, and fixing it if it is not. As automation *supports* manual work, work becomes labor-reduced and labor cost is reduced. Software-based support systems are making it easier to fill white-collar jobs with less-skilled employees. The following is a case in point (Longman, 1997):

> *Bill Davis ... recently became the first sales-and-leasing consultant hired without any sales experience by Lexus of Alexandria in Alexandria, Va. One of the reasons the dealership took a chance on Davis was a new [system] called*

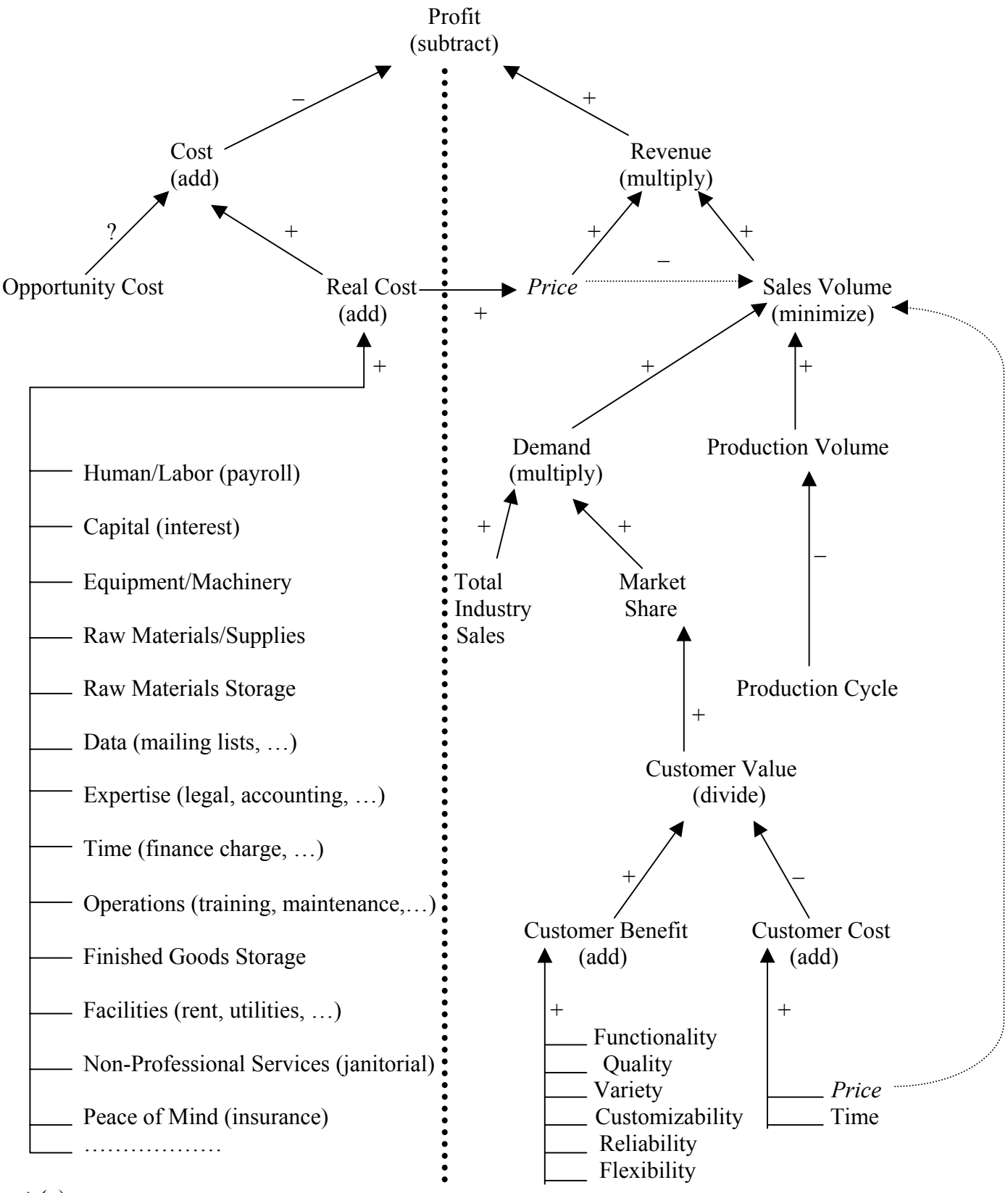
> *Lexus Labs. A program that runs on a personal computer, Lexus Labs provides interactive training both in the technical features of Lexus automobiles and the finer points of salesmanship. It is also a sales tool in itself, capable of generating detailed comparisons between Lexus and its competitors and of calculating complicated lease and finance terms…. In his first month he took orders for 70 cars, which is a solid performance for experienced salesmen in that dealership.*

Product Quality

The example of Lexus Labs offered above also points out to automation improving the quality of outcome. By automating the calculation of complicated lease and finance terms, the accuracy of the calculations becomes independent of the worker who would otherwise have to perform them. In other words, stored expertise leads to untrained workers performing at the same level as experts.

5. Conclusion

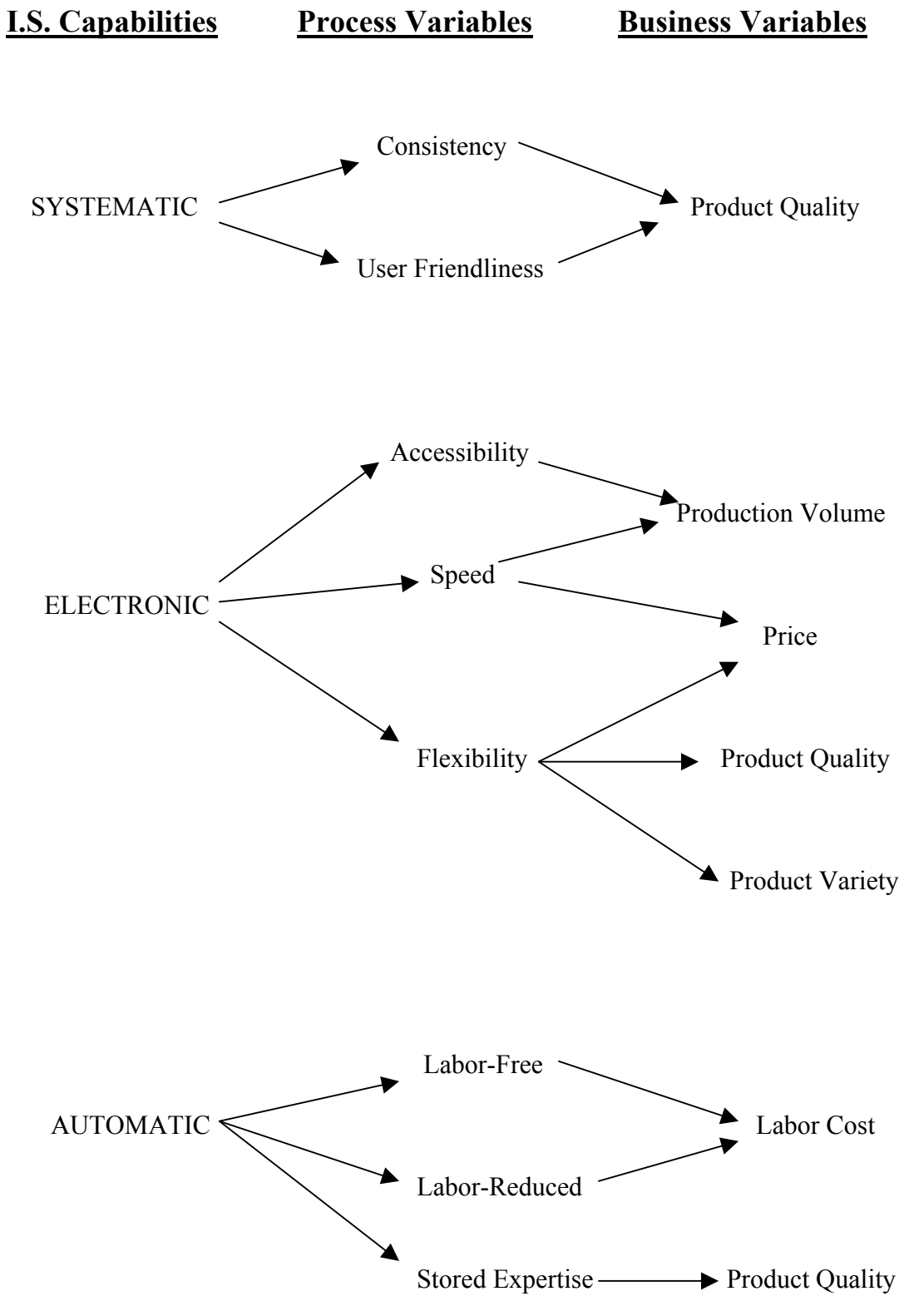
The linkages discussed above between business variables and systems capabilities are depicted in Figure 2. This paper has not aimed at a comprehensive identification of all business variables or systems capabilities. Rather it has focused on a selected group of such factors to explore their relationship and offer a visual way of showing their linkages.



A $\xrightarrow{+\,(-)}$ B: The greater the "A," the greater (the smaller) the "B," and vice versa.
Parentheses: Mathematical operations in terms of which a higher level can be computed as a function of lower levels.

Figure 1: Business as a System of Variables (The Business Map)

Linking I.S. Capabilities and Business Variables



References

Augarten, Stan. “Bit by Bit: An Illustrated History of Computers”, Ticknor & Fields, New York, 1984.

Davis, Paul. “Airline Ties Profitability Yield to Management”, SIAM News, Volume 27-5, May/June 1994.

Gale, Bradley. “Managing Customer Value”, Free Press, New York, 1994.

Longman, Phillip J. “The janitor stole my job – New software is expanding competition for white-collar jobs”, *U.S. News and World Report*, December 1, 1997.

Neumann, Seev. “Strategic Information Systems”, Macmillan, New York, 1994.