

Theory of the Pygmalion effect in the Information Technology

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The first premise of this article is that the information technology produces a real business value. Its quantification can be studied in indirect form using both direct measurement of the investments in Hardware; Software; Human Resources; Telecommunications and Technical Support; and measuring the impact that they have had in key areas of the organizations. Second, there's a direct relation between the participation of executive personnel with his investments in Information Technology and the obtained results. In other words, if exists a high managerial involvement then the results will be much better, and vice versa; and the amount of the investment is irrelevant in such cases.

Business values, hypothetical construct, IT investments, latent variable.

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Introduction

Suppose, a priori, that there is a real value of business generate by the investments in Information Technology (IT), although named value could not be dimensioning, for the moment. The possible results would be: that the investment creates a positive value of business, translate into tangible or intangible benefits from the company; or that does not create any business value and the results are only the spending of the use of the IT.

According to the former approach, from the point of view of business, it is worth to invest in the acquisition of IT if the business value is positive and exceeds the economic expectations; in other words, if it obtains more benefits than spending. The decision to not invest would be wrong.

If named value is minor to the spending that is generated, then, it does not worth to invest in the entry which only will provoke economic lost to the organization that pretends to acquired it. The decision to invest, in this case, would be also wrong. However, if it is necessary or forced get information technology, the correct would be choosing the most expensive option.

The business value of the IT

The concept "Business value of the Information Technology" is subjective and abstract; this is because, it is not possible to measure the direct form for many reasons, to know.

First because it only perceive the intangible form, because it does not count right now with any standardized representation and accepted by all about this value, in monetary terms. The executives glimpsed a value of business, but without a reference measure, it could not be dimensioning.

Second, is a hypothetical construct which could mean many things for the entrepreneurs.

Some understand as business value everything that contribute with determinate utility to the results of the company, or which has any countable sit in the active; For example when an investor searches a performance about capital, this express as a percentage of the original investment [9].

For others the business value is identified with the donations or contributions of each one of the productive elements to the best company performance. For example how much does the ideas that the employees provide worth? Or a discovery, a patent or a system of original information?

Third, this business value should be the sums of many tangible and intangible results provide by the productive factors and for one of the areas that the company has when they do intensive use of the IT. The Information Technology is another element in the system.

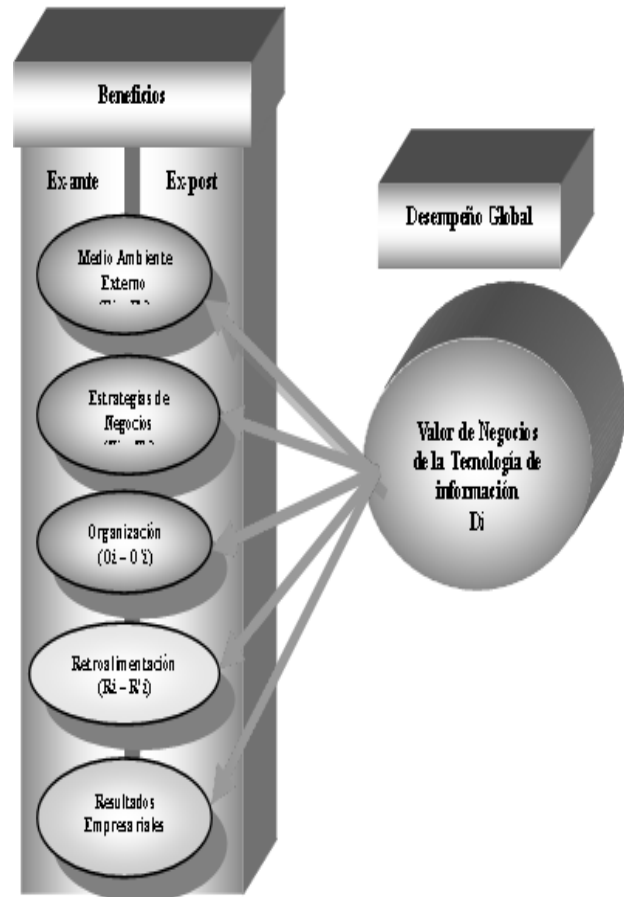
From here many arguments emerge which indicates that the intangibility of the business value is the result of the interaction of the IT with a group of components that analyzed, in a isolate form, lost their individual context and value of contribution. Consequently, there is not any correlation between the investment that the companies made in IT and the obtained benefits during the planning horizon? If there is any, how is it correlated?

The multidimensional nature of the IT

It arguments that the business value of the IT has a multidimensional nature conformed by five hypothetical construct: the external environment of the organization which is influenced by the IT; the strategies of business and its informatics support; the company organization and its support in the information technology; the control schemes and feedback of information in organizations; and the business results as outcome of the administrative management supported by the Information Technology, as sum [10], [14].

Each one of these constructs is caused by the construct Business Value, which is defined as an independent variable totalizing the casual effect.

Casual Relation between constructs of higher order



Graphic 1

Hypothetical construct

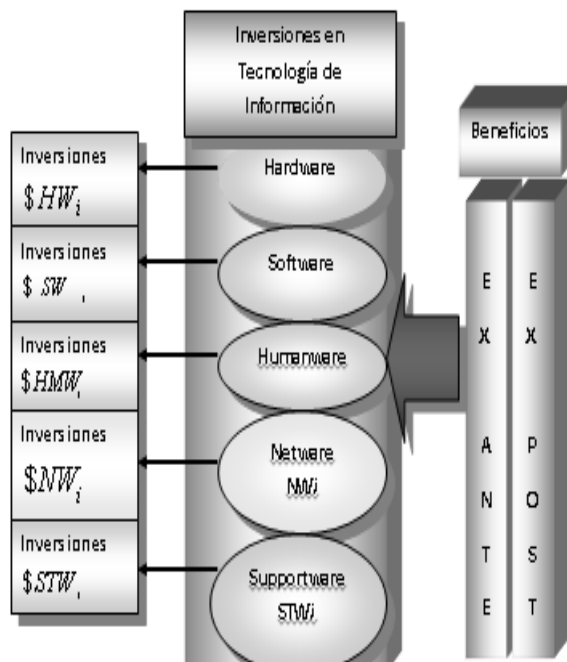
Each hypothetical concept is defined as a latent variable depended of the second order and as result of the difference of benefits expectative. This is why it's assumed that the directive of a company propose Ex-ante some expectative to intervene in it and that until now, it is possible to determinate the Ex-post benefits of named investments.

The construct of benefits were measured in an indirect form using many observed dependent variables and that the served as reference to determinate the nature of each construct.

According to the Figure 1, the five hypothetical constructs are abstract concepts which should have some real value; but to evaluate them is necessary measure them in some form. Then, it proceeded to relate each construct with five hypothetical constructs in a first level, starting with hardware and software, which are the most identifiable and know.

The other constructs were defined with three new names: humanware, netware y supportware, which conform the investments in IT by the studied companies [7].

Hypothetical constructs of first order



Graphic 2

This last group of latent variables ¹⁶, it is also hypothetical, but it has the support of its indirect measurement was made defining many observed variables that were measure, at the same time using a questionnaire projected to such effects.

Methodology

The modeling of the solution to the raised problem using a Structural Equations Model (SEM) to evaluate the existent correlations between the two different dependent and independent constructors and using the obtained values, through questionnaires, for the dependent variables observed.

To make the former process, of general form the next scheme was applied:

$$\text{Facts} = \text{Model} + \text{Residual}$$

Where:

Facts.- represent the measurement of the observed variables.

Model. - Represents the hypothetic structure that connect the observed variables with the latent variables.

Residual. - Represent the existent discrepancy between the hypothetical model and the observed facts.

First, it builds the matrix of variance-covariance Σ , also called covariance matrix of the model-involved.

¹⁶ The three formed concepts: humanware, netware and sportware do not have direct reference in the literature and have being define to support the theory that is exposed in this article, with the exception of the word netware which is use commercially for the Novell Company.

The elements of Σ are in function of the model parameters: each Σ element has a counterpart that corresponds to a numeric element of the variance-covariance matrix, S , of the observed sample for the consider variables.

After, it made the measurement or the evaluation of the existent difference between S matrixes (with elements s_{ij}) and Σ (with elements $\hat{\sigma}_{ij}$).

When the Σ and S matrixes are compared, it generates an equation system (the same numeric of no redundant elements) that corresponds to the same number of the parameters to be estimated in the model.

The above has sense if this process is seeing like adjust a model of structural equations through the solution of a given system of equations.

For each equation it has its left side is a numeric value which is obtained from the S matrix, while the right side corresponds to an expression of the parameters of the defined model in the Σ matrix.

If the values that will be compared would be scalars, then it only have to apply a simple rest between both matrixes, using the absolute values of the resulting references, to evaluate the distance between them. However, this could not be directly applied between the both S and Σ matrixes because there is not a number, but a matrix of the differences, this is the matrix of residual covariance $S - \hat{\Sigma}$

The elements of this residual matrix are then $s_{ij} - \hat{\sigma}_{ij}$ the standardized matrix of

residual has the elements $r_{ij} - \left(\frac{\hat{\sigma}_{ij}}{s_{ii}s_{jj}} \right)$ where

r_{ij} is the observed correlation between the i and j variables, $\hat{\sigma}_{ij}$ Is the predicted covariance, and s_{ii} , s_{jj} are the observed standardized deviations. The standardized residuals obtained from the correlation are easier to interpret than the not standardized residuals, based in the covariance, because those do not depend of the used scale in the made measures of the observed variables.

From the former paragraph it derived the concept of distance between the S and Σ matrixes which is a number that results of the comparison between the S elements with the elements of the matrix of the covariance of the imply-model.

This distance is, then, in function of the parameter of the model and of the variances and covariance of the observed elements.

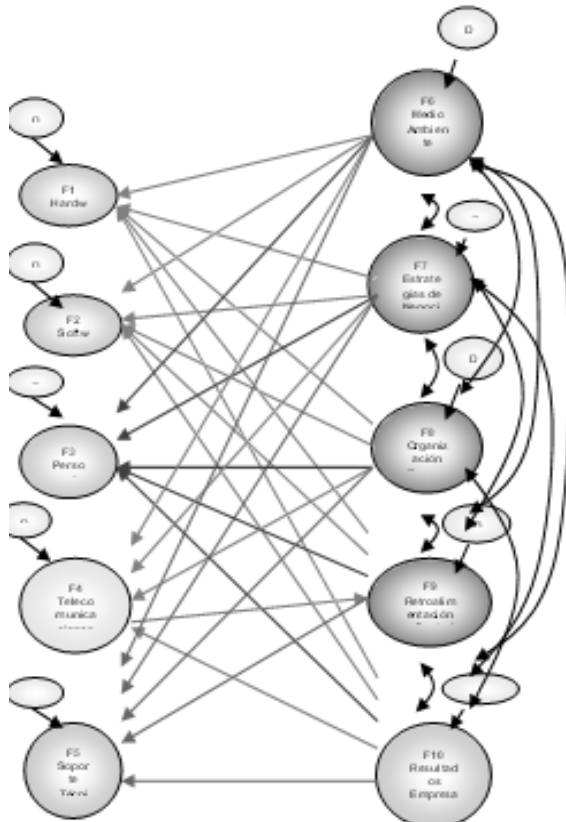
When we talk about the distance between matrixes and relation between the parameters of the model and S matrix, it also talking of an adjustment function analyze the distance between two matrixes, the value of F is always between zero and a positive value. If the value of F is equal to zero both S and Σ are identical.

Because the solution from the mathematic point of view is complex, the evaluation, adjustment and analysis of the proposed model with the observed facts were made leaning in a package of commercial computing, called TMEQS, Version 5.7b.

The statistical results and the conclusion that are exposed derived from the generate runs with this computational package.

Statistic theory in order to justify the process of adjustment of the model it possible to find in different published works about modeling of structural equations like [1], [6], [8] and in different journals like Multivariate Behavioral Research, Psychometrika, Sociological Methods & Research, Journal of Educational Statistics, British Journal of Mathematical and Statistical Psychology and Sociological Methodology.

Relation of latent factors of Intervention in IT against the latent factor of Ex-ante and Ex-post benefits



Graphic 3

Results

Frist, if we consider the original model, a latent factor that was discarded was the one of the Business Strategies. The results of the runs indicated a high maladjustment of the model with respect of the gotten sample facts. This was interpreted in the sense that the Business Strategies was a irrelevant factor inside the model because that’s how the surveyed executives consider it. Being eliminated this factor, it achieve a higher level of adjustment.

Checking the research made by Sanjay K. Singh [14] of the Alabama University, Birmingham, he also got a similar result.

The obtained result in this research also reveals a similar behavior in Mexican executives. When the business strategies are defined, these keep principally in the directive level and they do not spread to the rest of the levels in the organization. The IT it is not being used to support such important concept for the orientation of business.

However, the results are developers in the sense that there is a direct relation with its investments of Information Technology and the obtained results. In other words, to bigger involvement better results, being the volume of the investment a little bit irrelevant. This is resumed in:

1. If the directive takes the role of leaders in the inversion’s conduction in IT, together with its executives in technology, the results are highly satisfactorily.
2. If the directive does not assume the role of leader and left the responsibility to its executives in technology, the results tend to lose value.

The former conclusions are named “the Pygmalion effect of the IT”.

The second relevant aspect is the one generated by the construct Business Environment. This latent factor could be evaluated indirectly by eight variables without the indices of goodness of the model adjustments being affected.

Again, to consider the same study of Singh [14], the results that he found coincide with this aspect.

However the obtained results in the indices of goodness of the adjust reveals a partial adjust between the final model and the sample facts, could be conclude that there are statistical evidences pointing that with a N sample size, which contain at least five cases per construct, it could derived statistically better support results.

The final model tries to reflect not only a partial adjust of the facts, but also an explanation of how the business value could be conceptualized through a business dimension chart whom, at the same time, are influenced on its process by the use of the IT.

Discussion

The evaluation of the Information Technology, considering the benefits that the company contribute with, is complicated because it does not count with a standardized patron of measures to made such evaluation, or at least to make comparison of performance with other companies [9], [10]; For the entrepreneurs is necessary to determinate if this justify or not the investments in IT. Like Remenyi [12] points, in many organizations the investments in Information Technology are high and represent more than the 50% of the process associate with the IT, in direct or indirect form.

As well as there are cases of success in the incorporation of the IT to the business process, there are also cases of failures [7], [15] which carry heavy losses of billions of dollars. Then, the entrepreneurs demand that their investments on IT have the minimum uncertainty possible and the maximum probability of success. In the Mexican business exchange it is hard to find these bases.

For example, when the group of foreign passenger trucking “Flecha Amarilla” decided to acquire in 1999 an ERP system of the JD-Edwards company, none of the other Mexican companies did it before. There were not cases to be taken on account as reference of implementation only in foreign countries and of companies different to the trucking. Later, another company of trucking, Pullman de Morelos, did the same but acquiring its ERP system, from the SAP Company. Nowadays, more companies, like ADO, are installing these business systems but they have now same references. The above means that in the Mexican ambit has been investing in Information Technology more as a form of modernized their management process than a real strategy of business.

As corollary of the research it has and architecture of IT, to be efficient should answer questions like: Do we have the correct technology? Is it structured appropriately? What levels of access to the information, to share and should they stand? Which application should be develop and which should be buy? Who will maintain and actualize the tools, facts and the applications? Who will determinate if the architecture of IT is suitable and accomplish with the business necessities?

The answers to these questions will vary depending of the basic competencies of each company, of their strategies, of their administrative orientation, of their propensity and aversion to risk, of their economic capacity to invest in the Information Technology and other factors. Henry Mintzberg [11] points that the executives originally raised a group of basic strategies for the business, and passed a period of time, they develop emergent strategies, different from the firsts, creating with that a perception of the achieve strategies.

The directives that go on board in the adventure of support their business strategies with IT should be conscious that their acquisitions will require a big capacity of adaptation and change.

Conclusions

However the former paragraph could look trivial and inclusive obvious, the reality presents cases in which are forget or are taken for granted this fundamental aspects. The business decisions are taken, generally, under a big number of restrictions and limitations like:

The executives often suffer of the right information for their most important decision-making.

- The directives, as the majority of people, have to give bigger attention to the information that confirms their points of view, while discredit the facts and informs which could contravene their beliefs.
- The high directive often is insolate of the reality or the real situation of their organization.

The explosive growing of the Information Technology and of the information flows they have not being accompanied with a correspondent grown in the abilities of the directives to process such quantities of information [4].

The ahead emerges from the statistic evidences that point to a lack of orientation of the investment in IT to the business strategies of the organization as first conclusion.

The second conclusion is about the business environment of the organizations. The directives know about the changes in technology and market, even do, the statistic evidence points to a overcharge of information in such sense. It only needs canalize correctly all this group of information in order that the Mexican organization will be more competitive with the support of the Information Technology and as well they could generate a real value of business for their invest in that field.

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