Are your business and your IT strategy in phase ?

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Abstract

Business success does not come from advances in Information Technology (IT). True, IT has helped companies to produce more, but the only effect has been to bring prices down to their marginal value. Further, some have profited solely by the rapidity of information flow to gain an "opportunity" advantage over competitors. However, real business success can be traced back to new ideas or new ways, not new computers. A winning strategy for every business must therefore address, with the help of IT, the production of content as opposed to volume and speediness.

Information in the large is the prime material that companies process in their business. A company's information system can be used to build a valid model of its activities. Application of simple information theory measurements to this model yields the intrinsic value and cost of all activities. These measurements can equally be applied on the corresponding software systems and therefore produce a relative measure of how well the computer systems in place support the business activities.

With such a model it is possible to measure the goals and capabilities of any organization. Hence its capacity to elucidate the strategy and the relevance of decisions concerning the products, the organization, and the company's computer system.

Keywords

information theory, reengineering, systems, strategic management

1. INTRODUCTION

Companies choose their own goals. One of their objectives is to deliver goods to the market (at least for business enterprises). A century ago, the capability to deliver decided the price. Later, with mass production the price could no longer be fixed at will, hence the costs had to be part of the economic equation. Today, the only sure fact is that the price of any product or service will be driven downward to its production cost by the market pressure, companies having to abandon one after the other any given market depending on their individual cost structure.

In the field of Information Technology, 50 years of technological breakthrough seem to bring no real gain in either productivity or returns. The paradox is that technological progress should bring productivity and economical gains and it doesn't. This is known as the Solow paradox, after Robert Solow, Nobel prize in Economics in 1987, who demonstrated that there is an ever increasing gap between technological progress and economical gains.

Economical gains are generally measured as the difference between the price of the product or service on the market, and the costs to bring it to the market: customers are the independent and supreme judge for each product. This method of measuring gains suffers from the major drawback that gains are only known after the sale. The value of products is therefore felt only through their market value tomorrow on decisions made today.

These two aspects, technological progress and value, must first be brought together before the Solow paradox is explained: economical gains have been lagging behind technological progress because they are tied, not to the latter, but to the value of use. In our Information Technology world the difficulty is to measure the value of use of Information.

2. ON WHAT TO DECIDE

Some 20 years ago, many organizations went through a fitness program, in which consultants helped to make the production more "lean": in vain, the lower the price at which they were able to sell, the leaner they had to be. Companies were then told that in fact they hadn't been listening carefully enough to their customers, i.e. what customers were ready to buy and at which price they would buy today, and (hopefully) tomorrow. That meant that organizations not only had to be leaner, but also more flexible, forcing companies into Business Process Reengineering (BPR, the now famous management fad).

Since it is well known that BPR programs do not seem to provide any real sharp edge on competition, the alternative is to launch a good Total Quality Program: it is then discovered that the real goal of the company is to serve some evolving (human) need (forever): Quality is Eternity.

Anticipation must be taken into account. Hamel and Prahalad's book (1994) hits the point in this respect. A company's survivability must be built into its genes. However, one must add Senge's (1990) therapy to Hamel and Prahalad's diagnosis: in order to survive one must possess the right learning tools to adapt. But neither one of them show the path to be followed.

The flaw in this never-ending quest of the holy grail is that companies are not able to measure their business against (1) its goals, (2) its market, (3) its organization and people. This stems from the fact that no strategic model or Total Quality program can measure whether the organization of the enterprise is in phase with its objectives. The first decision that a company must make is to equip itself with the right measuring tools.

3. INFORMATION MODEL

The value of decisions, of product use, of knowledge itself is explicit in the existence of certain elements of information. The cost of gaining such information is directly linked to the diversity of meaning and represents in a valid way the cost of operation of the equipment and organization for which such information is needed. A measure of the quantity of information is a valid measure of the processes themselves. Information content becomes a controlling factor of the company's strategy since it represents both today's capabilities and tomorrow's possibilities and shortcomings.

The method developed by Michel Vicarini (1992) measures the activity of any company or service through measuring its information system. The method first measures an objective value (intrinsic) of the products and services, in other words its added value. It is used at the same time to measure the effort needed to produce such products and services, in direct relation with the actual operating costs.

The measures taken at the industrial activity level can be linked directly with the measures made at the Information System end, in particular but not exclusively in its computer system component. The software process can therefore be monitored through exogenous metrics, giving it the credibility needed to participate in the company's strategic decisions:

- does the intrinsic value of a given activity justify a computer system ?
- will the investment and exploitation costs of such a system leave room for profitability ?
- which architecture and capacity are needed for the computer system ?

The foundation of the method is that the value of any activity is carried by the data-elements or "views" describing the various "objects" (be it a product in the company, a customer, a procedure) in their relation to each other in participation in the activity. Every single view carrying the meaning of an object is a valid representation of that object: the semantics of any reality is derived from its structured expression. Measuring the information content of the data-elements of an activity is the measure of the activity itself.

Three types of objects characterize the activity, and define its context:

- products and services, at their various steps of development
- procedures used to manage the production of products and services
- partners responsible for the processes delivering the products and services.

Figure 1 - Activity Model

A view is therefore the situation within which a given object of an activity is referenced. To obtain a valid measure of any activity, data-elements must be expressed in a structured fashion

with a normalized vocabulary, so as to have a standard. Activity is therefore described by structured views attached to every object participating in the activity. The underlying model of activities that support the method gives the context of interpretation of the messages.

A view is described by its 3 ordered parts:

- a LITERAL, the etymological meaning of the data-element (e.g. date, name...),
- a *situation*, the meaning of the literals in the context,
- the **object** (or context) to which the view is attached.

Examples of views are:

DURATION *minimum* of **loan**

AMOUNT *desired* of **loan**

ADDRESS of **customer**

4. INFORMATION METRICS

The metrics used to measure the business activity are the mean information content and the quantity of decision applied to the formal description of the said activity. These metrics were formalized by Shannon and Weaver a few years ago (1949).

The mean information content is computed as the entropy, in the Information Theory sense, of the formalism used to describe the objects of the activity.

$$\text{Mean Information Content} = - \sum_i \frac{n_i}{N} \log_2 \left(\frac{n_i}{N} \right)$$

with n_i the number of occurrences of word i , and N is the total number of words used to describe the reality. As an example, mean information content of a uniformly random text written with an alphabet of 32 characters is 5 (the maximum).

Information value is derived by multiplying the Mean Information Content by the number M of distinct views built with the given alphabet.

$$\text{Information Value} = M * \text{Mean Information Content}$$

Quantity of decision is the logarithm of the number of distinct elementary decisions necessary to choose one outcome among a finite number of mutually exclusive events. This is called Complexity of use. For the activity, it corresponds to the number of distinct words used to describe it, i.e. the number of distinct literals, situation and objects. The formula is:

$$\text{Complexity of use} = (N_l * N_s * N_o) * \log_2(N_l * N_s * N_o)$$

in which N_l , N_s , N_o are respectively the number of distinct literals, the number of situations and the number of distinct objects.

For software this can be read as the measure of the difficulty to assemble the code: the complexity of use in this case is computed from the number of distinct verbs (instructions or modules depending on the point of view), user functions and distinct literals of the activity. It is

clear that a correspondence can be established between the complexity of the activity, and the complexity of the system used to support that activity.

Equating complexity with cost on one side, and complexity with processing power on the other, two rules of thumb are important at this level:

1. There is a diseconomy if the complexity of the supporting information system goes over 75% of the value of an activity. This departs radically from the use of function points where for every user change request a qualified estimate expressed in function points is produced. If it fits the budget it is accepted; if not it is rejected or postponed until next year. Now a much more efficient decision making process can be put to work: complexity in software can be accepted only if it stays within 75% of the complexity of the supported activity. That complexity itself can only be accepted if it corresponds to an adequate increase in the intrinsic value of the activity (adequate may mean to maintain or to improve on the efficiency measured as the ratio of intrinsic value to complexity).
2. The capabilities of the computer system necessary to handle a given level of complexity for an activity must match: complexity of the order of 30,000 can be handled on the desktop; 100,000 requires a client-server architecture; 300,000 a mainframe or a special purpose computer system. The question of what can be developed at the desktop level, what should be maintained as a client-server application, or what justifies the investment of a (still) multi-million dollar piece of equipment, rests in the hands of decision makers but not working solely from IS department decrees.

5. DECISION MAKING: AN APPLICATION

The example is taken from a loan acquisition process in a large French banking institution. The activities were modeled after the meta-model presented in Figure 1, the identification of the various objects being obtained from the views describing the loan acquisition process. The results of the analysis are shown in Figure 2. Values for the different activities are cumulative at each position, they are not the individual values corresponding to the views of the corresponding activity. Hence, the values of Information value and complexity of use increase from one position to the next. Moreover values computed for each object type (product, procedure, partner) are not additive. The values on the ACTIVITY line are computed from all the views on all the objects considered for all positions up to the current one.

The interpretation of data in Figure 2 is derived from some formal mathematical results on the activity model, and also from experimental data collected over some ten years in production and service industries.

Information values around 500 (loan identification position for ACTIVITY in Figure 2) are representative of common management activities: identification and indexation of the objects of the activity. Values around 1,000 are representative of management and resource planning: it is the Information value for the overall process described here. Control and forecast activities would have produced values up to 1,500.

Information value for a procedure should not go over 25% of the Information value for a product. The measures obtained are compatible with that limit.

Figure 2 - Loan process measurements

For an Information value of 1,000; Complexity of use should not be over 100,000. The reason is clear in the partners values (essentially the borrower in the present case) that are far too high. This can be interpreted in two different ways, as far as the strategy of the company is concerned:

- given the intrinsic values of the product (the loan), identification of the borrower is overly complex, i.e. unnecessary; or,
- with such detailed knowledge on the borrower, more sophisticated loans can be offered.

It should be noticed that these results can be produced specifically and systematically only because it is possible to attach a measure to each activity and to each object of the activity. You can control only what you can measure.

As for the organization, one can notice that all the intrinsic values for the product are reached at the scheduling position (223), and that the borrower's value is practically known at the first position (436 over 473). Adequate organization of the process (smooth operation without bottlenecks), requires that the value be accumulated in equal steps throughout the process. The BPR gurus could work on this.

The software application for the loan process is composed of some 40,000 lines of COBOL, made up of 14 transactions in 231 modules. The application needed restructuring in order to improve its reliability (the same controls were not applied consistently across the transactions) and its evolutivity (the backlog of evolution orders was more than 3 months).

The analysis of the software program showed that the number of distinct data-elements was equal to 167, due to the lack of a data dictionary. The Information value derived from the

views of the activity as processed in the software is 4,085. The complexity is 10,028,602 ($231 \text{ modules} * 14 \text{ functions} * 167 \text{ data-elements} * \log_2 \text{ of the same product}$).

We have found experimentally that the Information value of the software (4,085) must be at most equal to 25% of the Information value of the product (844): the present software program is not in phase with its purpose (in other words it does too many things for what it is used for).

As pointed out before, the complexity of the software ($>10,000,000$) should stay within 75% of the complexity of the product ($\approx 240,000$): gains in the present situation can only be found by mass-production of the product to offset the operating cost, not a likely occurrence here. The software must therefore be drastically reorganized to reduce its complexity of use under 180,000.

6. CONCLUSION

It is always very difficult in any business situation to reach optimal decisions with respect to the conduct of business. Intimacy with the organization, its goals and its market, help managers to make, most of the time, the right decision. Nevertheless, everybody tends to be dissatisfied with such a process, in the sense that hard facts can very seldom be pinpointed as the rational element behind the decision.

Modeling the activity from the information system point of view makes it possible to measure the goals and capabilities of the organization. The interpretation of the measurements for the various processes allows managers to elucidate the strategy and the relevance of decisions concerning the products and the organization. Moreover, adequate allocation of resources, in particular for the company's computer system, can be justified directly in terms of their value to the organization, as opposed to their cost.

7. ACKNOWLEDGEMENT

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9. BIOGRAPHY

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