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**BALANCE SCORECARD: BEYOND THE CAUSALITY
PRINCIPLE**

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BALANCE SCORECARD: BEYOND THE CAUSALITY PRINCIPLE

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Abstract

The present paper builds on an Action Research that combines Balance Scorecard (BSC) with the scenario simulation method (CIA-ISM) in actual context. The research is carried out with direct engagement and involvement of the organization's management team, and its main purpose is to find an explanation of all interdependencies related to the targets and objectives of BSC from organizations. Even if this is the main purpose of the research, we can assume two different sub-targets resulting from it and the increase of knowledge that entails. First goal aims to ensure that BSC+CIA-ISM is useful in decision-making, and the second goal intends to show that improving knowledge of the objectives decrease the uncertainty amongst them and thus, reduce its risk level. Since its birth in 1992 by Robert Kaplan and David Norton, Balanced Scorecard (BSC) has been a widely accepted and used tool in business environments in order to support assistance to management, and the achievement of the targets, by using information that goes further than a purely financial vision. Moreover, the combination of Cross-Impact Analysis and Interpretative Structure Modeling (CIA-ISM), has been successfully used to generate and to provide an accounting with regard to dynamic scenarios in high uncertainty contexts, such as emergency scenarios, risk analysis and assessment of business projects. BSC+CIA-ISM combination enables us to understand and model the existing interdependencies between the different variables that make up BSC inside the organization, and indeed to simulate the effects of partial or complete achievement of one or various

variables in a dynamic way, which may also involve an improvement of the tools currently used by organizations for decision-making. Furthermore, it comprises an improvement added and the implementation of temporal biases, which provides more information to the organization. In summary, the main contributions of this paper are providing an improvement of the BSC traditional usage by combining it with the scenario-based methodology of CIA-ISM. Thus, explaining the Principle of Causality between the objectives/targets on BSC, but it also includes the improvement of decision-making, by providing a combination of different methodologies, that allows to understand and model BSC. In addition, it will also help organizations to reduce the risk situations related to strategic decisions, by using CIA-ISM to simulate different adverse situations, or the relationships between the changes and target achievements, that allow also the training of the management teams. In conclusion, the combination BSC+CIA-ISM enables us to know the internal performance of the organization and the interdependencies between its targets/objectives. Graphic representations (ISM) and simulations (CIA) have been contrasted with the same direction and thus, allowing to conclude that this BSC extent provides more and better information than the traditional method. All things considered, it supports and improves decision-making progress by minimizing the level of uncertainty and hence the risk level too.

firms.

Keywords: Entrepreneurship; DSS; Business Success; CIA-ISM; Simulation

BALANCE SCORECARD: BEYOND THE CAUSALITY PRINCIPLE

1 Introduction

Balance Scorecard (BSC) is defined by Norton and Kaplan (1992) as an Administration/Management System, which goes further than the purely financial vision that was traditionally used to assess the organizational performance and serves as core indicator for decision-making. It is based on four fundamental pillars or main target groups with the corresponding indicator, that allows the organizational leadership to establish, identify and coordinate different strategies and endeavors, by measuring systematically the accomplishment of objectives and targets through the use of indicators. In summary, it is an administrative management tool that belongs to the information systems of a

company, and it is used by management teams to assess the situation of the organization, regarding to the accomplishment of objectives and targets in order to make decisions and propose multiple strategies. Additionally, the tool enables us to detect any deviations regarding to the targets set. For that reason, it is to some extent, one of the tools used by leadership in order to minimize risk situations (understanding risk, as defined in the ISO31000:2009, “*the effect of uncertainty on objectives*”) (International Standards Organisation, 2009). Therefore, greater knowledge of the organization and highest efficiency of BSC tool will improve risk prevention, since the tool minimize the effects of uncertainty on these matters. It must be emphasized that one of the main criticisms to BSC, as detailed below, is the lack of detailed and reasoned information on causality, and the interrelationships between targets/objectives. In fact, it is on this point where the integration of a methodology based on scenarios may provide and improve the current state of the art.

On the other hand, the implementation of scenarios in risk management is a methodology widely used (Table 1). In particular, CIA-ISM methodology (Victor A Bañuls & Turoff, 2011) allows the score of direct and indirect relations among a large number of elements, which are categorized and allow the performance of simulations. The results of calculations are presented using numerical data and graphs, which allows stakeholders to understand intuitively the outcomes achieved.

The extent or combination of BSC with CIAS-ISM will enable the recreation of the organization, targets/objectives through the use of its Key Performance Indicators (KPI) on the basis of the knowledge of the leadership and other experts. First outcomes will show the interdependencies of the Targets/Objectives, which will be classified in four different groups as the theory suggests. BSC+CIAS-ISM will also enable to meet and assess which interdependencies are more influential or vulnerable. Finally, it will enable the organization to perform simulations in order to train work teams, or to forecast the possible outcomes beforehand. In any event, the knowledge of the organizations will be improved, as well as the interdependencies between the targets, and the generation of scenarios minimize the uncertainty. Thus, it is possible to combat the adverse effects of risks concerning the objectives.

All things considered, this article proposes the application of methodologies in order to improve BSC and understand better the internal relations of BSC itself (Causality), the organization and its internal processes, which would help when minimizing risks and in particular, by improving the ability of decision support systems (DSS).

This study was carried out as a fieldwork, where data and information were directly obtained from a Spanish consulting firm, whose management team lent its full cooperation to researchers. The firm under consideration belongs to the professional services sector and is specialized in strategic consulting, and the development of business

models. It can be placed into the group of medium-sized consulting firms and operates on the market for 20 years now. This company has a large client range and has been included among the IBEX 36 main firms.

For this reason, the study is a fieldwork which has been directly implemented and contrasted in actual context. This constitutes a direct advantage when contrasting data and the results directly obtained from the organization, since validation of the results of simulations is carried out through forensic analysis. This way, through comparative analysis of the outcomes obtained from simulation, and the actual outcomes where agents are involved, it is possible to adjust the theoretical model if required. Otherwise, it is possible to provide an explanation of the deviations, in cases where the difference between the predictor and reality is caused by a single and isolated event, which has a logical explanation.

First section of this paper introduces the main theoretical and methodological concepts that give rise to research, as the methodological contribution of Temporal Matrix is also included. The following section integrates the study where the process followed in order to carry it out is described, as well as the first results (numerical results, graphs and simulations). Then other section describes the validation process that has been carried out from the outcomes and includes a subsection that shows the discussion with the organization. Beyond that it also integrates the results of a survey among the employees of the firm. Finally, conclusions and biography are presented.

That said, it is possible to start framing the study by presenting the theoretical and methodological background.

2 BSC and Causality

In contrast to other traditional scorecards, BSC provides a globalizing vision of the organization, due to “its capability to summarize variables and apparently disparate activities in a single management report, but nevertheless are essential for success and competitiveness of the organization.” (Carenys & Falguera, 1997)

The final purpose is to summarize key information intended for management team within the scope of their responsibility, as well as to report the results of management so that it supports decision-making, in cases where it may occur deviations compared to the stated objectives. Therefore, it represents an improvement on “traditional systems for management measures, which certainly have bias control due to its origin in the finance function. That is to say, traditional systems for measure of performance specify which actions are expected that employees perform, and then these systems check if the actions have been executed.” (Norton & Kaplan, 1992).

BSC puts emphasis on the financial and non-financial indicators, which must form part of the information system and be available for all employees in organization (Kaplan & Norton, 1997). Nevertheless, it goes further than the calculation made by a battery of indicators that inform on most relevant aspects of the organization. Information that BSC must present needs to be useful specially for management, hence on its design will have to prevail considerations such as:

- a. Guidance towards decision-making, by promoting an active attitude to foresee events, on the contrary to a merely reactive attitude to cope with budgetary deviations.
- b. Inclusion of the needed information, and only the information needed, avoiding the useless information overload for BSC users.
- c. Adaptation of the information needs of users (Carenys & Falguera, 1997).

To achieve this, formulation process and review of the strategy must be closely related to the design and monitoring process of BSC. Mission and action plans in order to achieve goals, both in the short and long term, must be defined during the formulation of the strategy. It is necessary to identify key factors for success during the process, with the participation of the executives implied. These are the factors that the organization is able to control and those which must excel in order to achieve the objectives stated. At this stage, it is required that managers understand clearly the organizational structure and organization graph (Amat, 1996). Indicators (monetary and non-monetary), that may report the development of key factors, are defined below. These indicators constitute BSC and are analyzed under four different perspectives.

These four perspectives must integrate outcome measures, as well as inductors, and it constitutes the following perspectives: Financial, Customers, Internal Processes and, Organizational capacity or Learning and Growth ("Strategic capabilities" in this study). If we contemplate the configuration of the four perspectives, it is possible to acknowledge that the relationship between financial and non-financial measures proves a cause-and-effect relationship, but also that non-financial measures have an impact on financial measures through a number of stages. For instance, the staff and appropriate technology that strategically engage in key activities, make customers feel satisfied and attract new businesses. (Olve, Roy, & Wetter, 1999).

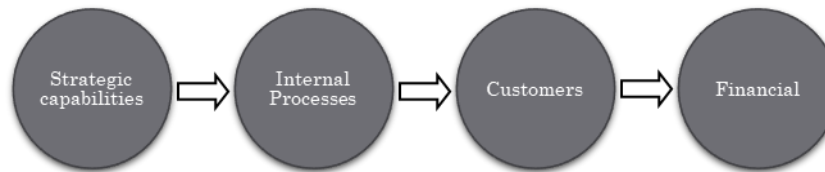


Figure 1. BSC Perspectives (Kaplan & Norton, 1992).

Francis D. Tuggle introduced a new concept into BSC, known as *strategy maps* (Tuggle, 2004). Strategy map was formulated as a causal relationships diagram between the strategy objectives, which are distributed over the four BSC perspectives in a balanced manner.

Strategy maps become a key tool for describing and reporting the strategy to the whole organization, and it also enables all members to understand the strategy and how it brings value to the organization.

BSC is nowadays only a part of a powerful management system, which is used for developing and aligning the internal and external strategy of the organization (Kaplan & Norton, 1996a). There is a set of characteristics in the process of designing BSC that must be taken into consideration. The following are among the most significant:

- Taking a broad strategic perspective balance their short-term goals, monetary and non-monetary indicators, as well as planned and historical data. This combination ensures that management control takes on a strategic dimension. (Smith, 1990).

- BSC has to turn the mission and strategy of the business unit into tangible goals and targets (Kaplan & Norton, 1997).

- Indicators construction process involves the participation of executives based on the organization's strategy. Therefore, the formulation process of BSC is essentially participatory (AECA, 1998).

- BSC should be simple, clear and designed bearing in mind the user. The number of indicators must be limited, and it must include only the ones considered to be most relevant. This constrain is intended to avoid excess data, which may hinder and make expensive its use (Carenys & Falguera, 1997). Kaplan and Norton, 1998, assert that organization can formulate and communicate its strategies using an integrated system of approximately two dozen indicators.

Indicators are generally divided following the four key perspectives of the organization: perspective of economic and financial results, customers, internal processes and employees (Norton & Kaplan, 1992).

It is required to identify not only key success factors and the corresponding indicators for each perspective, but also cause-effect relationships between different indicators, which give answer to how to achieve better results. Thus, it is not about locating indicators in any way, but rather is intended to remain interlinked. This means information about what is happening is not only obtained, but also information that explains the reason why it happens (AECA, 1997).

The most common criticism of BSC refers to causality among the perspectives. The argument set out by (Kaplan & Norton, 1996a, 2006; Norton & Kaplan, 1992; Tuggle, 2004), states that training programs to improve employee skills (Strategic Capability Perspective) get better the customer service (internal processes perspective), which enhance customer satisfaction and loyalty (customers perspective), and this last will raise all income and benefits (financial perspective). However, according to Norreklit (Norreklit, 2000), Kaplan and Norton did not provide any argument to underpin this causality assertion. Even if Kaplan and Norton continue to uphold the causality relationship, they sometimes do not give a proper response to the criticism related to their empirical studies, which prove causality among the perspectives.

Many studies have linked various perspectives to financial performance, for instance to processes (Ittner & Larcker, 1997), or to customers satisfaction with an increase in profitability (Ittner & Larcker, 1998; Rucci, Kirn, & Quinn, 1998). Nevertheless, any of the studies have linked the four perspectives together. Malina proved the relationship of causality and found only a partial subject to support BSC assertion (Malina, 2001).

BSC provides to management team a method to implement the four processes that strategy management involves, individually or jointly, which may have an impact on the relationship between short-term actions and long-term goals. (Kaplan & Norton, 1996b).

Bearing in mind the criticism about the lack of explanations in causality relationships of BSC, this research intends to elucidate on this shortcoming, by implementing scenarios methodology, particularly CIAS-ISM (V.A. Bañuls, López-Vargas, Tejedor, Turoff, & Ramirez de La Huerga, 2016; Victor A Bañuls, Turoff, & Hiltz, 2013; Ramirez de La Huerga, Bañuls, & Turoff, 2015). Since it has been proved in other researches, CIAS-ISM helps to overcome the problem of the complexity in high uncertainty contexts, where in addition there is not enough information available to allow the use of other statistical methodologies.

3 CIA-ISM and temporality

3.1 Cross-Impact Analysis (CIA)

CIA is a methodology used to support the determination of the interdependencies between elements, and how the interdependencies between different events (elements) may have an impact on other events, by decreasing the level of uncertainty in the future. Due to its capability to analyze complex contexts with a high degree of interactions, CIA is one of the most common techniques used for generating and analyzing scenarios, as it is historically (Turoff, 1971), and currently referred (Bañuls & Turoff 2011).

Analytic approach proposed by (Turoff, 1971) was specifically developed to restructure appropriately formalities of cross-impact at an interactive computer terminal. This requires users to modify and repeat its estimations, until they consider their deduced conclusion as consistent with their viewpoints. Additionally, this method is based on the idea that any event may be unique, in the sense that it only may occur just once (i.e. development of a particular finding or outbreak of a specific war).

According to Turoff, 1971, CIA may be used in events that, generally, do not have an historical significance of occurrence that may allow the probability of occurrence to be interfered. In this case, Cross-Impact Analysis problem consist in deducing the causal relationships between different viewpoints. This is performed on the basis of distortion of the initial vision of a participant, relating individually to each event and with knowledge concerning to the problem. In other words, the estimations of a subject actually estimate causality. Estimations of correlation coefficients (C_{ij}) can be calculated using a modification of the distribution function of Fermi-Dirac (Equation 1).

$$P_i = 1 / \left[1 + \exp \left(-G_i - \sum_{i \neq k} C_{ik} P_k \right) \right]$$

Equation 1. Distribution Function of Fermi-Dirac

Where:

- P_i represents the probability of occurrence of the i-th event.

- The coefficient C_{ik} represents the impact of i -th event on the k -th event.
- G_i (gamma factor) is the effect of those events that have not been specified in the model.
- C_{ik} positive means that k increases if i occurs, and negative increases the occurrence.

In other words, CIA methodology infers the probability of occurrence of any specific event, due to the occurrence of other one besides the correlation between all of them, and assuming that any of them have an historic base data to allow traditional inference. Events are also classified as triggers (those who are first to occur and cannot be directly “manipulated”), dynamics (those between triggers and the results, which are subjected to slightly change and model), and ultimately Result (those who are the final result of the model and do not have an influence over other elements further than those that belong to its same group).

In light of factors of influence as lineal, we can show the estimators of the relative relationships of any event, and those that have an influence on them by drawing relationships on a linear scale. We can then use a different modeling approach, as ISM, in order to analyze the complexity of the resulting weighted influence graph (Warfield, 1976). This extension would allow people to receive a graphical view of their value judgements and also enhance its capacity to make improvements.

3.2 Interpretative Structural Modeling (ISM)

Interpretative Structural Modeling, developed by Warfield in 1976, is a method that perfectly suits with the CIA approximation used by Turoff and Bañuls. ISM has been used to represent easily the interdependencies related to the elements of a CIA matrix. In this way, it is possible to see the direct, indirect and cascade relationships established by the matrix-generated model.

The ISM is constituted by a determined number of elements (n) that forms the set S :

$$S=(s_1, s_2, \dots, s_n)$$

Equation 2. ISM Set of Elements

Relationships between the elements of the set can be represented through a matrix ($n \times n$). Using a relatively easy mathematical calculation with ISM matrixes allows to calculate the Reachability Matrix (M), square, reflection,

transitive and binary matrix that shows the relationships between the elements of the set S . For instance, if the element $M(s_i, s_j)=1$ shows the relationships between the element s_i and the element s_j , or if in the opposite case $M(s_i, s_j)=0$ shows no sign of relationship. Each element of the set S may be considered as a node, and find a solution through graph theory.

For the last few years, a perturbation has been implemented to the theory in order to make it compatible with CIA (Murray Turoff, Hiltz, Bañuls, & Van Den Eede, 2013). This perturbation is based on turning the greater absolute values of impacts into 1 and leaving the rest as 0, in such a way as to examine C_{ij} matrix converted into a matrix easy to access. This allows to state various levels of sensibility in order to monitor the evolution of the interdependencies between the different elements.

This system allows also to create digraphs that enable us to monitor the interdependencies between the different elements of the set S , as well as to classify their significance with an overall view of determined graph, by offering a simple and tidy approach of the interdependencies.

3.3 Introduction to the Temporal Bias

One of the main contributions of this article concerning to CIA method, used in order analyze the BSC, is the inclusion of a second matrix that can bias the temporary influence of all events, discretely (uninterrupted), as well as the influence in sequential mode which is the most common used. Even if there are already certain contributions as the KSIM methodology (Kane, 1972; Lipinski & Tydeman, 1979), CIA develops models of ongoing impacts which are generated with the aid of Monte Carlo simulations. KSIM constitutes an important develop regarding to the temporality of impacts, but it is not adjustable to the functioning of the planned working model. Thus, we have chosen to develop this model on the basis of a temporal matrix.

The traditional methodology of CIA shows a scenario where all trigger events have an influence over the dynamics and outcomes. First, the event is presented, and then correlation of downstream impacts begins, which may act upon one or various dynamic events and/or results. However, it does not allow to select at what point these impacts occur.

In this case, temporal matrix is included and divided in different periods of time which range from Short to Long term (1=Short; 2=Medium-Short; 3=Medium-Long; 4=Long). This matrix identifies at what point a particular event can have an impact on other. Temporal matrix T , which is composed by T_{ij} elements, has the same dimension as matrix C_{ij} . In this matrix, each element T_{ij} states at what point event i affects event j .

As stated above, this allows analytically to see the sequence of impacts given the kind of event (Triggers→Dynamics→Outcomes), as well as to temporarily sequence those impacts for each of the periods of time (Short, Medium-Short, Medium-Long and Long term).

This provides improved information to decision-making agents of the organization, since it allows to look at the moment where a modification on dynamic objectives will have a greater and better effect. This modification would greatly improve the knowledge of the functioning and the interdependency between the objectives, as well as decision-making by agents.

To understand more easily the difference by introducing a model of 5 elements (1 trigger, 2 dynamics, 2 outcomes)

A: Trigger

B y C: Dynamics

D y E: Outcomes

In addition, it is supposed that the natural sequence of occurrence is the following: trigger events have an effect on dynamics, dynamics on itself and on outcomes, and the outcomes on itself.

$A \rightarrow B \leftarrow C \rightarrow D \leftarrow E$

On the other hand, we know that temporal matrix of events is the following (1= Short Term and 2= Long Term).

<i>C_{ij}</i>	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>
<i>A</i>	-				
<i>B</i>	1	-	2		
<i>C</i>	2	2	-		
<i>D</i>			2	-	2
<i>E</i>		1	2	2	-

Table 1. Example of Temporal Matrix

This being said, broadly speaking we know that in Short Term (S/T) (1) the sequence of events is:

$$A \rightarrow B \rightarrow E$$

(with the impact that shows matrix C_{ij})

In Long term (2) the sequence of events is not complete:

$$A \rightarrow B \leftarrow C \rightarrow D \leftarrow E$$

After raising the theoretical foundations of the research, we should describe which are its specific elements as well as the hypotheses set. The following step will involve the description of the chosen research methodology for this project.

4 Objectives and Methodology research

As stated above, the following section includes the main objectives and hypotheses proposed by researchers, as well as the research methodology followed. This research is based on an Action Research process, where we have actively cooperated with an actual firm and its steering committee, by studying the implementation and outcomes in an actual environment.

4.1 Objectives and hypotheses

This project comprises different objectives which are divided into primary and secondary ones (Table 2). Despite all several attempts, the first one tries to give a response to one of the biggest criticism that BSC receives, which is the lack of explanation between the Causality and Goals. Thus, the main goal consists in demonstrating that CIA-ISM provides an explanation for the Causality Principle of BSC.

Stating an explanation regarding the causality principle of BSC, improves the knowledge of the organization and its functioning, reason why it has theoretical and practical implications. On the one hand, it is possible to make simulations and trainings to improve decision-making about objectives, along with the opportunities that CIA-ISM methodology offers. On the other hand, knowing deeply the functioning and interrelation between goals reduce the effects of uncertainty under these goals. This means to reduce risk level, following the definition offered by ISO 31000:2009 (International Standards Organisation, 2009).

	Description
Primary Objective:	Showing that BSC+CIA-ISM allows to give a response to Causality Principle of BSC.
Secondary Objective A:	Showing that BSC+CIA-ISM helps to improve Decision-Making.
Secondary Objective B:	Showing that BSC+CIA-ISM reduces the risk level by decreasing uncertainty.

Table 2. Primary and Secondary Objectives

In order to give an answer to those goals, research is based on 3 main hypotheses, that are subdivided into different secondary hypotheses, as it is indicated in Table 3

Hypo	
H1	The use of BSC+CIA-ISM enables to give a response to Causality Principle of BSC, by allowing us to know the interrelation between goals.
h1.1	The use of impact matrixes improves the insight of the organization as well as the

	interrelationship between goals.
h1.2	The use of such graphs improves the insight of the organization as well as the interrelationship between objectives.
h1.3	Matrixes, Graphs and Simulations improve the insight of the organization and the interrelationship between objectives.
H2	The integration of CIA-ISM and BSC supports decision-making
h2.1	The use of simulations and temporal matrixes supports decision-making
h2.2	The use of CIA-ISM and Based Scored Card supports decision-making
H3	The information provided by CIA-ISM and BSC helps to understand and explain the interrelations between goals and the firm

Table 3. Primary and Secondary Hypotheses

H1 raises directly that BSC+CIA-ISM give a response to Causality Principle of BSC. This primary hypothesis is subdivided into three secondary hypotheses that will contradict straight questions to the experts involved.

Similarly, H2 intends to determine if this methodological integration improves or supports decision-making process. It is as well divided into different secondary hypotheses that will be contradicted through straight questions to the experts involved.

Together with the previous hypotheses, H3 intends to determine if BSC+CIA-ISM contributes to know and understand the organization, as well as the interrelationships between objectives. The reason is that if the knowledge of these elements and its functioning is improved, the uncertainty level is reduced, hence the risk level on objectives.

4.2 Action Research Methodology

On the basis of previous studies, we can find many references referring to Action Research (AR). In order to provide an introduction referring to research methodology, we follow the work of David Tripp (Tripp, 2005), where the author provides a solid and well-built introduction to this methodology.

According to what Tripp outlines, the implementation of this methodology is given by (Lewin, 1946), although there are certain previous references from its startup in 1993 (Altrichter, Posch, & Somekh, 2005). AR constitutes a

generic term for any research that follows a cycle with the following stages: Plan, Act, Describe and Assess, as it is explained in the following graph:

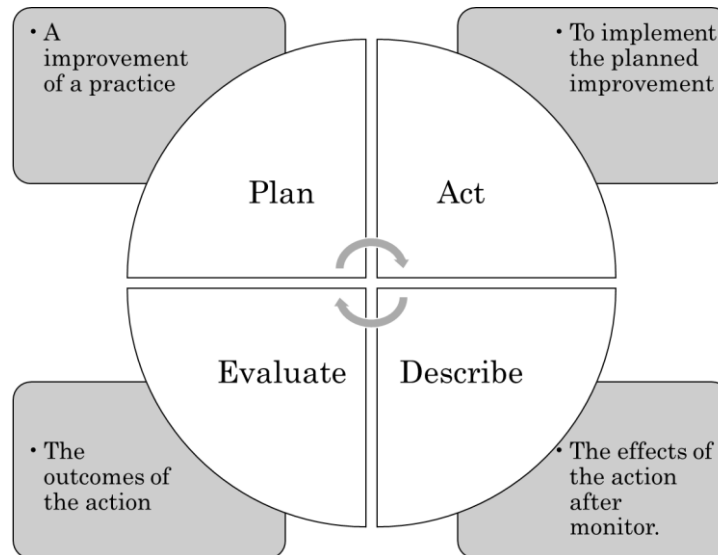


Figure 2. Cycle of Action Research.

There are different extensions, improvements and developments emerged from the underlying methodology developed by Lewin, which can be seen on the work of Tripp above mentioned. In any case, action research process is a practical process which is closely related to the actual implementation of research, in an environment that requires the involvement of stakeholders with a wide range of skills on the issue or other case study. According to the statement of Brown and Dowling: “Action research is a term used in projects where experts that pretend to make the necessary changes on its own practices...” (Brown & Dowling, 1998).

It is important to keep in mind that, AR is a scientific research methodology and is midway towards traditional scientific research and widespread practice in organizations. AR follows the same principles and criteria of other types of academic research, as peer reviews, significance, authenticity, soundness, etc. (Tripp, 2005). There are other features of the three routines compared in a summarized table (Table 4), that has been compiled by the author, and helps at understanding that AR bring together both perspectives (practical and scientific) in a research methodology.

#	Practical routine	AR	Scientific Research
1	Common	Innovative	Original resources

2	Continuous	Continual	Sometime
3	Response led by a need	Proactive led strategically	Led by methodology
4	Individual	Participatory	Collaborative / Collegial
5	Naturalist	Interventionist	Exploratory
6	Non-inspected	Problematized	Commissioned
7	On the basis of the experience	Deliberate	Argued
8	Non-articulated	Documented	Peer review
9	Pragmatic	Understood	Explained / Theorized
10	Context-specific		Widespread
11	Private	Disseminated	Published

Table 4. Eleven features of AR. (Source: Tripp, 2005)

AR's main goal consist in making practical changes in the application scope, which is an organization in this case. The following section provides the core of the conducted research, where AR methodology is applied in an actual context with the support of the leadership in an attempt to contrast the previous set out hypotheses.

5 Action Research

AR process followed by researchers is described in this section. The survey was conducted in a real organization, whose management team was involved in the development of the present work, by providing information and collaborating with researchers. Additionally, the company had to use actively BSC as an essential requirement.

Although the following sections cover the steps followed, it is necessary to make clear that the research has been conducted using the own BSC of the organization. Strategic objectives have been taken as elements of the model. Thus, an interactive process has been taken, in order to provide information about the interrelationships between them using Cross-Impact Analysis. This method allows to conduct Graphical Analysis of the interrelationships of those objectives. Finally, several simulations were run to monitor the degree of misalignment of the model, as well as to compare the estimated and real results as a validation method.

The following graph shows the way we integrate AR methodology to our research:

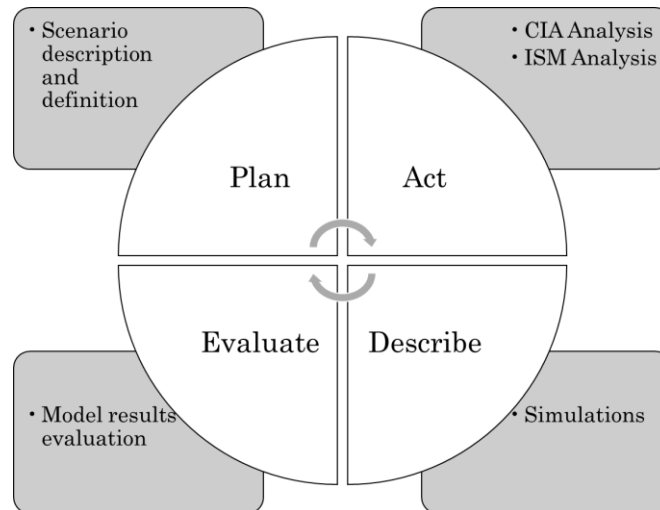


Figure 3. Stages of Research.

5.1 Planning: Description and definition of the Scenario

To carry out the survey, we have chosen a Spanish consulting organization whose management team has cooperated directly with the researchers. This firm develops its activity in the professional services sector that are specialized in strategic consulting and the development of business models. It can be also included within the medium-size consulting firms and operates in the market for over 20 years. This consulting organization counts on a wide portfolio of customers, including the main IBEX 35 firms.

5.1.1 Definition of the events set

Description of indicators and KPI:

The events selected to elaborate this working model are based on Strategic Objectives of BSC which were defined by the organization analyzed. According to the generally accepted framework for BSC, there are 4 distinct sections (Figure 4) articulated through several Key Performance Indicators (KPI), as will be explained later.

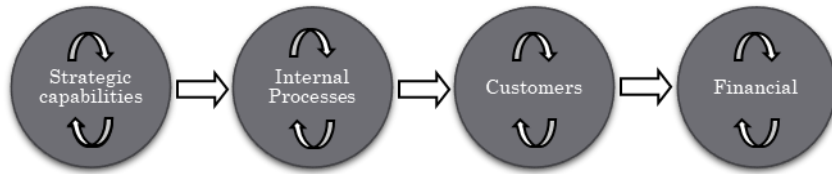


Figure 4. Impact Relationships Between Objectives

Objectives defined are illustrated in detail in the following table (Table 5), where the first column includes the objective reference by indicating to which group it belongs through a letter (F: Financial; C: Customers, I: Internal Processes; P: Strategic Capabilities), and a number that indicates the order they follow for the purpose of differentiate them.

ID	Objectives
F1	Achieving long-term sustainable growth of the organization
F2	Increasing the average levels of productivity levels of staff
F3	Achieving the development of larger scale projects
F4	Holding a relevant place among our strategic customers
F5	Enhancing positioning and turnover in the segments defined as strategic
C1	Standing out in the market as the most reliable option with the aim at helping in processes of change and transformation
C2	Standing out in the market as innovative experts
C3	Ensuring our customers display/making the results of the project tangible
C4	Transferring to market a trademark image that reflects the firm's values
I1	Formulating proposals in order to turn the needs of customers into business transformation solutions that generate a differential value
I2	Promoting projects management on the basis of the methodology and criteria from <i>Project Management Institute</i>

I3	Ensuring that all projects comply with the standards of technical quality of such services for customers, as well as the standards of economic efficiency for the firm
I4	Researching and developing models for managing innovative changes and transformation, so that our company is perceived on the market as real experts and thus, taking this fact as a competitive advantage
I5	Launching technology solutions that support the implementation of transformation projects, by making the process of change easier in stakeholders, apart from providing a display and outcomes management.
I6*	Ensuring levels of excellence on each point of customer contact
I7	Being actively involved in main business forums
I8	Broadcasting this ‘new core’ through all notifications and distinctive elements of <i>The Firm</i> . Apart from the channels of communication, services portfolio and reasoning of all firm’s professionals
I9	Strengthening relationships with key customers in order to deepen their knowledge, level of confidence and generate emotional and removal costs.
I10	Having and managing complementary partners portfolio and committing themselves to provide strategic value to the organization
I11	Orientating commercial effort towards segments, customers and strategic service portfolio
P1	Adapting human capital structure to critical competencies
P2*	Adapting permanently new solutions and own ways of carrying out issues, with the purpose of fitting the markets’ new needs.
P3*	Developing a uniform management model on the basis of growth of its team of professionals through focus on values and performance
P4	Having behaviors associated to company’s values by all members of the company

Table 5. Table of BSC Objectives and Outlines

The organization itself had defined a set of performance/efficiency indicators for each of those objectives. KPI (Key Performance Indicators) enables the company to assess and evaluate the achievement of each specific goal, by taking into account the degree of compliance. On the other hand, if a particular objective has more than one indicator

associated, the organization is responsible of previously considering the indicators importance, so that the sum of the KPI weightings is 100% for one indicator.

The Table 6 illustrates the Objective of Internal Processes number 8, as well as its KPI associated and estimated weight for each of those indicators.

Objective	KPI	Weight	Objective 2014
I9: Strengthening relationships with key customers in order to deepen their knowledge, level of confidence and generate emotional and removal costs.	I9.1: % Strategic customers with proposal	0.3	18%
	I9.2: % Visited strategic customers	0.7	25%

Table 6. Example of KPI for Objective I9

It is necessary to make clear that each KPI is a measurable indicator within the organization. Therefore, they are defined in its strategic approaches during analysis, as data associated to KPI of the objectives I6, P2 and P3 was not available. This is the reason why it is still unknown in which way goals are accomplished. Nevertheless, this situation should not prevent the elaboration of a complete working model, since first step is to know the interrelations between objectives, and then to carry out simulations with available data.

Having defined the objectives composing the events set of this working model, the following step is to evaluate each of them and establish its own evaluation system.

5.1.2 Definition of baseline odds

Having defined the elements that compose the Working Model (Strategic Goals, Internal Processes, Customers and Financial), the following step is to question experts in order to acquire information that enables the calculation of Cross-Impact Matrix. In this case, it was decided to undertake a consultation using Delphi method (Linstone & Turoff, 1975), in order to gain an agreed vision of the interrelations between goals. Delphi method is frequently used in order to devising baseline estimates, which are required for carrying out CIA-ISM analysis (Victor A Bañuls & Turoff, 2011).

Delphi method was developed by the organization RAND in Santa Monica in the middle of the 20th century, and it involved the participation of several authors over the years (N. Dalkey, 1969; Helmer & Rescher, 1959; Linstone & Turoff, 1975). The performance of this method is based on a systematical and detailed process of questionnaires for experts. This process consists of several stages where modifications of the information provided to each expert are undergone. Such information was retrieved from the group that belongs to the previous round. That way, experts can reflect on a specific idea on the basis of views of the panel and its own previous choices (Landeta, 1999).

Unique responses are one of the features of Delphi method, and any of its participants know a priori the response of other experts that take also part on this study. Additionally, the confidentiality of these questionnaires makes the modification of expert responses easier, since the rest is not going to know wide-ranging differences of its opinion. Likewise, in case its reasoning is wrong, anonymity implies that the interviewed expert will never see its image damaged.

This feature disappears in other group communication techniques, such as group meetings where the lack of anonymity may probably keep many of the group members from freely engage in discussions. However, panel participants in Delphi process can anonymously answer or make necessary changes, as if it was a secret ballot.

Delphi method is characterized by iteration with controlled feedback. This means that, even if questionnaires are filled several times, successive responses are going to be controlled by the results of previous responses, since this are going to be also included in the following questionnaires. In doing so, it is necessary to pay particular attention to a proper understanding of the responses in order to avoid misconceptions which may jeopardize the rest of the process.

According to the origin of Technological Forecasting, Delphi method has been one of the most widely used methodologies. By way of example, its utilization can be quoted in Japan (NISTEP, 1997, 2001), Spain (OPTI, 1999, 2000, 2001) and Germany (Cuhls, 2003).

In order to undertake this process, a total of 5 experts have been consulted, as they can reflect expert knowledge and functioning of the organization. The consulting has been carried out by means of several rounds of questions that are articulated through questionnaires with the aim of reaching a consensus.

Following Turoff's approach, 1971, in order to obtain an initial relational data, insights of experts must be "disrupted" by asking about the occurrence of certain events, in case other took place or not. In this particular case a

questionnaire was created, which includes questions such as how positive modification would have an impact on certain objectives/targets in case another objective has been previously accomplished. Experts had to evaluate on a five-point scale (No impact – Possible impact – Likely impact – Very likely – Very highly likely), or otherwise write ‘NR’ in case they were unsure or do not know the response.

NR	No Impact	Possible Impact	Likely impact	Very likely	Very highly likely
-	50%	60%	70%	80%	90%

Table 7. Scale Used for Questionnaire

As it is indicated in Figure 2, the model we use is based on the fact that Strategic Objectives have direct impacts between them and Internal Processes. Internal Processes have an impact on themselves but also on Customer Objectives. Similarly, Customer Objectives have an impact on themselves and Financial Objectives, and those have an impact on themselves. It is essential to make clear that direct, indirect and cascade relationships can be inferred by means of CIA. This model has been carried out through the use of those questionnaires, based on the direct relationships between each element that compose this Working Model, as it can be seen in other researches. (V.A. Bañuls et al., 2016; Ramirez De La Hueriga et al., 2015; M. Turoff, Bañuls, Plotnick, Hiltz, & Ramirez de la Hueriga, 2016).

The designing of this model in a staged manner is consistent with the definition itself of events types analyzed by means of CIA. There are a number of triggers and dynamic events and other for outcomes events. Dynamic events are those which may be directly disrupted by the organization in this case, while outcomes events are those which may not be modified directly by the organization itself, but indirectly through the achieving of others or not. Taking our case as an example, the organization can modify, change, enforce certain strategic objectives or internal processes, but the attainment of a number of customers or a specific turnover level does not depend directly on the organization. Organization can pursue the desired objective, but not force anyone to be a customer, and either to make customers bill a specific amount. But organization can enforce the goals and providing the resources needed on its strategic objectives and internal processes, so that the attaining of that number customers and bill is easier. In terms of CIA, both group P (Strategic) and group I (Internal Processes) are trigger and dynamic events, while group C (Customer) and F (Financial) are outcomes events.

Having consulted expert panel in a first round, an analysis of the data was conducted by noting which were those relations where there was more disagreement. A second round of questions was held and experts were asked to give a new estimate, taking into account the others’ responses and by providing this time, the possibility of giving a

narrative explanation to its numerical estimate. After the second round, it succeeded in reducing the percent of serious disagreements and reaching a consensual vision (Table 8).

<i>Great disagreement</i>	12,98%
<i>Small disagreement</i>	35,11%
<i>Disagreement</i>	51,91%

Table 8. Percent of final Agreement-Disagreement

Acceptable degree of agreement was reached after this second round of questions, where serious disagreements had no significance. Although as is logical, there were certain differences between the assessments of each expert, since everyone has a different vision.

The information provided by the five responders members was processed in the form of a matrix (Table 9), using Dalkey Mean (N. C. Dalkey, 1975) in order to minimize and normalize the differences in very diverse responses. This type of Mean is frequently used together with CIA and Delphi processes, as it can be seen in other articles such as (Victor A Bañuls & Turoff, 2011; N. C. Dalkey, 1971).

MEANS	F1	F2	F3	F4	F5	C1	C2	C3	C4	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	I11	P1	P2	P3	P4	
F1	OVP	0.79	0.83	0.69	0.71																				
F2	0.73	OVP	0.76	0.66	0.66																				
F3	0.74	0.65	OVP	0.73	0.73																				
F4	0.72	0.72	0.79	OVP	0.78																				
F5	0.71	0.69	0.67	0.83	OVP																				
C1	0.69	0.69	0.72	0.72	0.72	OVP	0.83	0.81	0.77																
C2	0.67	0.67	0.67	0.67	0.69	0.81	OVP	0.76	0.76																
C3	0.65	0.64	0.69	0.67	0.67	0.67	0.63	OVP	0.64																
C4	0.58	0.58	0.60	0.60	0.62	0.63	0.63	0.67	OVP																
I1						0.67	0.65	0.69	0.69	OVP	0.61	0.54	0.61	0.56	0.60	0.52	0.65	0.68	0.52	0.63					
I2						0.54	0.52	0.65	0.62	0.56	OVP	0.81	0.54	0.63	0.65	0.52	0.52	0.67	0.52	0.60					
I3						0.59	0.56	0.67	0.65	0.60	0.79	OVP	0.54	0.58	0.64	0.54	0.52	0.71	0.52	0.61					
I4						0.82	0.82	0.76	0.75	0.69	0.52	0.54	OVP	0.54	0.52	0.72	0.65	0.54	0.54	0.54					
I5						0.70	0.68	0.74	0.68	0.64	0.56	0.56	0.58	OVP	0.56	0.61	0.56	0.59	0.54	0.56					
I6						0.58	0.60	0.71	0.79	0.61	0.59	0.64	0.54	0.54	OVP	0.50	0.54	0.71	0.50	0.61					
I7						0.74	0.74	0.74	0.74	0.63	0.50	0.50	0.76	0.54	0.54	OVP	0.65	0.58	0.50	0.58					
I8						0.67	0.65	0.65	0.67	0.56	0.50	0.50	0.58	0.54	0.50	0.58	OVP	0.56	0.50	0.59					
I9						0.67	0.63	0.74	0.65	0.63	0.57	0.61	0.52	0.57	0.61	0.56	0.65	OVP	0.50	0.61					
I10						0.60	0.60	0.62	0.56	0.54	0.52	0.54	0.54	0.54	0.52	0.61	0.50	0.56	OVP	0.59					
I11						0.64	0.64	0.67	0.69	0.68	0.52	0.52	0.56	0.52	0.60	0.71	0.50	0.58	0.50	OVP					
P1											0.62	0.63	0.67	0.56	0.56	0.60	0.69	0.65	0.56	0.54	0.63	OVP	0.71	0.76	0.65
P2											0.71	0.52	0.58	0.67	0.58	0.52	0.62	0.76	0.68	0.59	0.58	0.58	OVP	0.62	0.62
P3											0.65	0.58	0.58	0.58	0.58	0.58	0.64	0.63	0.54	0.53	0.60	0.74	0.71	OVP	0.71
P4											0.65	0.54	0.54	0.56	0.54	0.68	0.60	0.61	0.52	0.54	0.56	0.60	0.63	0.67	OVP

Table 9. Mean Matrix

Having known the means of responses, the following step consist in the implementation of Cross-Impact Analysis. However, throughout the consulting process, it was suggested that not all objectives have influence over the rest at the same point in time. This way the idea of temporary biasing the effects of the interdependencies between elements

of the model was conceived, using therefore a Temporal Matrix. Said matrix is set up as another contribution to CIA-ISM method.

5.1.3 Temporal Matrix

Thus, same experts were asked about at what point the occurrence of a particular objective had influence over the rest. In this case there were direct and indirect relationships, by taking into account the sequence of those objectives. This means that strategic goals would have an influence over the rest, either direct or indirect, as well as on themselves. However, the rest might not influence on strategic objectives. Furthermore, internal processes follow a similar pattern, by having an impact on themselves but also on customers and financial objectives.

Similarly, customers will have an impact on themselves and financial objectives, and finally financial would only influence on themselves.

With the intention of indicating in which moment some objectives would have an impact over others, they were asked to complete a matrix similar as to the preceding type. They also had to enter a value from 1 to 4 (Table 10) in each cell of the matrix according to its timescale (1: Short; 2: Medium-Short; 3: Medium-Long; 4: Long). Taking the mode of responses and rounding it to the nearest whole number, the following matrix (Table 11) was obtained and can be used for the subsequent analysis of scenarios and events.

Timescale	#
Short	1
Medium-Short	2
Medium-Long	3
Long	4

Table 10. Table of Timescale

	F1	F2	F3	F4	F5	C1	C2	C3	C4	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	I11	P1	P2	P3	P4	
F1	OVP	3	2	1	1	1	1	3	3	3	3	3	3	3	2	4	3	2	3	3	2	2	3	3	
	OVP	3	2	1	1	1	1	3	3	3	3	3	3	3	2	4	3	2	3	3	2	2	3	3	
F2		1	OVP	1	1	1	1	1	3	2	1	1	1	1	2	3	3	2	2	3	1	2	1	2	
		2	OVP	1	1	1	1	1	3	2	1	1	1	1	2	3	3	2	2	3	1	2	1	2	
F3		1	4	OVP	1	1	1	1	2	2	2	3	2	2	2	3	3	2	1	3	1	2	2	3	
		1	4	OVP	1	1	1	1	2	2	2	3	2	2	2	3	3	2	1	3	1	2	2	3	
F4		1	4	2	OVP	1	1	1	2	2	2	3	3	2	2	2	4	3	2	2	1	1	2	3	
		1	4	2	OVP	1	1	1	2	2	2	3	3	2	2	2	4	3	2	2	1	1	2	3	
F5		1	4	2	1	OVP	1	2	2	2	3	3	3	3	2	1	4	3	1	1	2	2	1	3	3
		1	4	2	1	OVP	1	2	2	2	3	3	3	3	2	1	4	3	1	1	2	2	1	3	3
C1						OVP	2	3	2	3	3	2	2	2	2	3	3	1	2	3	1	2	2	4	
						OVP	2	3	2	3	3	2	2	2	2	3	3	1	2	3	1	2	2	4	
C2						1	OVP	3	2	3	3	3	2	2	2	2	2	2	2	2	2	1	2	3	
						2	OVP	3	2	3	3	3	2	2	2	2	2	2	2	2	2	1	2	3	
C3						1	2	OVP	2	4	2	2	1	1	2	3	2	1	1	2	2	2	3	4	
						1	2	OVP	2	4	2	2	1	1	2	3	2	1	1	2	2	2	3	4	
C4						1	2	2	OVP	2	3	3	2	3	3	2	1	2	2	2	1	2	2	2	
						1	2	2	OVP	2	3	3	2	3	3	2	1	2	2	2	1	2	2	2	
I1										OVP	2	3	1	2	2	2	2	2	2	1	2	2	3	2	
										OVP	2	3	1	2	2	2	2	2	2	1	2	2	3	2	
I2										2	OVP	1	1	1	2	3	3	2	2	2	2	2	2	1	
										3	OVP	1	1	1	2	3	3	2	2	2	2	2	2	1	
I3										2	1	OVP	1	1	2	3	2	2	1	2	1	1	1	2	
										2	1	OVP	1	1	2	3	2	2	1	2	1	1	1	2	
I4										3	3	3	OVP	3	2	2	3	3	3	3	2	3	4	3	
										3	3	3	OVP	3	2	2	3	3	3	3	2	3	4	3	
I5										4	3	3	2	OVP	3	4	4	4	2	4	3	3	3	4	
										4	3	3	2	OVP	3	4	4	4	2	4	3	3	3	4	
I6										2	2	2	3	2	OVP	2	3	1	3	2	1	2	2	3	
										2	2	2	3	2	OVP	2	3	1	3	2	1	2	2	3	
I7										3	3	3	2	2	3	OVP	2	2	3	2	1	1	2	4	
										3	3	3	2	2	3	OVP	2	2	3	2	1	1	2	4	
I8										1	3	2	1	1	2	1	OVP	2	2	2	1	2	3	2	
										1	3	2	1	1	2	1	OVP	2	2	2	1	2	3	2	
I9										3	3	1	2	2	1	2	2	OVP	2	2	2	2	2	3	
										3	3	1	2	2	1	2	2	OVP	2	2	2	2	2	3	
I10										3	2	2	2	2	3	3	2	2	OVP	2	1	1	2	2	
										3	2	2	2	2	3	3	2	2	OVP	2	1	1	2	2	
I11										2	2	2	1	2	2	2	2	2	2	OVP	1	1	2	2	
										2	2	2	1	2	2	2	2	2	2	OVP	1	1	2	2	
P1																					OVP	2	3	3	
																					OVP	2	3	3	
P2																					1	OVP	3	4	
																					2	OVP	3	4	
P3																					2	2	OVP	4	
																					2	2	OVP	4	
P4																					2	2	2	OVP	
																					2	2	2	OVP	

Table 11. Temporal Matrix

Once elements that will be part of the Working Model are defined, it is possible to pass on to the Stage of Operation where CIA-ISM will be implemented to BSC as a tool for its improvement.

5.2 Operating: CIA-ISM analysis

5.2.1 Cross-Impact Analysis

Having known the probabilities of occurrence estimated by experts, the process of cross-impact analysis is performed. To that end, Cross-Impact Matrix is computed and the first obtained outcomes explain the causal interrelationships between objectives, including the possibility of determining in which moment those causal interrelationships start to take effect as well.

The impact of each event per column over the rest of events per row will be indicated by C_{ij} . Calculation process follows the indications of Turoff's approximation (Murray Turoff, 1971), where in this case initial values are R_{ij} . As described above, the likelihood that a particular event occurs will depend if other one occurred before. In order to calculate each of those C_{ij} values, there is a glaring need of knowing R_{ij} and P_i values (baseline odds) for each of the events. As they are not found out in detail, this baseline odds are estimated as 0,5 – in other words, it is as if there was a neutrality condition where it is as easy it occurs or not. The used calculation formula for C_{ij} was obtained from the previous formula (1):

$$C_{ij} = \frac{1}{1 - P_j} [\varphi(R_{ij}) - \varphi(P_i)]$$

Equation 3. Calculation of C_{ij}

Where:

$$\varphi(P_i) = L_n(P_i / (1 - P_i))$$

Equation 4. Calculation of P_i

$$\varphi(R_{ij}) = L_n(R_{ij} / (1 - R_{ij}))$$

Equation 5. Calculation of R_{ij}

As an outcome of the C_{ij} value calculation, Gamma value (γ_i) is calculated for each of the events. Gamma is the measure of events effects that are not specified in the model (external factors).

$$\gamma_i = \varphi(P_i) - \sum_{k \neq 1}^n C_{ik} P_k$$

Equation 6. Gamma Calculation

Final impact matrix (Table 12) is illustrated below, once all calculations have been performed. Additionally, in the last raw gamma values can be seen for each of the events.

EVENTS	F1	F2	F3	F4	F5	C1	C2	C3	C4	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	I11	P1	P2	P3	P4
F1	OVP	2	2.11	1.93	1.79	1.57	1.39	1.22	0.65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F2	2.65	OVP	1.23	1.93	1.57	1.61	1.39	1.18	0.65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F3	3.19	2.33	OVP	2.65	1.39	1.93	1.39	1.57	0.83	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F4	1.57	1.36	1.95	OVP	3.19	1.93	1.39	1.45	0.83	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F5	1.79	1.36	1.95	2.54	OVP	1.93	1.61	1.39	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C1	0	0	0	0	0	OVP	2.87	1.45	1.06	1.43	0.32	0.72	2.98	1.72	0.68	2.11	1.39	1.39	0.83	1.18	0	0	0	0
C2	0	0	0	0	0	3.19	OVP	1.06	1.06	1.22	0.16	0.5	2.98	1.54	0.84	2.11	1.23	1.04	0.83	1.18	0	0	0	0
C3	0	0	0	0	0	2.87	2.33	OVP	1.39	1.61	1.22	1.43	2.33	2.11	1.79	2.11	1.23	2.11	1	1.18	0	0	0	0
C4	0	0	0	0	0	2.44	2.33	1.18	OVP	1.61	1	1.22	2.15	1.54	2.65	2.11	1.39	1.22	0.5	1.56	0	0	0	0
I1	0	0	0	0	0	0	0	0	0	OVP	0.49	0.84	1.61	1.18	0.88	1.06	0.5	1.04	0.34	1.54	1	1.79	1.22	1.22
I2	0	0	0	0	0	0	0	0	0	0.88	OVP	2.65	0.16	0.5	0.72	0	0	0.55	0.16	0.16	1.06	0.16	0.66	0.32
I3	0	0	0	0	0	0	0	0	0	0.32	2.87	OVP	0.32	0.5	1.11	0	0	0.88	0.32	0.16	1.45	0.66	0.66	0.32
I4	0	0	0	0	0	0	0	0	0	0.88	0.32	0.32	OVP	0.66	0.32	2.33	0.66	0.16	0.32	0.5	0.5	1.45	0.68	0.5
I5	0	0	0	0	0	0	0	0	0	0.49	1.06	0.66	0.32	OVP	0.34	0.32	0.34	0.55	0.32	0.16	0.5	0.66	0.68	0.34
I6	0	0	0	0	0	0	0	0	0	0.84	1.22	1.18	0.16	0.5	OVP	0.32	0	0.88	0.16	0.84	0.83	0.16	0.66	1.54
I7	0	0	0	0	0	0	0	0	0	0.16	0.16	0.32	1.93	0.88	0	OVP	0.66	0.49	0.88	1.76	1.57	1	1.18	0.84
I8	0	0	0	0	0	0	0	0	0	1.22	0.16	0.16	1.22	0.49	0.32	1.22	OVP	1.27	0	0	1.22	2.33	1.06	0.89
I9	0	0	0	0	0	0	0	0	0	1.54	1.43	1.76	0.32	0.72	1.83	0.68	0.5	OVP	0.5	0.68	0.49	1.54	0.34	0.16
I10	0	0	0	0	0	0	0	0	0	0.16	0.16	0.16	0.32	0.32	0	0	0	0	OVP	0	0.32	0.72	0.2	0.34
I11	0	0	0	0	0	0	0	0	0	1.06	0.84	0.88	0.32	0.5	0.88	0.66	0.72	0.89	0.72	OVP	1.06	0.65	0.83	0.5
P1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	OVP	0.63	2.11	0.84
P2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.79	OVP	1.79	1.04
P3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.33	1	OVP	1.43
P4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.22	1	1.79	OVP
GAMMA	-6.33	-6.11	-7.64	-6.83	-6.79	-10.06	-9.47	-12.36	-11.45	-7.35	-4	-4.8	-4.81	-3.38	-4.65	-5.92	-5.78	-6.24	-1.36	-5.25	-1.79	-2.31	-2.38	-2

Table 12. Cross-Impact Matrix

It is essential to recall the following in order to understand cross-impact matrix. There are four types of events depending on each of the groups made for BSC.

F (Financial); C (Customers); I (Internal Processes); P (Strategic Objectives)

Each column illustrates the impact that each event, located in columns, exerts over the rest of events located in rows. Furthermore, there is a sequence of events that take place defined below.

On the other hand, using Temporal Matrix enables to bias results after making a simulation, and noting the expected effects for each of the timescales described before.

The four impact calculations tables are listed below. This tables (Table 13,Table 14,Table 15,Table 16) have been compiled taking into account only at what point in time they occur (Temporality of impacts). In this sense, the impacts on S/T only show the events that are marked with 1. Impacts on Medium-Short term include also the impacts that are marked with 1 or 2. Medium-Long are those marked with 1, 2 or 3, and finally, events that have impact on Long Term (L/T) include all types of events.

Additionally, matrixes include two rows and one added column which are describe below:

Gamma Row: Gamma value is the value calculated by this method and indicates the degree of lack of explanation of said event (per column) in the model. The larger absolute value of Gamma, greater lack of explanation for said event there is within the model. Explanation is related to said event per column has external influence of other events or elements that are not referred to within the model. For example, external factors of the company, such as market, economy, competition, etc.

Sum Row: said row adds up value of impacts released by the event per columns. Thus, the larger value, the greater influence the event will exert over the rest of the model.

Sum Column: said column adds up the values of impacts in the row of any specific event. Thus, it is possible to identify which event is more “susceptible” within our model.

5.2.1.1 Short-Term

	F1	F2	F3	F4	F5	C1	C2	C3	C4	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	I11	P1	P2	P3	P4	Sum.	
F1	OVP		0.00	1.93	1.79	1.57	1.39	0.00																	6.69	
F2	2.65	OVP	1.23	1.93	1.57	1.61	1.39	1.18																		11.57
F3	3.19		OVP	2.65	1.39	1.93	1.39																			10.57
F4	1.57			OVP	3.19	1.93	1.39																			8.09
F5	1.79			2.54	OVP	1.93																				6.26
C1						OVP												1.39								1.39
C2						3.19	OVP																			3.19
C3						2.87		OVP				2.33	2.11					2.11	1.00							10.42
C4						2.44			OVP								1.39									3.83
I1										OVP		1.61							0.34							1.95
I2											OVP	2.65	0.16	0.50											0.32	3.64
I3											2.87	OVP	0.32	0.50					0.32		1.45	0.66	0.66			6.79
I4													OVP	0.00												
I5														OVP												
I6															OVP			0.88			0.83					1.70
I7																OVP					1.57	1.00				2.57
I8										1.22		1.22	0.49		1.22	OVP					1.22					5.36
I9												1.76			1.83			OVP								3.58
I10																			OVP		0.32	0.72				1.04
I11												0.32								OVP	1.06	0.65				2.03
P1																					OVP					
P2																					1.79	OVP				1.79
P3																							OVP			
P4																								0.00	OVP	
Sum.	9.20		1.23	9.06	7.94	17.48	5.58	1.18		1.22	2.87	4.41	5.97	3.60	1.83	1.22	1.39	4.38	1.67		8.23	3.03	0.66	0.32		
Gamma	-3.34	-5.79	-5.28	-4.05	-3.13	-0.70	-1.60	-5.21	-1.92	-0.97	-1.82	-3.40			-0.85	-1.29	-2.68	-1.79	-0.52	-1.01		-0.89				

Table 13. Impact Matrix with Short-Term Bias

In Short-Term the Event that has greater influence is C1 (Standing out in the market as the most reliable [15.91]

Interestingly, F1 (Achieving impact in L/T) exert also much impact in S/T over the group of Financial Events. [9.20]

P1 (Achieving an adequate structure of human capital) is the Strategic Event that has greater impact on S/T [8.23]

F1, F2 (Increasing the productivity level per member), and C3 (Ensuring that customers make the results tangible) are those events that receive more impacts from S/T.

F2, F3 (Achieving the development of larger scale projects) and F4 (Holding a relevant place) and C3, are those events that in S/T have greater influence by the environment.

5.2.1.2 Medium-Short Term:

	F1	F2	F3	F4	F5	C1	C2	C3	C4	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	I11	P1	P2	P3	P4	Sum.	
F1	OVP		2.11	1.93	1.79	1.57	1.39																		8.80	
F2	2.65	OVP	1.23	1.93	1.57	1.61	1.39	1.18																		11.57
F3	3.19		OVP	2.65	1.39	1.93	1.39	1.57	0.83																	12.96
F4	1.57		1.95	OVP	3.19	1.93	1.39	1.45	0.83																	12.31
F5	1.79		1.95	2.54	OVP	1.93	1.61	1.39	1.00																	12.22
C1						OVP	2.87	1.06				0.72	2.98	1.72	0.68			1.39	0.83							12.23
C2						3.19	OVP		1.06				2.98	1.54	0.84	2.11	1.23	1.04	0.83	1.18						15.99
C3						2.87	2.33	OVP	1.39		1.22	1.43	2.33	2.11	1.79		1.23	2.11	1.00	1.39						21.20
C4						2.44	2.33	1.18	OVP	1.61			2.15			2.11	1.39	1.22	0.50	1.56						16.48
I1										OVP	0.49		1.61	1.18	0.88	1.06	0.50	1.04	0.34	1.54	1.00	1.79		1.22		12.64
I2										0.88	OVP	2.65	0.16	0.50	0.72			0.55	0.16	0.16	1.06	0.16	0.66	0.32		7.99
I3										0.32	2.87	OVP	0.32	0.50	1.11			0.88	0.32	0.16	1.45	0.66	0.66	0.32		9.59
I4																OVP	0.32	2.33			0.50					3.15
I5													0.32	OVP						0.32						0.65
I6										0.84	1.22	1.18		0.50	OVP	0.32		0.88		0.84	0.83	0.16	0.66			7.43
I7													1.93	0.88		OVP	0.66	0.49		1.76	1.57	1.00	1.18			9.47
I8										1.22		0.16	1.22	0.49	0.32	1.22	OVP	1.27			1.22	2.33		0.89		10.34
I9												1.76	0.32	0.72	1.83	0.68	0.50	OVP		0.50	0.68	0.49	1.54	0.34		9.35
I10											0.16	0.16	0.32	0.32					OVP		0.32	0.72	0.20	0.34		2.56
I11										1.06	0.84	0.88	0.32	0.50	0.88	0.66	0.72	0.89	0.72	OVP	1.06	0.65	0.83	0.50		10.50
P1																					OVP	0.63				0.63
P2																					1.79	OVP				1.79
P3																					2.33	1.00	OVP			3.33
P4																					1.22	1.00	1.79	OVP		4.01
Sum.	9.20		7.24	9.06	7.94	17.48	14.71	6.77	6.16	5.93	6.79	8.94	16.97	10.96	9.36	10.49	6.24	11.77	5.52	9.27	14.82	11.64	6.32	3.60		
Gamma	-4.40	-5.79	-6.48	-6.16	-6.11	-6.12	-8.00	-10.60	-8.24	-6.32	-4.00	-4.80	-1.58	-0.32	-3.72	-4.74	-5.17	-4.68	-1.28	-5.25	-0.31	-0.89	-1.66	-2.00		

Table 14. Impact Matrix with Medium-Short Term Bias

In Medium/Short term, C1 is kept as the event that have greatest impact over the rest, but now is extended with I4, I5, I7, I9 and P2 (particularly, I7 has higher growth of impact experimented in short-term).

For its part, C2, C3 and C4 are those events that experiment more impacts over the rest of events referred to within the model.

Finally, it is necessary to mention that those elements are the ones that have a largest component which cannot be explained by the elements of the model, and may be due to external causes (market...).

5.2.1.3 Medium-Long Term:

	F1	F2	F3	F4	F5	C1	C2	C3	C4	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	I11	P1	P2	P3	P4	Sum.	
F1	OVP	2.00	2.11	1.93	1.79	1.57	1.39	1.22	0.65																12.67	
F2	2.65	OVP	1.23	1.93	1.57	1.61	1.39	1.18	0.65																	12.22
F3	3.19		OVP	2.65	1.39	1.93	1.39	1.57	0.83																	12.96
F4	1.57		1.95	OVP	3.19	1.93	1.39	1.45	0.83																	12.31
F5	1.79		1.95	2.54	OVP	1.93	1.61	1.39	1.00																	12.22
C1						OVP	2.87	1.45	1.06	1.43	0.32	0.72	2.98	1.72	0.68	2.11	1.39	1.39	0.83	1.18						20.12
C2						3.19	OVP	1.06	1.06	1.22	0.16	0.50	2.98	1.54	0.84	2.11	1.23	1.04	0.83	1.18						18.93
C3						2.87	2.33	OVP	1.39		1.22	1.43	2.33	2.11	1.79	2.11	1.23	2.11	1.00	1.39						23.32
C4						2.44	2.33	1.18	OVP	1.61	1.00	1.22	2.15	1.54	2.65	2.11	1.39	1.22	0.50	1.56						22.90
I1										OVP	0.49	0.84	1.61	1.18	0.88	1.06	0.50	1.04	0.34	1.54	1.00	1.79	1.22	1.22		14.70
I2										0.88	OVP	2.65	0.16	0.50	0.72				0.55	0.16	0.16	1.06	0.16	0.66	0.32	7.99
I3										0.32	2.87	OVP	0.32	0.50	1.11				0.88	0.32	0.16	1.45	0.66	0.66	0.32	9.59
I4										0.88	0.32	0.32	OVP	0.66	0.32	2.33	0.66	0.16	0.32	0.50	1.45			0.50		8.94
I5										1.06	0.66	0.32	OVP	0.34					0.32		0.50	0.66	0.68			4.55
I6										0.84	1.22	1.18	0.16	0.50	OVP	0.32			0.88	0.16	0.84	0.83	0.16	0.66	1.54	9.30
I7										0.16	0.16	0.32	1.93	0.88		OVP	0.66	0.49	0.88	1.76	1.57	1.00	1.18			11.00
I8										1.22	0.16	0.16	1.22	0.49	0.32	1.22	OVP	1.27			1.22	2.33	1.06	0.89		11.55
I9										1.54	1.43	1.76	0.32	0.72	1.83	0.68	0.50	OVP	0.50	0.68	0.49	1.54	0.34	0.16		12.49
I10										0.16	0.16	0.16	0.32	0.32					OVP	0.32	0.72	0.20	0.34	2.72		2.72
I11										1.06	0.84	0.88	0.32	0.50	0.88	0.66	0.72	0.89	0.72	OVP	1.06	0.65	0.83	0.50		10.50
P1																					OVP	0.63	2.11	0.84		3.58
P2																					1.79	OVP	1.79			3.57
P3																					2.33	1.00	OVP			3.33
P4																					1.22	1.00	1.79	OVP		4.01
Sum.	9.20	2.00	7.24	9.06	7.94	17.48	14.71	10.49	7.46	11.32	11.42	12.81	17.14	13.17	12.35	14.71	8.30	11.93	6.89	10.95	15.32	13.75	13.17	6.65		
Gamma	-6.33	-6.11	-6.48	-6.16	-6.11	-10.06	-9.47	-11.66	-11.45	-7.35	-4.00	-4.80	-4.47	-2.27	-4.65	-5.50	-5.78	-6.24	-1.36	-5.25	-1.79	-1.79	-1.66	-2.00		

Table 15. Impact Matrix with Medium-Long Term Bias

In Medium-Long term, it is remarkable that F2 has some consequence on the model, by having an impact on P1 exclusively, and to the widespread growth of impacts should be added the growth of P3.

Once more customers are the group that receive more impacts of the whole model, mainly because of it counts with a very wide upper group of events (Internal Processes).

Customers is also the group that is most influenced by external elements and this influence is not explained in the model.

5.2.1.4 Long-Term:

	F1	F2	F3	F4	F5	C1	C2	C3	C4	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	I11	P1	P2	P3	P4	Sum.		
F1	OVP	2.00	2.11	1.93	1.79	1.57	1.39	1.22	0.65																	12.67	
F2	2.65	OVP	1.23	1.93	1.57	1.61	1.39	1.18	0.65																		12.22
F3	3.19	2.33	OVP	2.65	1.39	1.93	1.39	1.57	0.83																		15.29
F4	1.57	1.36	1.95	OVP	3.19	1.93	1.39	1.45	0.83																		13.67
F5	1.79	1.36	1.95	2.54	OVP	1.93	1.61	1.39	1.00																		13.57
C1						OVP	2.87	1.45	1.06	1.43	0.32	0.72	2.98	1.72	0.68	2.11	1.39	1.39	0.83	1.18							20.12
C2						3.19	OVP	1.06	1.06	1.22	0.16	0.50	2.98	1.54	0.84	2.11	1.23	1.04	0.83	1.18							18.93
C3						2.87	2.33	OVP	1.39	1.61	1.22	1.43	2.33	2.11	1.79	2.11	1.23	2.11	1.00	1.39							24.93
C4						2.44	2.33	1.18	OVP	1.61	1.00	1.22	2.15	1.54	2.65	2.11	1.39	1.22	0.50	1.56							22.90
I1										OVP	0.49	0.84	1.61	1.18	0.88	1.06	0.50	1.04	0.34	1.54	1.00	1.79	1.22	1.22			14.70
I2										0.88	OVP	2.65	0.16	0.50	0.72			0.55	0.16	0.16	1.06	0.16	0.66	0.66	0.32		7.99
I3										0.32	2.87	OVP	0.32	0.50	1.11			0.88	0.32	0.16	1.45	0.66	0.66	0.32			9.59
I4										0.88	0.32	0.32	OVP	0.66	0.32	2.33	0.66	0.16	0.32	0.50	0.50	1.45	0.68	0.50			9.62
I5										0.49	1.06	0.66	0.32	OVP	0.34	0.32	0.34	0.55	0.32	0.16	0.50	0.66	0.68	0.34			6.75
I6										0.84	1.22	1.18	0.16	0.50	OVP	0.32		0.88	0.16	0.84	0.83	0.16	0.66	1.54			9.30
I7										0.16	0.16	0.32	1.93	0.88		OVP	0.66	0.49	0.88	1.76	1.57	1.00	1.18	0.84			11.84
I8										1.22	0.16	0.16	1.22	0.49	0.32	1.22	OVP	1.27			1.22	2.33	1.06	0.89			11.55
I9										1.54	1.43	1.76	0.32	0.72	1.83	0.68	0.50	OVP	0.50	0.68	0.49	1.54	0.34	0.16			12.49
I10										0.16	0.16	0.16	0.32	0.32						OVP		0.32	0.72	0.20	0.34		2.72
I11										1.06	0.84	0.88	0.32	0.50	0.88	0.66	0.72	0.89	0.72	OVP	1.06	0.65	0.83	0.50			10.50
P1																						OVP	0.63	2.11	0.84		3.58
P2																						1.79	OVP	1.79	1.04		4.61
P3																						2.33	1.00	OVP	1.43		4.76
P4																						1.22	1.00	1.79	OVP		4.01
Sum.	9.20	7.04	7.24	9.06	7.94	17.48	14.71	10.49	7.46	13.42	11.42	12.81	17.14	13.17	12.35	15.04	8.64	12.49	6.89	11.11	15.32	13.75	13.85	10.30			
Gamma	-6.33	-6.11	-7.64	-6.83	-6.79	-10.06	-9.47	-	-	-7.35	-4.00	-4.80	-4.81	-3.38	-4.65	-5.92	-	-6.24	-	-5.25	-1.79	-2.31	-2.38	-2.00			

Table 16. Impact Matrix with Long Term Bias

The structure of exerted impacts illustrates that I7, I8, I9 and I11 receive a great amount of impacts in L/T, although they would be grouped in a third level behind Customers and Financial.

C3 and C4 are the elements that present a higher reporting burden that is not explained in the model.

5.2.2 Graphic Analysis (ISM)

Second part of the analysis is focused on turning numerical data of Impact Matrix into a determined graph, using ISM methodology, as it is mentioned in previous sections. Taking P₇₅ values of the matrix as reference, is possible to represent a digraph or graph that represents the map of goals of the organization.

It is illustrated in the following figure:

PERCENTIL 75

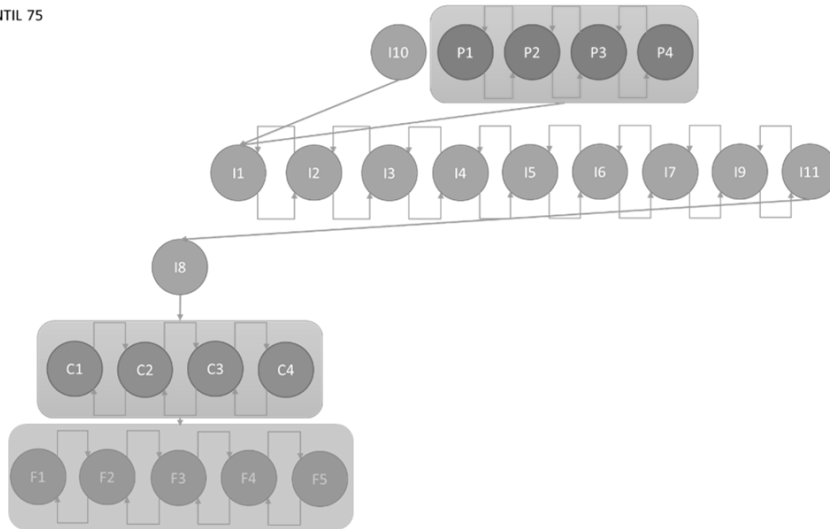


Figure 5. ISM Graph 75th Percentile

ISM analysis reveals direct, indirect and cascade effects of analyzed elements. In this case, objectives of the organization in BSC are going to be analyzed. The reading of the graph is performed from top to bottom, where blue arrows illustrate impacts between one event and another, or between one event and a group of events.

Each height level indicates the significance of these events and its classification. Events located at the top are triggers, which do not suffer any impact caused by others, while events located at the bottom are outcome events, which only receive impacts of other events. Furthermore, when a group of events of the same type receive same impacts and have impacts on the same events, they are considered as macro events or micro scenarios.

That said, it is noted that for arbitrary value equal to P_{75} , map of objectives is really consistent with the given planning. Events Type P are at the top, and Type F are located at the bottom, which overlaps with the initial planned approximation. Moreover, almost all events (goals) of a specific type are conceived as a unique macro goal, which is also correlated with the own structure of BSC.

On the other hand, we can go one step further and select only impacts related to P_{90} (90th Percentile) or higher, where reduced number of total impacts is included, and only 10% of the higher is provided in the model. It can be seen in the following graph:

PERCENTIL90

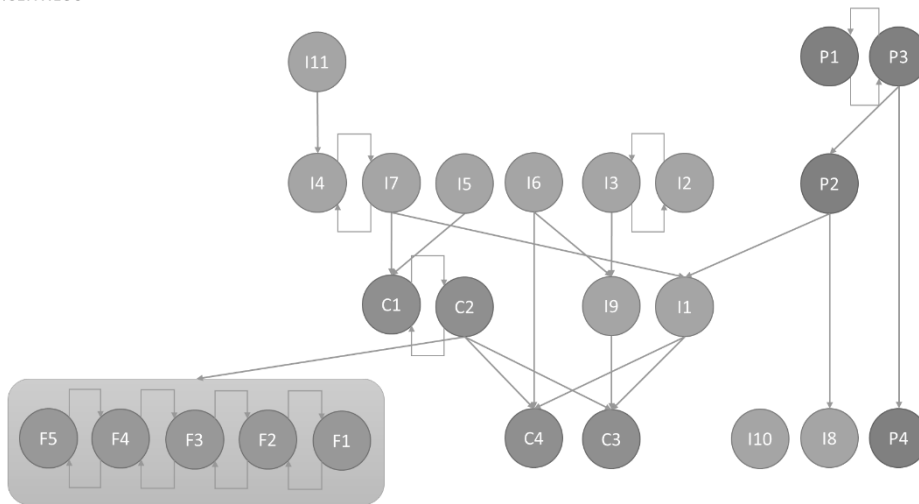


Figure 6. ISM Graph 90th Percentile

At this level, it is clearly illustrated that objectives are a clear group and well defined as final macro event.

Events related to Customers have an intermediate position between final and dynamic (which is true according to our parameters), but has rarely influence over Financial. However, a substantial and remarkable consideration is that Strategic Events/Goals have its first effect on themselves and then, over the rest of events even if it is in an indirect manner.

Analyzing each of the digraphs for the different percentiles, enables to show how goals characterizations can change ending with a final structure which is similar to P₇₅ structure. In this way, ISM analysis not only illustrates direct effects from objectives, but also indirect and cascade effects, showing graphically the causality of objectives within the scorecard of the analyzed company (BSC).

Having analyzed the results and noted first findings, it is time to take required actions which allow description of results of CIA-ISM integration in BSC. Thus, agreement with the organization is reached in order to make different simulations and taking data from previous years as reference, so that results obtained can be evaluated at a further stage.

5.3 Definition of simulations

CIA methodology enables simulation of the Working Model functioning proposed through impact matrix. This system allows to simulate changes in the initial status of objectives and note how these changes affect to the rest of the system.

It is essential to take into account two distinctive features of the model, in order to make concrete simulations. First of all, it is necessary to pre-process data for converting them to an appropriate scale. Secondly, it is important to take into account the distinctive features of the model and its construction, which means that there is a need of perform interactions to produce the final outcome.

5.3.1 Processing of data to make simulations

As it has been previously mentioned, the organization has available a set of numerically quantified objectives, either in units, financial amounts or rates (Table 17). Objectives have been articulated through KPI indicators, that at the same time has a weight assigned within the goal they belong to.

ID	Definition	KPY	Type	Weight	2014	Objective 2014	2015	Objective 2015
I9	Strengthening relationships with key customers in order to deepen their knowledge, level of confidence and generate emotional and removal costs.	I9.1: % strategic customers with a purpose	Perctange	30%	16.00	18.00	18.69	22.00
		I9.2: % Strategic customers that have been visited	Percentage	70%	27.00	25.00	29.34	30.00

Table 17. Objective - KPIs - Outcomes (2014 - 2015)

First step to make simulations is to convert available data into the same scale and format used by this methodology. The used methodology estimates the impacts produced by any change in the baseline odds of the events that comprise the Working Model. On the basis of this difference and using impact matrix that shows the correlation between the elements of this model, it is possible to estimate the assessments of the rest of events.

Taken approach consist in converting all data into a percentage scale. This way, objective set out for a specific year is 100% and the outcome of that year for that objective will be the total percentage achieved. This calculation is made for each KPI where its weight in the total is also included (Table 18).

ID	Definition	KPY	Type	Weight	2014	Objective 2014	2015	Objective 2015	2014	2015
I9	Strengthening relationships with key customers in	I9.1: % strategic customers	Perctange	30%	16.00	18.00	18.69	22.00	27%	25%

	order to deepen their knowledge, level of confidence and generate emotional and removal costs.	with a purpose								
		I9.2: % Strategic customers that have been visited	Percentage	70%	27.00	25.00	29.34	30.00	70%	68%
		CIA value							97%	94%

Table 18. Objective - KPIs – Scaled Outcomes Example (2014 - 2015)

In line with the previous example, I9 is composed of I8.1 in 30% and I9.2 in 70%. The expected outcome for 2014 was 18 and 24 respectively but the results achieved were 16 and 27 where first KPI contributed with a 27% (over a maximum of 30%) and the second KPI with 70% (considered as the maximum since this objective was exceeded). In this way, the total level of compliance of I9 for the year 2014 was calculated and the outcome was 97%.

On the other hand, it is necessary to take into account that the simulator works taking as starting-point a situation of uncertainty, which is articulated taking 50% as P_i . Thus, it is required to transform the values achieved on a 0,5 scale to 1 (Table 19).

ID	Definition	KPY	Type	Weight	2014	Objective 2014	2015	Objective 2015	Trans. 2014	Trans. 2015
I9	Strengthening relationships with key customers in order to deepen their knowledge, level of confidence and generate emotional and removal costs.	I9.1: % strategic customers with a purpose	Percentage	30%	16.00	18.00	18.89	22.00		
		I9.2: % Strategic customers that have been visited	Percentage	70%	27.00	25.00	29.34	30.00		
		CIA value							97%	94%

Table 19. Objective - KPIs – Scaled and Transformed Outcome (2014-2015)

This transformed data (TR) will be the indicators that we must incorporate in the simulator, while the outcomes provided will be scaled data (ESC).

In line with the process described it is possible to obtain Scaled and Transformed values for each of the objectives and years for which data are available (Table 20).

Variable	2014 ESC	2015 ESC	2014 TR	2015 TR
F1	0.94	0.93	97.06%	96.50%

F2	0.95	0.92	97.32%	96.12%
F3	1.00	0.90	100.00%	94.95%
F4	0.89	0.86	94.72%	92.78%
F5	1.00	0.92	100.00%	95.83%
C1	1.00	0.85	100.00%	92.42%
C2	0.00	1.00	50.00%	100.00%
C3	0.63	0.55	81.67%	77.25%
I1	1.00	1.00	100.00%	100.00%
I2	0.75	0.89	87.50%	94.44%
I3	1.00	1.00	100.00%	100.00%
I4	1.00	0.50	100.00%	75.00%
I5	0.80	0.83	90.00%	91.67%
I7	0.60	0.63	80.00%	81.25%
I8	0.81	0.87	90.50%	93.25%
I9	0.97	0.94	98.33%	96.97%
I10	0.94	0.53	97.09%	76.56%
I11	0.86	0.98	93.13%	98.92%
P1	1.00	0.67	100.00%	83.33%
P4	0.98	0.91	99.23%	95.63%

Table 20. Table of Values of Scaled and Transformed Objectives

Finally, although this tool allows to enter data numerically and in a completely personalized way, we believe that it becomes more convenient to articulate the system in a way that the user can interact with the simulator. The user can select a nominal value and the tool assigns a number to complete the calculations Table 21:

Complete Achievement	High Achievement	Medium Achievement	Low Achievement	Unclear-Without progress
0.99	0.85	0.70	0.60	0.50

Table 21. Table of Nominal-Numeral relationship (simulator)

5.3.2 Simulations process (Iterations)

Given the distinctive features of this matrix regarding to the way they are built, in a staged manner, where changes of a specific type of event affect to those of the same type, and to those of the ‘upper level’. It is necessary to make iterations over the simulation itself in order to note domino effects.

Taking this example as reference, in case we modify one of those element from Group P, its effects in the simulation will affect to the elements themselves of the Group (P) and to the elements of the following level (Group I).

In order to see the effects given in C, simulation must be repeated, taking as input data the outcome events of the first simulation (T1) and thus obtain outcome events in T2. This way it will be possible to notice how a change in P affects to C, and likewise outcomes of T2 will be used to make the simulation of T3 and notice the effects in Group F.

Therefore, depending on which group of events is modified, we will have to repeat the simulation up to three times in order to see the total effect of changes in events of a specific group over itself or the following groups. Explanatory table is given below (Table 22):

		Effect			
		F	C	I	P
Modification	F	T1	-	-	-
	C	T1	T1	-	-
	I	T2	T1	T1	

P	T3	T2	T1	T1
---	----	----	----	----

Table 22. Temporal Indicator of Effects Sequence

In case we modify an element (row), the results will be noticed in T indicated in the column. For instance, if we modify I, the effects over C appear in T1. However, the effects over F appear in T2.

In previous section, it has been remarked that the first probability of achieving each of the objectives was 50% in isolation, since there was any indicator to provide more detailed information. On the basis of that fact, user of the simulator can increase the likelihood of success in a particular objective and notice how this change affect to the rest. Furthermore, it is necessary to keep in mind that depending on the type of objective we modify, total results in T1, T2 or T3 will be given.

For instance, the following table (Table 23) illustrates a simulation performed where P1 and P4 objectives are complete accomplished (99%). This example is performed, ceteris paribus, which means that the rest of objectives maintain its initial value of 0.5 (which implicates uncertainty) and for Long-Term.

Nº Objective	Estado	T1	T2	T3	Final Sim
1 F1 - Achieving long-term sustainable growth of the organization				0,89	0,89
2 F2 - Increasing the average levels of productivity levels of staff				0,89	0,89
3 F3 - Achieving the development of larger scale projects				0,92	0,92
4 F4 - Holding a relevant place among our strategic customers				0,92	0,92
5 F5 - Enhancing positioning and turnover in the segments defined as strategic				0,93	0,93
6 C1 - Standing out in the market as the most reliable option...			0,93		0,93
7 C2 - Standing out in the market as innovative experts			0,92		0,92
8 C3 - Ensuring our customers display/making the results of the project tangible			0,96		0,96
9 C4 - Transferring to market a trademark image that reflects the firm's values			0,96		0,96
10 I1 - Formulating proposals in order to turn the needs of customers into business transformation...		0,75			0,75
11 I2 - Promoting projects management on the basis of the methodology and criteria ...		0,66			0,66
12 I3 - Ensuring that all projects comply with the standards of technical quality...		0,70			0,70
13 I4 - Researching and developing models for managing innovative changes and transformation		0,62			0,62
14 I5 - Launching technology solutions that support the implementation of transformation projects		0,60			0,60
15 I6 - Ensuring levels of excellence on each point of customer contact		0,76			0,76
16 I7 - Being actively involved in main business forums		0,77			0,77
17 I8 - Broadcasting this "new core" through all notifications and distinctive elements of The Firm		0,74			0,74
18 I9 - Strengthening relationships with key customers in order to deepen their knowledge...		0,58			0,58
19 I10 - Having and managing complementary partners portfolio and committing themselves...		0,58			0,58
20 I11 - Orientating commercial effort towards segments, customers and strategic service portfolio		0,68			0,68
21 P1 - Adapting human capital structure to critical competencies	Complete Accomp.	0,99			0,99
22 P2 - Adapting permanently new solutions and own ways of carrying out issues...		0,80			0,80
23 P3 - Developing a uniform management model on the basis of growth of its team...		0,86			0,86
24 P4 - Having behaviors associated to company's values by all members of the company	Complete Accomp.	0,99			0,99

Table 23. Example of P1 and P4 Simulation – 99% (Total Accomplishment)

As it can be seen above, modifying the specified values will enable us to achieve a number of direct results in T1, since $P \rightarrow P$ and $P \rightarrow I$ in the first term of the sequence, as it is illustrated in Table 9. Outcomes for values $P \rightarrow C$, $I \rightarrow C$ and $C \rightarrow C$ are noted in T2, as well as the results of all objectives over F in T3.

5.4 Assessment

This section provides detailed information about the process followed in order to validate the outcomes achieved in this AR (Figure 7). Process for validation has been two-fold. On the one hand, by comparing and discussing the simulations with the real previous results. On the other hand, conducting of a survey to agents involved has been performed.

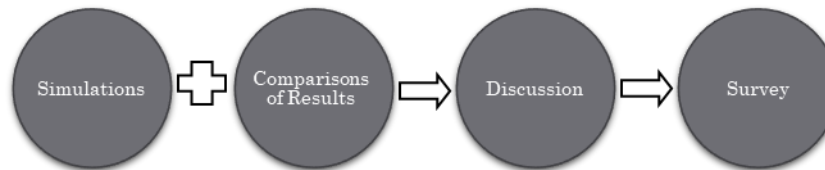


Figure 7. Validation Process

5.4.1 Simulation and Comparison

This section is referred to as forensic due to two reasons. First of all, since we are going to analyze the outcomes once they occurred (past events), as in other areas of research. On the other hand, since the process is articulated by means of an open meeting with the agents involved, where each one proposes its own ideas as if it was a forum. In our case, using available data from two consecutive years, has allowed the performance of two simulations where it was possible to see expected and not expected deviations. The following step consisted in asking experts about said deviations.

Here are the two simulations made for each of the two years for which data from 2014 and 2015 are available, and performed in Long-Term. The objective for these simulations is two-fold. On the one hand, it is intended to check the reliability of the simulation performed through forensic analysis. Since by noting the differences between real states achieved and performing of simulations, it is possible to note the accuracy of the simulator. In case there are differences, it would also be possible to find out a logical explanation, while in case there are not differences, it would be possible to adjust the Working Model, or discarding the utilization of this methodology as suitable.

Following subsections illustrate the outcomes from the two simulations. In order to be understood, it is important to take into account that these outcomes appear in each of the columns: first one (Simulation) shows the outcomes of working model, once values are entered, and the second one shows actual value (Real). Difference between both values can be found in the third column (Estimate – Real).

Differences between estimations and reality can be interpreted in three different ways:

- a) Model does not correctly predict because it has not enough information available.
- b) Model does not correctly predict because objectives have not been stated properly.
- c) Model does not correctly predict because it is not well-constructed.

If third column gives a positive value, is because the estimation is under reality. Underestimation may be due to the third causes mentioned before:

Simulator has not been provided with enough information to adjust the simulation (a). In this case, the amount of information has been increased in the model, which means that values have been included in order to arrive at the estimate. In accordance with management team, it is noted how these differences decrease, which seems to indicate that it offers a value consistent with reality, even if the adjustment is not perfect.

Second reason may be that objectives stated by the organization were not well-written (b), in such a way that stated objective was too low for the capacity of the organization and therefore, it is always possible to reach 100%. In order to see if this is the case, it is essential to raise and discuss the outcomes with management team and consider their explanations.

In case after having discussed both outcomes with management team it is determined that the model is not well constructed, adjustment process of impacts must be carried out. This process must address in particular those events that have influence over the events that do not fit right.

Conversely, if the value of the third column is negative means that simulated value is higher than the real one since the estimate has been overvalued. Overestimation due to the fact that the influences of the impacts are all positive, may not be caused by a lack of information. Therefore, a) makes sense if an external event has influenced in the model, which however was not covered. In either case, it is important to ask organization about the cause of deviation (external event, wrong estimate of goals...). If it is not caused by any of the facts previously mentioned, it will be required to readjust the model.

Before starting with simulations, it is necessary to bear in mind that for us is enough to state that outcomes of simulations adjust to the operational model of the organization. Moreover, these outcomes support management team

in order to adjust their decisions and objectives, as well as predicting to what extent can certain changes affect the rest of the targets.

Simulation A:

In *Simulation 'A'* (Table 24) real and standard data of P1 and P4 achievement has been introduced for each of the two years. Naturally, including 2 of 4 elements will develop an underestimate problem specially, to those events that receive direct impacts of events that are not included (P2 and P3). ‘Empty’ cells are due to the fact that some values are not included.

It is possible to note that underestimate is drastically reduced in parallel simulations where P2 and P3 are added.

2014				2015		
<i>Simulation</i>	<i>Real</i>	<i>Difference</i>	<i>ID</i>	<i>Simulation</i>	<i>Real</i>	<i>Difference</i>
89%	94%	5%	F1	88%	93%	5%
89%	95%	5%	F2	88%	92%	4%
92%	100%	8%	F3	91%	90%	-1%
92%	67%	-25%	F4	91%	67%	-24%
93%	100%	7%	F5	92%	92%	0%
93%	100%	7%	C1	90%	85%	-5%
92%	100%	8%	C2	88%	100%	12%
96%	63%	-33%	C3	94%	55%	-39%
96%	88%	-9%	C4	94%	83%	-11%
75%	100%	25%	I1	72%	100%	28%
66%	75%	9%	I2	63%	89%	26%
70%	100%	30%	I3	66%	100%	34%
62%	100%	38%	I4	60%	50%	-10%
60%	80%	20%	I5	58%	83%	25%

76%			I6	74%		
77%	60%	-17%	I7	72%	63%	-10%
74%	81%	7%	I8	70%	87%	16%
58%	97%	39%	I9	56%	94%	38%
58%	94%	36%	I10	57%	53%	-4%
68%	86%	18%	I11	65%	98%	33%
99%	100%	1%	P1	65%	67%	2%
80%			P2	76%		
86%			P3	82%		
99%	98%	-1%	P4	99%	91%	-8%

Table 24. Simulation-Comparison of Strategic Objectives achievement.

Simulation B:

Outcomes achieved in events ‘I’ for 2014 and 2015 (Table 25) have been simulated. Same verification must be made as in the previous section.

2014			2015			
Simulation	Real	Difference	Simulation	Real	Difference	
92%	94%	3%	F1	91%	93%	2%
92%	95%	3%	F2	91%	92%	2%
94%	100%	6%	F3	94%	90%	-4%
94%	67%	-27%	F4	93%	67%	-27%
95%	100%	5%	F5	94%	92%	-3%
99%	100%	1%	C1	97%	85%	-12%

99%	100%	1%	C2	95%	100%	5%
100%	63%	-36%	C3	99%	55%	-45%
99%	88%	-12%	C4	98%	83%	-15%
99%	100%	1%	I1	99%	100%	1%
70%	75%	5%	I2	85%	89%	4%
99%	100%	1%	I3	99%	100%	1%
99%	100%	1%	I4	60%	50%	-10%
85%	80%	-5%	I5	85%	83%	-2%
88%			I6	89%		
60%	60%	0%	I7	60%	63%	3%
85%	81%	-4%	I8	85%	87%	2%
99%	97%	-2%	I9	99%	94%	-5%
99%	94%	-5%	I10	60%	53%	-7%
93%	86%	-7%	I11	91%	98%	7%
			P1			
			P2			
			P3			
			P4			

Table 25. Table 15. Simulation-Comparison of the Achievement of Internal Processes Objectives.

In both situations are used only those events that belong to groups P and I, which are those defined in the model as dynamic events on which organization can make certain changes.

Outcomes are also achieved in both simulations, even though input data of the two different Groups P or I are taken, and it is noted that largest mismatches (over estimates) appear in elements C3, C4, F4 and I7.

5.4.2 Discussion of outcomes-simulations

After presenting the outcomes achieved to the leadership of the organization in a meeting, it is concluded that these deviations are caused mainly by two grounds explained below. Throughout the year 2014, the firm signed an

agreement with one of the leading European firms of the large-scale consumer sector. Due to the large-size of the project, firm had to substantial reduce those efforts and resources that were not directly linked with the production, by resulting in a negative deviation in I7 objective (external event ‘a’). This cascade effect was responsible of the delay in the implementation of other strategic projects, as the development of technological applications for measuring and transferring outcomes, that explain the negative differences identified in objectives C3 and C4. As leadership commented, negative differences in objective F4 may be due to the obstacles encountered for changing the current insight that customers share about experts and positioning of the firm.

Finally, leadership concludes that obtained deviations in the year 2015 were clearly motivated by an overestimate at stating objectives (‘b’).

At the end, after discussing outcomes with management team it has been determined that differences between predictions and the model are mainly due to a wrong establishment of the objectives, and signing of the large-scale agreement, which led to concentration of the resources of the organization in just one project. These outcomes point that simulation helps leadership at noting possible deviations of the objectives at modifying other objectives and also, at defining the targets and objectives more properly.

It is essential to take into consideration that simulations have been performed for Long-Term, which means, taking into account all the interrelations that exist since objectives consisted in identifying what happened two years ago. However, it is important to remind that if the objective is to take a decision, short-, medium- and long-term simulation can be made depending on the information requirements.

5.4.3 Outcomes survey

With the purpose of providing an increased support to these conclusions, questionnaire has been developed for a group of experts in order to assess outcomes and data achieved with the implementation of the purposed methodological combination. Heterogeneous group was comprised by members from management team of the organization we are analyzing (four management team members and an external consultant, which is closely associated to the organization). Furthermore, same questionnaire was developed for a group of other five experts with strong experience in the field of business consulting and strategic decision-making. After having reviewed the case and outcomes achieved, these professionals contribute their insights as if they were part of the management team. Responses of ten different experts are thus available in order to analyze outcomes in this particular case.

Questionnaire had twelve different questions where each of the professionals had to answer with the degree according to a seven-point Likert scale, and it was split into two blocks.

First block (Table 26) had six different questions, whose purpose consisted in finding out the Perception of Usability. This section is directly derived from the work of Fred Davis (Davis, 1989), whose aim was to see if this combination provided a usability enhancement of information systems in a firm.

	Question		1	2	3	4	5	6	7	
1	Using BSC&CIA-ISM at work enables me to perform tasks faster	Unlikely				X				Likely
2	Using BSC&CIA-ISM enhances labor performance	Unlikely				X				Likely
3	Using BSC&CIA-ISM at work increases productivity	Unlikely				X				Likely
4	Using BSC&CIA-ISM enhances effectiveness at work	Unlikely					X			Likely
5	Using BSC&CIA-ISM would make easier doing my work	Unlikely						X		Likely
6	I find BSC&CIA-ISM useful at work	Unlikely						X		Likely

Table 26. Perception of Usability.

The average of responses that appear in the previous table illustrates that there is certain uncertainty regarding if this would help at boosting speed, labor performance and productivity. After having searched for a better explanatory description, it was found that it occurred because there was not available a user-friendly system to carry out simulations and calculations. All this, made a bit more difficult carrying them out and it also required some time and knowledge in order to interpret them properly.

On the other hand, there was common agreement with regards to if this combination was a facilitator system to bring more convenience to the everyday work of management and decision-making teams, as well as enhancing effectiveness of the work.

The second block of questions (*Table 27*) was aimed at assessing directly the methodology proposed and the objectives stated in this work. Questions were directly related to the hypotheses proposed in section 4.1. of this article.

	Question		1	2	3	4	5	6	7	
7	Using impact matrixes enhances understanding of the organization and interrelationship between objectives.	Totally disagree							X	Totally agree

8	Using graphs enhances the understanding of the organization and interrelationship between objectives.	Totally disagree								X	Totally agree
9	Matrixes, Graphs and Simulations improve the knowledge of the organization and interrelationship between objectives.	Totally disagree								X	Totally agree
10	Using simulations and temporal matrixes may help with decision-making.	Totally disagree						X			Totally agree
11	Considering CIA-ISM together with Base Score Card may help with decision-making.	Totally disagree								X	Totally agree
12	Information provided by CIA-ISM and Based Score Card helps us to understand and describe interrelationships between the objectives of the firm.	Totally disagree								X	Totally agree

Table 27. Survey on Objectives-Hypotheses.

The average of responses was practically unanimous in “Totally agree”. Three first questions are aimed at checking if the methodological combination helps enhancing the understanding of the organization and its objectives, beyond what would be done just using BSC. Particularly, these questions were also aimed at finding out if this knowledge would help mitigate the levels of uncertainty and thus, improving the achievement of objectives (by minimizing risks).

Questions 10 and 11 had the purpose of finding out the perception of the people surveyed about whether this combination helps decision-making and if either of them does it better. Outcome achieved revealed that temporal matrix provides information and help decision-making, but generally the complete combination of both is the one that improves and facilitates most this task.

At the end, question 12 was aimed at finding out to what extent BSC helps understand the interrelationships between targets and objectives (Principle of Causality) and the response of all people surveyed was unanimous again in “Totally agree”.

6 Conclusions

There are a great number of conclusions derived from this paper. This article proposes theoretical and methodological contributions which emerge at integrating a new scenario-based methodology to BSC. BSC is a tool wide acclaimed on behalf of management teams involved and experts consulted. Nevertheless, it is also true that the tool has certain failings which must be solved in future researches. It is essential to keep in mind that this research involved direct participation of the agents involved, and leadership committee of a real organization which is

currently operating in market. Thus, conclusions that came out are derived from a real feedback of the organization and, in our view, market entails significant improvement regarding to validity of the findings and transference of outcomes of the academic research carried out.

In general, using CIA-ISM in combination with BSC improves the quality and amount of information offered by BSC and displaying it graphically and numerically. Particularly, this combination offers the possibility of categorizing, displaying targets in an orderly manner, as well as exposing their interrelations. Thus, there is also given a reasonable explanation for the Principle of Causality, which constitutes the main focus of this research. Moreover, working with simulated situations enables a better understanding of the organization and its functioning, apart from offering the possibility of preventing possible decision-making effects before they became real. This can be used as a training tool for management teams and Decision Support Systems (DSS). At any event, an enhancement of general and specific knowledge of the organization and its targets, reduce the effects of uncertainty about goals and thus, reducing risk level too.

On the other hand, as a methodological contribution to CIA-ISM, integration of Temporal Bias will enable management teams to determine which targets have to be modified and strengthened, in order to achieve strategic objectives depending on the available operating times.

Therefore, it is essential to highlight that BSC extent using CIA-ISM has a wide range of implications that can be assessed from various perspectives.

Using CIA-ISM in order to understand BSC (Principle of Causality) and as a tool to improve BSC.

The combination/extent of BSC with CIA-ISM, enables us to develop contrasted reasoning to the principle of causality, that link objectives in BSC (heading 3.2). Moreover, it is confirmed by the organization leadership after presenting data previously illustrated and contrasted by means of a survey. In particular, the most direct way to note this causality is through the use of the graphs listed and the use of “ceteris paribus” simulations, where it is noted how the modification of a target affect to the rest. Lastly, generation of simulations will enable management teams to adjust the objectives stated for the organization in greater detail. Thus, efficiency and effectiveness in functioning of the organization will be promoted.

Using CIA-ISM to shape BSC

Methodological combination illustrated enhances and improves the information provided by BSC. Specially, it allows building a ductile model that allows to make simulation and provides further information about the interrelations of their elements. As it has been previously stated, all this generates multiple benefits.

Using CIA-ISM together with BSC to understand the Organization

The following implication of this paper is that leadership agrees in using the combination/extent of BSC, as a tool to understand better the organization. Since graphs listed (Step 3) and impact matrixes, both temporal and general bias, offer a joint and detailed vision of how targets interact which each other, and which is the degree of relationship, depending on the timescales considered (Temporal Bias – Outcomes).

Using CIA-ISM together with BSC as a tool for decision-making (DSS)

Other implications that entails the use of this proposed combination is that it improves decision-making, particularly strategic decisions, since the simulator allows to recreate effects of decision-making beforehand, or to raise possible scenario simulations to settle them before they occur. This means, BSC+CIAS-ISM can simulate effects, as well as training management teams and providing them with more information.

Using CIA-ISM together with BSC as a tool to minimize risks (reduction in uncertainty)

Furthermore, as a direct consequence of above implications, it is essential to have available wider knowledge of the organization, interrelations between targets, simulations and decision-making support systems based on scenarios. All these consequences directly imply that organization must have available a tool to largely minimize uncertainty faced in strategic decision-making. As explained in the Introduction of this paper, narrowing uncertainty consist in minimizing risks.

Another advantage of this work is that faults, misstatements or weaknesses have been detected and must be taken into account in further researches. Weaknesses to take into account are various. First one is strengthening the interface for simulations, which must have a system that displays outcomes in a more clear and user-friendly manner from now on and, taking into consideration the particularities of this Working Model. Moreover, following step is to set up an assessment system for susceptibilities between targets, apart from also covering temporal bias and provide a further understanding of them. It would be also appropriate to build a working model that includes non-linear,

positive or negative impacts. Thus, simulations and interactions can be performed more accurately between the targets assessed.

In conclusion, we consider that BSC extent with CIA-ISM scenario-based methodology enhances the state of the initial art, by allowing to describe better the interrelation between targets and objectives and providing a reasoned explanation for the most common criticism of BSC, as it was previously stated. In addition, increase of knowledge of the organization, its targets and interrelationships dramatically decrease the impact of uncertainty on objectives. This enables the possibility of improving decision-making and minimizing risk related to the own organization in general, and strategic decision in particular.

Since there are several weaknesses in this paper, researchers know that impacts between objectives cannot be linear, and therefore it is possible that depending on the level of accomplishment of certain objectives, these may have different impacts on the rest. Another weakness of this research is that it has been conducted in just one company, which despite all the advantages resulting, it supposes a weakness with regard to a round-up of major findings.

Both weaknesses create opportunities to continue working in following researches, since it is intended to design a more complex impact matrix, which may enable us to meet not only the size of the impact, but also its direction, and by including a non-linear pattern of behavior between objectives. Similarly, it is intended to extend this research to other organizations that use BSC with the aim at replicating this work, and compare findings with the final purpose of validating the statements presented.

7 References

- AECA. (1997). *Indicadores de gestión para las entidades públicas*. Madrid: Asociación Española de Contabilidad y Administración de Empresas.
- Altrichter, H., Posch, P., & Somekh, B. (2005). *Teachers investigate their work An introduction to the methods of action research*. *British Journal of Educational Technology* (Vol. 39). http://doi.org/10.1111/j.1467-8535.2008.00870_1.x
- Amat, J. M. (1996). *Control de gestión : una perspectiva de dirección*. Gestión 2000.
- Bañuls, V. A., López-Vargas, C., Tejedor, F., Turoff, M., & Ramirez de La Huerga, M. (2016). Validating cross-impact analysis in project risk management. In *ISCRAM 2016 Conference Proceedings - 13th International Conference on Information Systems for Crisis Response and Management*.
- Bañuls, V. A., & Turoff, M. (2011). Scenario construction via Delphi and cross-impact analysis. *Technological*

- Forecasting and Social Change*, 78(9), 1579–1602. <http://doi.org/10.1016/j.techfore.2011.03.014>
- Bañuls, V. A., & Turoff, M. (2011). Scenario construction via Delphi and cross-impact analysis. *Technological Forecasting and Social Change*, 78(9), 1579–1602. <http://doi.org/10.1016/j.techfore.2011.03.014>
- Bañuls, V. A., Turoff, M., & Hiltz, S. R. (2013). Collaborative scenario modeling in emergency management through cross-impact. *Technological Forecasting and Social Change*, 80(9), 1756–1774. <http://doi.org/10.1016/j.techfore.2012.11.007>
- Brown, A., & Dowling, P. (1998). *Doing research/reading research [electronic resource]: a mode of interrogation for education. Master classes in education series.* Retrieved from <http://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=144841&site=ehost-live>
- Carenys, J., & Falguera, J. (1997). El cuadro de mando, un documento informativo para la toma de decisiones y la buena gestión. *Barcelona Management Review*, 5.
- Comes, T., Hiete, M., Wijngaards, N., & Schultmann, F. (2011). Decision maps: A framework for multi-criteria decision support under severe uncertainty. *Decision Support Systems*, 52(1), 108–118. <http://doi.org/10.1016/j.dss.2011.05.008>
- Cuhls, K. (2003). From forecasting to foresight processes? new participative foresight activities in Germany. *Journal of Forecasting*, 22(2–3), 93–111. <http://doi.org/10.1002/for.848>
- Dalkey, N. (1969). The Delphi Method: An Experimental Study of Group Opinion. *The RAND Corporation*. [http://doi.org/10.1016/S0016-3287\(69\)80025-X](http://doi.org/10.1016/S0016-3287(69)80025-X)
- Dalkey, N. C. (1971). An elementary cross-impact model. *Technological Forecasting and Social Change*, 3(C), 341–351. [http://doi.org/10.1016/S0040-1625\(71\)80022-7](http://doi.org/10.1016/S0040-1625(71)80022-7)
- Dalkey, N. C. (1975). Toward a Theory of Group Estimation. In *The Delphi method: Techniques and applications* (pp. 231–255).
- Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly*, 13(3), 319. <http://doi.org/10.2307/249008>
- Helmer, O., & Rescher, N. (1959). On the Epistemology of the Inexact Sciences. *Management Science*, 6(1), 25–52. <http://doi.org/10.1080/00263200600922999>
- International Standards Organisation. (2009). ISO 31000 - Risk management. *ISO 31000:2009 - Risk Management*. <http://doi.org/10.1080/07366981.2012.682494>
- Ittner, C. D., & Larcker, D. F. (1997). The Performance Effects of Process Management Techniques. *Management Science*, 43(4), 522–534. <http://doi.org/10.1287/mnsc.43.4.522>
- Ittner, C. D., & Larcker, D. F. (1998). Are Nonfinancial Measures Leading Indicators of Financial Performance? An Analysis of Customer Satisfaction. *Journal of Accounting Research*, 36, 1. <http://doi.org/10.2307/2491304>

- Kane, J. (1972). A primer for a new cross-impact language- KSIM. *Technological Forecasting and Social Change*, 4(2), 129–142. [http://doi.org/10.1016/0040-1625\(72\)90010-8](http://doi.org/10.1016/0040-1625(72)90010-8)
- Kaplan, R. S., & Norton, D. (1996a). *The Balanced Scorecard Translating Strategy In Action*. (Harvard Business School Press, Ed.) *Harvard Business School Press* (First Edit).
- Kaplan, R. S., & Norton, D. (1996b). Using the Balanced Scorecard as a strategic management system. *Harvard Business Review*.
- Kaplan, R. S., & Norton, D. (1997). *Cuadro de mando integral = The balanced scorecard* (1ª edición). Barcelona: Gestión 2000.
- Kaplan, R. S., & Norton, D. (2006). *Alignment : using the balanced scorecard to create corporate synergies*. Boston, Mass.: Boston, Mass.: Harvard Business School Press, c2006. Retrieved from <http://id.lib.harvard.edu/aleph/009890699/catalog>
- Landeta, J. (1999). *El método Delphi : una técnica de previsión para la incertidumbre*. Ariel. Retrieved from <https://dialnet.unirioja.es/servlet/libro?codigo=208626>
- Lewin, K. (1946). Action Research and Minority Problems. *Journal of Social Issues*, 2(4), 34–46. <http://doi.org/10.1111/j.1540-4560.1946.tb02295.x>
- Linstone, H. A., & Turoff, M. (1975). *Delphi Method: Techniques and Applications*. 1975. <http://doi.org/10.2307/1268751>
- Lipinski, H., & Tydeman, J. (1979). Cross-impact analysis. Extended KSIM. *Futures*, 11(2), 151–154. [http://doi.org/10.1016/0016-3287\(79\)90035-1](http://doi.org/10.1016/0016-3287(79)90035-1)
- Malina, M. A. (2001). *Management control and the Balanced Scorecard : an empirical test of causal relations*. University of Colorado.
- Montibeller, G., Gummer, H., & Tumidei, D. (2006). Combining scenario planning and multi-criteria decision analysis in practice. *Journal of Multi-Criteria Decision Analysis*, 14(1–3), 5–20. <http://doi.org/10.1002/mcda.403>
- NISTEP. (1997). *The Sixth Technology Forecast Survey - Future Technology in Japan Toward The Year 2025 -*. Retrieved from <http://data.nistep.go.jp/dspace/handle/11035/650>
- NISTEP. (2001). *The Seventh Technology Forecast Survey - Future Technology in Japan Toward The Year 2030 -*. Retrieved from <http://data.nistep.go.jp/dspace/handle/11035/618>
- Norreklit, H. (2000). The balance on the balanced scorecard a critical analysis of some of its assumptions. *Management Accounting Research*, 11(1), 65–88. <http://doi.org/10.1006/MARE.1999.0121>
- Norton, D., & Kaplan, R. S. (1992). Translating Strategy into Action: The Balanced Scorecard. *Harvard Business Review*, (January-February), 71–79. <http://doi.org/ieeexplore.ieee.org>

- Olve, N.-G., Roy, J., & Wetter, M. (1999). *Performance drivers : a practical guide to using the balanced scorecard*. J. Wiley. Retrieved from <https://www.wiley.com/en-us/Performance+Drivers:+A+Practical+Guide+to+Using+the+Balanced+Scorecard-p-9780471495420>
- OPTI. (1999). *Primer Informe de Prospectiva Tecnológica Industrial*. Madrid.
- OPTI. (2000). *Segundo informe de prospectiva tecnológica industrial*. Madrid: Fundacion OPTI.
- OPTI. (2001). *Tercer Informe de Prospectiva Tecnológica Industrial*. Fundación OPTI.
- Ramirez de La Hueriga, M., Bañuls, V. A., & Turoff, M. (2015). A scenario-based approach for analyzing complex cascading effects in Operational Risk Management. In *ISCRAM 2015 Conference Proceedings - 12th International Conference on Information Systems for Crisis Response and Management*. <http://doi.org/10.1016/j.engappai.2015.07.016>
- Ramirez De La Hueriga, M., Bañuls Silvera, V. A., & Turoff, M. (2015). A CIA-ISM scenario approach for analyzing complex cascading effects in Operational Risk Management. *Engineering Applications of Artificial Intelligence*, 46, 289–302. <http://doi.org/10.1016/j.engappai.2015.07.016>
- Rucci, A. J., Kim, S. P., & Quinn, R. T. (1998). The employee-customer-profit chain at SEARS. *Harvard Business Review*, 76(1), 82–97. <http://doi.org/0058>
- Smith, M. (1990). The Rise and Rise of NFI. *Management Accounting*, June.
- Tripp, D. (2005). Action research: a methodological introduction. *Educação E Pesquisa*, 31, 443–466. <http://doi.org/10.1049/ip-sen:20020540>
- Tuggle, F. D. (2004). Strategy Maps: Converting Intangible Assets into Tangible Outcomes. *Academy of Management Executive*, 18(2), 163–165. <http://doi.org/10.5465/AME.2004.13835877>
- Turoff, M. (1971). An alternative approach to cross impact analysis. *Technological Forecasting and Social Change*, 3(C), 309–339. [http://doi.org/10.1016/S0040-1625\(71\)80021-5](http://doi.org/10.1016/S0040-1625(71)80021-5)
- Turoff, M., Bañuls, V. A., Plotnick, L., Hiltz, S. R., & Ramirez de la Hueriga, M. (2016). A collaborative dynamic scenario model for the interaction of critical infrastructures. *Futures*, 84. <http://doi.org/10.1016/j.futures.2016.09.003>
- Turoff, M., Hiltz, S. R., Bañuls, V. A., & Van Den Eede, G. (2013). Multiple perspectives on planning for emergencies: An introduction to the special issue on planning and foresight for emergency preparedness and management. *Technological Forecasting and Social Change*, 80(9), 1647–1656. <http://doi.org/10.1016/j.techfore.2013.07.014>
- Warfield, J. N. (1976). *Societal Systems: Planning, Policy and Complexity*. (Wiley, Ed.) (Illustrate). New York: John Wiley & Sons.