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DETECTION AND ASSESSMENT OF CAUSES IN BUSINESS DIAGNOSIS

Abstract. In this paper is proposed a contribution to the firm's diagnosis analysis, specifically in the detection and valuation of causes in firms, using a fuzzy diagnosis approach and the Balanced Scorecard theory (BSC). Through the BSC as a starting point, is proposed a specific vademécum of causes that generate firm's problems. This list of causes can also be grouped into key areas for an easier monitoring. The assessment proposal through the fuzzy methods allows formalizing the expert's opinions, reducing subjectivity and working with multiple variables. These opinions are translated into linguistic labels that represent the incidence of each cause or problem. The analysis of causes can be applied to any business or industry with the necessary adjustments because is a result of a screening through the Balanced Scorecard that summarize all the dimensions of the company. This allows the estimation of the membership matrix of causes, as first step in firm´s economic-financial diagnosis.

Keywords: business diagnosis; causes; symptoms; fuzzy relations; Balanced Scorecard.

JEL Classification: G33, L25, M21

1. Introduction

In literature there are very few works which analyze the causes that generate problems or diseases in firms. Most efforts are oriented to determinate the best indicators able to predict failure or distinguishing between "healthy" and "unhealthy" businesses (Flagg et. al, 1991; Grunert et. al., 2005; McGahan and Porter, 1997, etc.). The most outstanding contributions in terms of cause's analysis

are Argenti (1976 and 1983), Ooghe and Waeyaert (2004), Porter (1991) and Gabás (1997) who point out some of the causes that should be analyse in business diagnosis. Argenti (1983), Porter (1991) and Ooghe and Waeyaert (2004) introduce some relationship between causes and symptoms in an unstructured and not formalized form without consider the firm´s problems as an endogenous variable.

In this paper is proposed the valuation of the causes detected through the Balanced Scorecard (BSC) theory of Kaplan and Norton (1992, 1996) by using fuzzy logic.

This specific *vademécum* of causes is identified according to the BSC´s perspectives (finance, customers, the internal business process, and learning and growth) and is adjusted to the methodological postulates of the business model (Vigier and Terceño, 2008 and 2011)[1]. This list of causes is applied to a group of SMEs (Small and Medium-sized Enterprises) of the construction sector. Though the BSC has not been used to predict bankruptcy, we consider its analysis through strategic maps that synthesize cause effect relations, offers the framework to identify and schematize the disease-generating causes. In this analysis, instead of using the BSC´s vertical impact scheme of perspectives into a last generating cause is taken the strategic maps analysis and the cause effect relationship to identify all factors of each perspective and then summarize them into a unique strategic map that conceives all factors.

2. The detection of causes

When talking about data clustering, there are a few basic concepts which need to be discussed, such as distance metric, similarity matrix and clustering algorithms. Conventional clustering methods mainly consist of two parts: the construction of a similarity matrix between documents and the construction of clusters using a clustering algorithm. Taking as reference the works of Argenti (1976, 1983), Gabás (1997), Gil Aluja (1990), Ooghe and Waeyaert (2004), SWOT analysis of Porter (1991), works of bankruptcy prediction with non-financial variables (Peel et al., 1986; Flagg et. al., 1991; and Grunert et. al., 2005; etc); and the strategic map of causal relations of Terceño et al (2014) is developed a specific list of causes grouped according to the BSC´s perspectives (finance, customers, the internal business process, and learning and growth; see Table 1). Inside each perspective, is selected a set of areas to control, that are made up by others key factors or causes to diagnose performance´s firms. These factors have been partially studied in most of the contributions of business failure.

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[1] Also Delcea and Scarlat (2009) presented a similar fuzzy model and mention the absence of a valuation methodology of the multiple subjective causes that generate problems in firms.

Table 1. *Vademécum* **of causes**

Learning and Growth		Finance
Business learning	**Innovation and technology**	**Results of activity**
Firm's age	Technological level	Shareholders remuneration
Type of organization	Degree of investment	Wage level
Manager's education	Firm´s leadership	Liabilities
Frequency of management changes		Debtor category
Property`s changes		Type of financing
Centralization of decision making	**Labor quality**	**Risk management**
Participation of partners	Work force's educational level	Projects above possibilities
Management information	Difficulty of getting qualified labor	Guarantees
Mistakes in decision making	Degree of unionization	Risk aversion
Delays in decision making	Frequency of employee training	Financial history
Computerization of the firm		**Use of assets**
Information fluidity	**Cost optimization**	Budgetary control
Type of internal communication	Planning	Financial planning
Stakeholders' restrictions	Knowledge of units cost	Taking financial decisions
Adaptability to change	External advice	Search for short and long term funding
		Capital contribution frequency

Business process	Customers
Technical efficiency	**Commercial management**
Oversizing	Location
Work accidents	Market reach
Absenteeism	Sales payment´s type
Productivity	Clients' mean time of payment
Use facilities	Default portfolio
Lead times	Contracts
Unnecessary costs	**Customer satisfaction**
Excess capacity	Measure of customer satisfaction
Cost level compared to sector	Delivery service
Purchase policies	**Quality and prices**
Suppliers' choice	Quality level
Problems with deliveries	Price level
Stock policies	Advertising and promotions
Suppliers' mean time of payment	**Sectorial evolution**
Exogenous changes	Demand changes
Political changes	Competition
Regulatory changes	Substitutes
Macroeconomic changes	Sector experience
Regional economy changes	
Technological changes	

In the learning and growth perspective are considered aspects like business learning, innovation and technology, labor quality and cost optimization. Inside business learning, following Argenti (1976 and 1983), we include factors that characterize a poor management, defined by aspects such as the centralization of decision-making (rule of one man), the low participation of the partners, shareholder´s restrictions, weak financial function that leads to bad decisions and failure to respond to change, among others; and the internal causes mentioned by Gabás (1997)as inefficient management, business´s age and wrong and inappropriate strategies. Ooghe and Waeyaert (200) refer to these causes within the business aspect (motivations, character, experience, etc.). Some of the models of

failure prediction, though not distinguished between symptoms and causes, added non-financial variables as an effort to improve the estimated results. Peel et al. (1986) include factors like delays and adjustments in financial statements and changes in management and ownership of firms. Flagg et al (1991) take the agency theory to explain the role of managers to avoid bankruptcy. Hillegeist et al (2004)add the market information to supplement the accounting information; and Grunert et al. (2005) highlight the usefulness of including variables as age, type of business and sector in combination with financial ratios. In innovation and technology are considered the productive investments (Gabás, 1997) and the firm´s leadership in the market. With regard to labor quality are considered the labor training and their ability to perform the management´s orders. Cost optimization includes the organization´s factors that improve its competitive position. These factors are selected considering Argenti´s work (1976 and 1983) about the importance of the cost system and the planning; Porter (1991) regarding of the competitive advantages of firms and Becchetti and Sierra (2003) on the advantage of including variables related to the organization´s strategy, for example, the competitive position, the market concentration or the export level to improve the predictive ability of the models.

The internal business process is characterized by technical efficiency, purchase policies and exogenous changes. Technical efficiency and purchase policies are considered in Gabás (1997)when mention the inefficient production system as a general cause and in Porter (1991) when considers bargaining power of suppliers; while exogenous changes are regarded by Argenti (1976 and 1983) and Gabás (1997) among others. Ooghe and Waeyaert (2004) mention the causes within the general environment which include economic, technological, political, social and foreign countries performance changes.

Client´s perspective takes into account the commercial management, the customer satisfaction, the quality and prices, and the sector´s evolution. Regarding the sector´s evolution, Gabás (1997) considers the causes link to the market´s evolution and the product life cycle, while Argenti (1976) identifies the trend of competition. Porter (1991) focuses these considerations in bargaining power of buyers, rivalry among existing competitors, the threat of substitute of products or services and the threat of new entrants. These aspects are summarized in Ooghe and Waeyaert (2004) into the causes related to the environment of the company. With regard to commercial management, Gabás (1997) identifies an increasing default rate, and Argenti (1976) includes customer´s satisfaction and the quality and prices in non-financial symptoms. These factors besides be effect of problems in business administration, may also be diseases. Also McGahan and Porter (1997) and Rumelt (1997) mentioned that external factors are those that best explain the business failure. Among these factors are the changes in demand, the changes in consumer´s preference, the competitive between current and future competitors, the declining demand and the technological uncertainty, etc.

Within finance perspectives we propose monitor the use of assets, the risk management and the results of activity. Here Argenti (1976)puts special emphasis on budgetary control, cash flow estimation and the valuation of assets. In addition, mentions the projects above the financial possibilities, the overhang debt and the high financial risk. Gabás (1997)also includes unsolved bankruptcy problems and the excessive indebtedness as causes of crisis. In this sense, Gil Aluja (1990) in their diagnostic model to measure the risk of an investment presents a parallel between health and disease, where presents some of the business´s diseases such as illiquidity, the covered of discount lines, the lack of credit of suppliers, the short term credit restricted, the long term loan exhausted, the fully mortgaged assets, the impossibility of new guarantees and without likelihood enlarge own resources.

Taking as reference Terceño et al (2014), where is presented the integration of the fuzzy diagnosis model and the BSC, now is proposed the methodology to detect and valuate causes, and its application to a specific sector. This allows us to outline the causes and through a methodology that includes objective and subjective causes forecast firm´s health. This means that, through the integration, are formalized and generalized the aspects stated in the theory of management control and supplemented the theoretical contributions with the formalization of the fuzzy logic.

3. The methodology of valuation

Vigier and Terceño (2008) consider that the causes are fundamental in business failure because they are the true disease-generating. These authors develop a valuation methodology of objective and subjective causes, although they don't define the set of causes and don´t study in- depth the disease-generating factors. According to these authors, when the analyst carries out the diagnosis, try to identify the level of incidence of each cause for the firm.

Subjective causes are obtained by constructing linguistic labels, between a scale [0, 1], that reflect the opinion of experts about the impact of the cause on firm´s performance. The model indicates that higher degrees correspond to causes that have greater incidence level (Zimmermann, 1991).
That means:

- To each expert is given a set of linguistic labels, with which must assess the existence of the cause in each firm.
- The expert chooses between the groups of linguistic labels that are translated into a quantitative scale which show the incidence level of the cause.

- Each label represents a level of incidence that depends on the number of alternatives, or linguistic labels making up the scale. This incidence level is constructed through the cumulative frequency of the label in each scale[2].

The objective causes must be ordered in the sense of impact (if the sense is positive is from lowest to highest, and if it is negative from the highest to lowest level). Then, once the elements are ordered, we estimate the level of incidence of the cause C_j at firm E_h, $\mu_{C_j}(c_{hj})$, through the ratio between the ordinal of the cause C_j established for the firm in the ordered and the cardinal of the set, which is the number of firms. That is: $(\mu_{C_j}(c_{hj}) = |c_{hj}|/ m = p_{hj})$.

In this methodology the expert has a major role in evaluating the incidence of the causes. That means the expert according to his experience knows the firm´s behaviour and its environment. Next is presented this methodology applied to a group of 15 SMEs in the construction sector (about 15% of the activity in two Argentinean cities, for only corporate companies, the percentage is around 30%).

4. Detection and assessment of causes

The purpose of text mining is to process unstructured textual information in order to extract meaningful information. In this application we propose identify and valuate the disease-generating causes of a set of firms in construction sector, particularly of two subsectors: construction and building materials. These activities meet the requirements of information necessary to estimate the Vigier and Terceño model (2008; 2011). A standardized questionnaire is designed to detect potential causes of diseases in companies, by using linguistic labels, following the *vademecum* of causes identified according to the theory.

The experts of the SMEs, according to their experience and judgment have the mission to assess qualitatively and quantitatively the performance of their companies following the guidelines. In most cases the experts were individuals who maintained a long relationship with the company, which evidenced a vast experience and knowledge of the workings of the firm and its environment. In Argentine SMEs, this role is fulfilled accounting advisors, managers and business owners (in many cases, the latter two are the same person). The questionnaire is design to know the firms problems according to the *vademécum* or list of causes proposed in table 1.

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[2] If we suppose five states sorted from lowest to highest (always, often, sometimes, rarely and never) the scale is distributed linearly among the five states, corresponding a 20% of the scale to each state. These are: 0.2; 0.4; 0.6; 0.8; 1.0. If they are seven states the incidence levels would be 0.14; 0.29; 0.43; 0.57; 0.71; 0.86 and 1.0. These mean that the incidence level changes according to the number of states established by the researcher for each cause.

Most of causes are measured in a subjective way, by linguistic labels, between a scale [0, 1], that translate the experts' opinion and reflect the incidence of each cause at the firm. In cases where the cause reflects more than an opinion, that means several questions, we propose to identify a single level of incidence through the arithmetic average of the expressed opinions. For example, the cause that investigates "the frequency and type of liabilities" is valuated through the arithmetic average of trades', labours', financial institutions', taxes' and pensions' liabilities.

In the case of objective causes, like "productivity and excess capacity", the experts give quantitative information to estimate the ratios. For example, productivity is measured through the ratio between the sales deflated by the construction´s price index and the number of employees. When is applied the methodology described in section 3, is sorted the cause from highest to lowest and is estimated the cumulative frequency of each firm according to their scale position (84; 126; 140; 203; 245; 315; 318; 341; 500; 527; 612; 659; 1101; 1192; 3038) and is obtained the respective levels of incidence (0.07; 0.13; 0.20; 0.27; 0.33; 0.40; 0.47; 0.53; 0.60; 0.67; 0.73; 0.80; 0.87; 0.93; 1.00). Appendix (tables A.1 to A.4) shows the causes, the proposed questions and the linguistic labels scaling to valuate the firm´s performance based on the four perspectives of the BSC and the *vademécum* of causes presented in table 1. The questionnaire is also available at http://fuzzybusinessdiagnosis.blogspot.com.ar/

For example to identify the firm´s leadership, within the area innovation and technology in the learning and growth perspective, we ask the expert about he considers that the firm is between the 5 first business of the sector, giving 8 options of answer (far away; far; half away; half; nearly half; near; very near; sector´s leader). These options are valued with the labels shown in column (c) that is: 1.00; 0.88; 0.75; 0.63; 0.50; 0.38; 0.25; 0.13. Thereby, are proposed the questions and the linguistic labels for the 15 causes identified in business learning, the 4 causes associated to the labor quality and the 3 causes linked with cost optimization (see table A.1, Appendix).

In technical efficiency within the business process perspective, for example, is proposed a question about the production lead times that are measured subjectively by the expert according to their frequency (a lot: 1.00; enough: 0.80; some: 0.60; a few: 0.40; neither at all: 0.20). Appendix presents all the causes that are considered within this perspective (see table A.2).

For the cause location, in commercial management´s area within client´s perspective, we ask the expert about the negative impact over sales of the firm´s location. In this question we propose 8 linguistic labels (very much; much; enough; ordinary; more than a little; a little; almost nothing; nothing) evaluated according to the shown methodology of cumulative frequency (1.00; 0.88; 0.75; 0.63; 0.50; 0.38; 0.25; 0.13). Appendix shows the questions about the 15 causes identified within this perspective, grouped into 4 key areas (see table A.3).

In finance perspective we propose a set of questions that considerer the 14 causes identified in table 1 (budgetary control, financial planning, search for short and long term funding, taking financial decisions, capital contribution frequency, projects above possibilities, guarantees, financial history, risk aversion, shareholders remuneration, wage level, liabilities, debtor category, type of financing). For example, to evaluate the benefits requirements we propose to ask the expert about the frequency of projects above firm´s financial possibilities (see appendix, table A.4). This was evaluated by 5 linguistic labels (always: 1.00; often: 0.80; sometimes: 0.60; rarely: 0.40; never: 0.20).

Most of causes are measurable subjectively, and through the experts' opinion about firm´s are detected. The proposed methodology doesn't inhibit measuring them through objectives indicators calculated from information given by the experts. This option does not solve information quality issues and measured problems linked to ratios' selection. In this particular case, we interview experts as analysts who know the cause´s incidence at the firms. This proposal may lead to misdiagnosis followed by the wrong opinion of the expert or his ignorance, although it is suppose that the expert know with certainty the firm´s problems and its behaviors.

5. Estimation of the membership matrix of causes

The membership matrix of causes (P) shows the incidence of each cause over firm´s performance according to Vigier y Terceño (2008; 2011). Following the described methodology of assessment through linguist labels for subjective causes and the cumulative frequency´s method for objective causes we estimate the membership matrix of causes. This is done for the 72 causes listed in the *vadémecum* (table 1). From the estimated data, the experts' opinions is formalized and the membership matrix of causes is built (P_{hj}= 15x72; see Appendix, table A.5).

Through the membership matrix of causes is possible to diagnose the firms, taking into account the cause´s incidence degree (p_{hj}< 0.50; 0.50≤ p_{hj}< 0.75; p_{hj}≥ 0.75). A horizontally analysis is performed for each of the companies to detect the degree of each cause for the firm. For example, firm 12 shows problems in learning and growth´s cluster, in diseases related to business learning (participation of partners (1.00); type of organization (1.00); centralization of decision making (0.83); management information (0.83) and adaptability to change (0.71). In aspects related to innovation and technology shows not so important problems in firm´s leadership (0.71), but in diseases related to labour quality has problems in frequency of employee training (1.00), the labor force's educational level (0.83); the difficulty of getting qualified labour (0.83) and the degree of unionization (0.71). At last in cost optimization there are diseases related to planning and external advice (0.83). In business process perspective related to technical efficiency the more important disease is productivity (0.93) and in aspects related

to stock policies (1.00), suppliers' mean time of payment (0.71) and suppliers' choice (0.70) within purchase policies. Exogenous changes that most directly affect sales are regulatory changes and regional economy changes (0.80). In customers perspective has disadvantages in commercial management (market reach (0.80); contracts (0.80) and default portfolio(0.75)) and in demand changes (0.75) in sectorial evolution. In finance perspective shows problems in use of assets (budgetary control(0.88); financial planning(0.78); search for short and long term funding (0.80) and taking financial decisions (0.80) and in results of activity (shareholders remuneration (1.00)). In this firm the finance perspective shows more intensity problems ($p_{hj} \geq 0.75$), following by learning and growth´s cluster, the business process´s perspective and the customers' cluster.

This analysis also allows sorting and grouping companies, according to the intensity of the causes (Table 2)[3].

Table 2. Sorting of firms

Firms	
Healthier firms (p´< 0.50)	2, 4, 11
Moderate sick companies ($0.50 \leq$ p´< 0.75)	1. 6, 7, 10. 15
Sicker firms (p´ $\geq$ 0.75)	3, 5, 8, 9, 12, 13, 14

Also, by analysing the matrix by columns it can be made a sectorial research, through evaluating each perspective of the BSC for the set of firms. The finance´s and the business process´s perspectives show more level of incidence with an average for the set of firms of $p_{hj} = 0.54$, follow by the customers' perspective (0.49) and the learning and growth´s cluster (0.46).It should be pointed out that in the fourteen causes monitoring in the finance cluster, the most important are capital contribution frequency (showing in 12 out of the 15 firms a $p_{hj} \geq 0.75$), search for short and long term funding (being in 11 out of the 15 firms a $p_{hj} \geq 0.75$), Risk aversion (in 10 out of 15 with $p_{hj} \geq 0.75$) and shareholders remuneration (in 9 out of 15 with $p_{hj} \geq 0.75$). In the eighteen causes of the business process´s cluster, the most relevant are the macroeconomic changes and the regional economy changes (in 12 out of 15 with $p_{hj} \geq 0.75$) and the regulatory changes (in 9 firms out of the 15). Then with less impact is the firm`s stock policies present in 6 out of the 15 firms. In the customer´s perspective, the market reach (in 9 out of the 15) and the impact of advertising and promotions (being in 8 out of 15) are the most relevant. In Learning and Growth cluster, the more important diseases are related to management information and planning presented in 7 of of the 15 with$p_{hj} \geq 0.75$.

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[3] One of the firms detected as sick fail in May 2014 as reported in
http://receptorias.scba.gov.ar/busqueda.php

6. Conclusion

While Argenti (1976; 1983) and others go forward in the cause's analysis, it is done partially or in an unstructured way, without advance in cause detection. Vigier and Terceño´s model (2008, 2011) recognizes and formalizes the relationship between causes and symptoms, but doesn´t define the causes that generate diseases. With this approach through the BSC, the specific *vademécum* of causes is identified for a set of firms grouped into key areas. We understand that the list of causes is a contribution, although to improve, because it´s useful to detect in advance possible reasons of business failure. Also through the integration of the Vigier and Terceño (2008, 2011) fuzzy logic model with the BSC is possible to formalize expert's knowledge, to treat uncertainty and working with multiple variables.

This v*ademécum* of causes identified according to the BSC´s perspectives (finance, customers, the internal business process, and learning and growth) taking as reference the works of Argenti (1976, 1983), Gabás (1997), works of business failure with non-financial variables (Flagg et al, 1991; Grunert et al, 2005; McGahan and Porter, 1997; etc.) and SWOT analysis of Porter (1991). Also, this disaggregated list of causes can be grouped or synthesize in key areas for an easy monitoring and for facilitate experts' task in firms' diagnosis.

The most outstanding works till now (Argenti, 1976 and 1983; Ooghe and Waeyaert, 2004; Porter, 1991) show in a partially and described way the relationship between causes and symptoms, without formalizing its relevance. While others models introduce the topic to consider additional factors for improve the prediction of business failure (Flagg et al,1991; Gabás, 1997; etc.). This first time using the BSC in business failure enable have a firm´s overview, through strategic maps that show the relationship between causes and symptoms helpful to analyse any firm or business sector. Through this general scheme is obtained a specific list of causes that we use in the simulation applied to the construction sector.

Also, the expert's opinion is formalized to estimate the cause´s incidence as a start point to predict and diagnose diseases according to Vigier and Terceño (2008, 2011).

Through causes' estimation, is founded a methodology which allows know the firm´s state and all the causes that generate the business´ problems and are visible through the symptoms. Making a comparison in medical terms, we could say that doing symptoms´ analysis (widely studied in the literature, Quintana and Gallego (2004), Ferrer et al(2009), among others) and with a list of causes and the relationship between them is possible to predict the firm´s pathology and accordingly apply the necessary treatment to cure. We understand that this point is relevant because most models estimate only the firm´s state but not the firms' problems; so we know that the company is sick or dying but we don´t know why, or at least there isn't a methodology to estimate it.

Through the simulation to this case of study to firms of the construction sector in Bahía Blanca (Argentina) is verified the Vigier and Terceño (2008, 2011) model and is checked its reasonable and easy understanding results for business owners and managers.

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Appendix

Table A.1. Learning and Growth Perspective

Learning and Growth Persp.(a)		Questionnaire (b)	Linguistic labels and cause incidence (c)
Innovation and technology	Firm´s leadership	Characterization of the firm. ¿Do you think is between the first five in the sector?	far away (1.00); far (0.88); half away (0.75); half (0.63); nearly half (0.50); near (0.38); very near (0.25); sector´s leader (0.13)
	Technological level	How is the modernization of tools and machines?	none (1.00); very old (0.88); old (0.75); old medium (0.63); middle age (0.50); some modern (0.38); modern (0.25); very modern (0.13)
		How do you think are you technologically with regard to technological frontier or leadership companies?	far away (1.00); far (0.88); half away (0.75); half (0.63); nearly half (0.50); near (0.38); very near (0.25); technological´s leader (0.13)
	Degree of investment	How often do you invest?	never (1.00); more than 10 years (0.86); between 5 and 10 years (0.71); according to need (*) (0.57); between 3 and 5 years (0.43); between 2 and 3 years (0.29); every year (0.14)
Labor quality	Labor force's educational level	What level of training have the labor force of the company?	without training (1.00); very low (0.83); low (0.67); average (0.50); high (0.33); very high (0.17)
	Difficulty of getting qualified labor	Do you have problems to find qualified work force´s?	always (1.00); often (0.80); sometimes (0.60); rarely (0.40); never (0.20)

	Degree of unionization	How much influence does the union?	very high (1.00); high (0.86); almost high (0.71); mean (0.57); almost low (0.43); low (0.29); very low (0.14)
	Frequency of employee training	How often do you train the employees?	never (1.00); rarely (0.80); sometimes (0.60); often (0.40); always (0.20)
Cost optimization	External advice	Do you have external advice from others professionals?	never (1.00); rarely (0.80); sometimes (0.60); often (0.40); always (0.20)
	Planning	How often do you make planning?	never (1.00); sometimes (0.83); biennially (0.67); annually (0.50); quarterly (0.33); monthly (0.17)
	Knowledge of units cost	Do you know unit cost of the products?	never (1.00); rarely (0.80); sometimes (0.60); often (0.40); always (0.20)
Business learning	Firm's age	How old is the firm?	less than 5 years (1.00); between 5 and 10 years (0.75); between 10 and 19 years (0.50); more than 20 years (0.25)
	Type of organization	Which is the type of organization?	It is not used because all the firms are organized
		Is it organized in areas?	no (1.00); yes (0.00)
	Manager's education and experience	How many experience the manager have?	less than a year (1.00); between 1 and 3 years (0.80); between 3 and 5 years (0.60); between 5 and 10 years (0.40); more than 10 years (0.20)
		Manager's education	without training (1.00); primary (0.86); secondary (0.71); expert (0.57); diplomate (0.43); university (0.43); postgraduate (0.29)
		Do you take management training?	never (1.00); rarely (0.80); sometimes (0.60); often (0.40); always (0.20)
	Frequency of management changes	How often are management changes?	always (1.00); often (0.80); sometimes (0.60); rarely (0.40); never (0.20)
	Property`s changes	Do you have property changes?	always (1.00); often (0.80); sometimes (0.60); rarely (0.40); never (0.20)
	Mistakes in decision making	Do you think you have taken wrong decisions in the last year?	all (1.00); many (0.86); too many (0.71); average (0.57); a few (0.43); very few (0.29); none (0.14)
	Management information	How do you take decisions? (all information used)	intuition (1.00); inside information + intuition (0.83); inside information+ accountant (0.67); all factors (0.50); inside information + accountant + auditor (0.33);); inside information + accountant + auditor + external advice (0.17)
	Delays in decision making	How long is the delay in taking decisions?	more than 6 months (1.00); between 3 and 6 months (0.86); between 2 and 3 (0.71); a month (0.57); fifteen days (0.43); a week (0.29); less than a week (0.14)
		How long is the delay in implementing decisions?	more than 6 months (1.00); between 3 and 6 months (0.86); between 2 and 3 (0.71); a month (0.57); fifteen days (0.43); a week (0.29); less than a week (0.14)

(*) It is considered that the investments according to need are similar to the mean in the others categories

Learning and Growth Persp. (a)		Questionnaire (b)	Linguistic labels and cause incidence (c)
	Computerization of the firm	What grade of computerization has the firm?	very low (1.00); low (0.86); almost low (0.71); mean (0.57); almost high (0.43); high (0.29); very high (0.14)
	Information fluidity	Do you think the firm has information fluidity?	very low (1.00); low (0.86); almost low (0.71); mean (0.57); almost high (0.43); high (0.29);

		very high (0.14)
	Do you think it´s easy gather inside information?	very difficult (1.00); difficult (0.86); almost difficult (0.71); mean (0.57); almost easy (0.43); easy (0.29); very easy (0.14)
Type of internal communication	How do you make internal communication? (all you used)	Phone (1.00); orally (0.80); phone + orally (0.60); mail (0.40); daily memo (0.20)
Stakeholders' restrictions	Have the manager restrictions from stakeholders about profits?	always (1.00); often (0.80); sometimes (0.60); rarely (0.40); never (0.20)
Adaptability to change	Do you think you adapt easily to market conditions?	very slow (1.00), slow (0.86); almost slow (0.71); mean (0.57); almost fast (0.43); fast (0.29); very fast (0.14)
Participation of partners	Which is the degree of partners´ participation?	very low (1.00); low (0.86); almost low (0.71); mean (0.57); almost high (0.43); high (0.29); very high (0.14)

Table A.2. Business Process Perspective

Business Process Perspective (a)		Questionnaire (b)	Linguistic labels and cause incidence (c)
Technical efficiency	Oversizing	Do you think the staff is appropriated to develop the activity?	very low/ very high (1.00); low/ high (0.75); almost low/ almost high (0.50); appropriate (0.25)
	Absenteeism	How much absenteeism have your employees?	always (1.00); often (0.80); sometimes (0.60); rarely (0.40); almost never (0.20)
	Work accidents	How often your employees have work accidents?	often (1.00); sometimes (0.80); rarely (0.60); almost never (0.40); never (0.20)
	Productivity	Sales- square meters building- number of employees- qualification of the firm (small, little, medium, big)	two indicators are building: sales/ employees and employees/square meters. The incidence level is estimated through objective´s causes methodology.
	Lead times	Do you have lead times of construction or in the sale?	a lot (1.00); enough (0.80); some (0.60); a few (0.40); neither (0.20)
	Unnecessary costs	Do you think the firm has unnecessary cost? How are they?	very high (1.00); high (0.88); almost high (0.75); mean (0.63); almost low (0.50); low (0.38); very low (0.25); neither (0.13)
	Cost level compared to sector	How is the cost level compared to the sector´s average?	very high (1.00); high (0.86); almost high (0.71); mean (0.57); almost low (0.43); low (0.29); very low (0.14)
	Excess capacity	Do you think the firm is under its building or sale capacity? How many square meters built or how many tons of the first product sales (concrete)? What is the maximum you can built (sq. meters) or sale (tons of concrete)?	more than 50% (1.00); between 30 and 50% (0.80); between 10 and 30% (0.60); between 10 and 5% (0.40); don´t have (0.20) It is proposed to compare the information in the previous question
Purchase policies	Suppliers' choice	How you choice your suppliers? a) According to proximity	always (1.00); often (0.80); sometimes (0.60);rarely (0.40); never (0.20)
		b) According to way and mean time of payment	always (1.00); often (0.80); sometimes (0.60); rarely (0.40); never (0.20)

		c) According to the price	never (1.00); rarely (0.80); sometimes (0.60); often (0.40); always (0.20)
		d) According to quality	never (1.00); rarely (0.80); sometimes (0.60); often (0.40); always (0.20)
		e) According to variety of products	never (1.00); rarely (0.80); sometimes (0.60); often (0.40); always (0.20)
		f) According to excess capacity and continuity in production	never (1.00); rarely (0.80); sometimes (0.60); often (0.40); always (0.20)
	Problems with deliveries	Do you have problems with the delivery of products?	always (1.00); often (0.80); sometimes (0.60); rarely (0.40); never (0.20)
	Stock policies	Do you practice stock policies?	never (1.00); rarely (0.80); sometimes (0.60); often (0.40); always (0.20)
	Suppliers' mean time of payment	Which is the suppliers´ mean time of payment?	pre-payment (1.00); pay down (0.86); 30 days (0.71); 60 days (0.57); 90 days (0.43); 120 days (0.29); more than 120 days (0.14)
Exogenous changes	Political changes	How much are you affected by political changes?	a lot (1.00); enough (0.80); some (0.60); a little (0.40); nothing (0.20)
	Regulatory changes	How much are you affected by regulatory changes?	a lot (1.00); enough (0.80); some (0.60); a little (0.40); nothing (0.20)
	Macroeconomic changes	How much are you affected by macroeconomic changes?	a lot (1.00); enough (0.80); some (0.60); a little (0.40); nothing (0.20)
	Regional economy changes	How much are you affected by regional economy changes?	a lot (1.00); enough (0.80); some (0.60); a little (0.40); nothing (0.20)
	Technological changes	How much are you affected by technological changes?	a lot (1.00); enough (0.80); some (0.60); a little (0.40); nothing (0.20)

Table A.3. Customers Perspective

Customers Perspective (a)		Questionnaire (b)	Linguistic labels and cause incidence (c)
Commercial management	Location	Do you think the location damage your sales?	very much (1.00); much (0.88); enough (0.75); ordinary (0.63); more than a little (0.50); a little (0.38); almost nothing (0.25); nothing (0.13)
	Market reach	What is your market scope?	local (1.00); zone (0.80); region (0.60); state (0.40); all states (0.20)
	Sales payment´s type	Main consumers (diversification): final consumer- SMEs- corporate- public sector	1 customer (1.00); two customers (0.75); three customers (0.50); all type of customers (0.25)
	Clients' mean time of payment	Way of payment	building joint ventures (1.00); current account/ loans (0.80); check/ work registration (0.60); credit card (0.40); cash/ debit (0.20)
		Which is the clients' mean time of payment?	more than 120 days (1.00); 120 days (0.86); 90 days (0.71); 60 days (0.57); 30 days (0.43); pay down (0.29); pre-payment (0.14)
	Contracts	Do you sign contracts with clients?	never (1.00); rarely (0.80); sometimes (0.60); often (0.40); always (0.20)
		Do you sign contracts with suppliers?	never (1.00); rarely (0.80); sometimes (0.60); often (0.40); always (0.20)
	Default portfolio	How is the default portfolio?	very high (1.00); high (0.88); almost high (0.75); mean (0.63); almost low (0.50); low (0.38); very low (0.25); neither (0.13)

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Customer satisfaction	Measure of customer satisfaction	How do you qualify the customer satisfaction?	very bad (1.00); bad (0.83); so so (0.67); good (0.50); very good (0.33); excellent (0.17)
		Which is the average time on non-delivery of works or goods?	more than a month (1.00); 30 days (0.80); between 15 and 30 days (0.60); between 7 and 15 days (0.40); less than a week (0.20)
		Do you meet de delivery of products?	never (1.00); rarely (0.80); sometimes (0.60); often (0.40); always (0.20)
		How do you qualify the degree of customer satisfaction?	very low (1.00); low (0.86); almost low (0.71); average (0.57); almost high (0.29); very high (0.14)
	Delivery service	How do you qualify the delivery of works or goods?	very bad (1.00); bad (0.83); so so (0.67); good (0.50); very good (0.33); excellent (0.17)
	Price level	How do you qualify the price level? (% upper the average price in sector)	very high (1.00); high (0.86); almost high (0.71); mean (0.57); almost low (0.43); low (0.29); very low (0.14)
	Quality level	How do you qualify the quality of your products or works? (% upper the average in sector)	very low (1.00); low (0.86); almost low (0.71); average (0.57); almost high (0.29); very high (0.14)
	Advertising and promotions	Do you think advertising and promotions benefit your sales?	very much (1.00); much (0.86); enough (0.71); average (0.57); more than a little (0.43); a little (0.29); almost nothing (0.14)
		How often do you do advertising and promotions?	never (1.00); rarely (0.80); sometimes (0.60); often (0.40); always (0.20)
	Sectorial evolution	Have you experienced an increased or a fall on the demand in the last year?	very much (1.00); much (0.88); enough (0.75); average (0.63); more than a little (0.50); a little (0.38); almost nothing (0.25); nothing (0.13)
		Is your demand affected by changes in regional economy?	always (1.00); often (0.80); sometimes (0.60); rarely (0.40); never (0.20)
	Substitutes	Is your demand affected by changes in the way of construction and the development of new products?	always (1.00); often (0.80); sometimes (0.60); rarely (0.40); never (0.20)
	Competition	Do you think your demand is affected by competition?	always (1.00); often (0.80); sometimes (0.60); rarely (0.40); never (0.20)
		How do you qualify the sector´s competition?	very high (1.00); high (0.88); almost high (0.75); mean (0.63); almost low (0.50); low (0.38); very low (0.25); there isn´t competition (0.13)
	Sector experience	Market knowledge	very low (1.00); low (0.86); almost low (0.71); average (0.57); almost high (0.29); very high (0.14)

Table A.4. Finance Perspective

Finance Perspective (a)		Questionnaire (b)	Linguistic labels and cause incidence (c)
Use of assets	Budgetary control	How often do you do budgetary controls?	never (1.00); sometimes (0.88); biennially (0.75); annually (0.63); quarterly (0.50); monthly (0.38); weekly (0.25); daily (0.13)
		How often do you make the cash flow?	never (1.00); sometimes (0.88); biennially (0.75); annually (0.63); quarterly (0.50); monthly (0.38); weekly (0.25); daily (0.13)

	Financial planning	Do you make financial planning?	never (1.00); sometimes (0.88); according to need (0.78); biennially (0.67); annually (0.56); quarterly (0.44); monthly (0.33); weekly (0.22); daily (0.11)
	Taking financial decisions	Do you take financial decisions?	never (1.00); rarely (0.80); sometimes (0.60); often (0.40); always (0.20)
	Search for short and long term funding	Do you search long term funding?	never (1.00); rarely (0.80); sometimes (0.60); often (0.40); always (0.20)
	Capital contribution frequency	How often do you take capital contributions?	never (1.00); sometimes (0.88); biennially (0.60); annually (0.40); according to need (0.20)
Risk management	Projects above possibilities	How often do you make projects above firm´s financial possibilities?	always (1.00); often (0.80); sometimes (0.60); rarely (0.40); never (0.20)
	Guarantees	How is the firm´s guarantee?	very high (1.00); high (0.88); almost high (0.75); mean (0.63); almost low (0.50); low (0.38); very low (0.25); neither (0.13)
		Which type of guarantees the firm has to use?	neither (1.00); mutual guarantee society (0.80); assets of the firm (0.60); mixture (personal and the firm) (0.40); personal assets (0.20)
	Financial history	If the firm has financial history: Do you think affect the business development?	nothing (1.00); very little (0.86); little (0.71); average (0.57); enough (0.43); much (0.29); very much (0.14)
	Risk aversion	Do you take a profit loan in term and rate?	always/ never (1.00); often/ rarely (0.67); according to need (0.33)
		How often do you take personal loans to finance your own projects?	always/ never (1.00); often/ rarely (0.67); according to need (0.33)
Results of activity	Type of financing	How often do you use each of these types of financing? a) Bank overdraft b) Trade credit c) Short term loan d) Discount documents e) Leasing	always (1.00); often (0.80); sometimes (0.60); rarely (0.40); never (0.20)
		f) Long term loan g) Loan programs h) Reinvested income i) Capital contribution j) Venture capital k) Friends and relatives contribution	never (1.00); rarely (0.80); sometimes (0.60); often (0.40); always (0.20)
	Wage level	How are the wages according to the average of the sector or the wage agreement?	very high (1.00); high (0.86); almost high (0.71); mean (0.57); almost low (0.43); low (0.29); very low (0.14)
	Shareholders remuneration	How is the firm dividend policy?	according to need (1.00); annually (0.80); twice a year (0.60); quarterly (0.40); monthly (0.20)
		How is the shareholders' remuneration?	according to need (1.00); with wage without planning the withdraws (0.67); with wage and with planning of the withdraws (0.33)
		How do you think is the shareholders remuneration according to the business activity?	very high (1.00); high (0.80); appropriate (0.60); low (0.40); very low (0.20)

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Liabilities	Type and frequency of the liabilities: (a) Trade; (b) Labors; (c) Financial; (d) Taxes; (e) Pensions	always (1.00); often (0.80); sometimes (0.60); rarely (0.40); never (0.20)
	Category debtor in the financial system	in justice (1.00); default (0.80); refinancing (0.60); current (0.40); without debt (0.20)
	Category tax debtor in Argentina (Resolution 019/07)	6- in justice (1.00); 5- more than 10.000 (0.86); 4- between 5001 and 10000 (0.71); 3- between 3001 and 5000 (0.57); 2- between 1501 and 3000 (0.43); 1- between 500 and 1500 (0.29); 0- without debt (0.14)

Table A.5. Membership matrix of causes (P)

	Learning and Growth																								
	Business learning															Innovation and technology			Labor quality				Cost optimization		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
E1	.25	1.0	.50	.20	.20	.50	.86	.33	.29	.43	.29	.36	1.0	.20	.43	.12	.57	.13	.83	.83	.57	.60	.50	.20	.67
E2	.25	.50	.43	.20	.20	.17	.14	.83	.29	.14	.14	.14	.60	.20	.14	.50	.57	.13	.75	.75	.57	.60	.33	.20	.17
E3	.25	.50	.36	.20	.20	.17	.14	.50	.43	.50	.29	.50	.73	.20	.29	.53	.43	.13	.61	.61	.79	.60	.83	.20	.17
E4	.25	.50	.44	.20	.20	.67	.14	.83	.43	.50	.57	.50	.80	.20	.57	.29	.14	.13	.67	.67	.14	.60	.83	.20	.50
E5	.25	.50	.36	.20	.60	.17	.14	.67	.57	.43	.57	.71	.47	.60	.71	.39	.57	.13	.83	.83	.71	.80	.33	.40	.50
E6	.25	.80	.36	.20	.40	.17	.14	.50	.29	.21	.57	.36	.53	.80	.57	.47	.57	.13	.56	.56	.57	.60	.17	.20	.17
E7	.25	.50	.36	.20	.40	.17	.14	.50	.29	.21	.57	.36	.53	.80	.57	.47	.57	.13	.56	.56	.57	.60	.17	.20	.17
E8	.25	.50	.36	.20	.40	.17	.14	.50	.29	.21	.57	.36	.53	.80	.57	.47	.57	.13	.56	.56	.57	.60	.17	.20	.17
E9	.75	.50	.50	.20	.20	1.0	1.0	.83	.29	.14	.43	.43	.60	.20	.57	.47	.14	.63	.67	.67	.43	.80	.17	.20	.67
E10	.25	1.0	.23	.20	.20	1.0	.14	.50	.43	.21	.57	.64	.60	.20	.14	.61	.57	.38	.72	.72	.57	.60	.17	.20	.17
E11	.25	.50	.44	.40	.40	1.0	.14	.83	.29	.36	.57	.21	.50	.60	.29	.24	.57	.25	.50	.50	.14	.60	.83	.20	.83
E12	.50	1.0	.64	.20	.20	.83	1.0	.83	.57	.36	.57	.57	.60	.20	.71	.58	.57	.63	.83	.83	.71	1.0	.83	.20	.83
E13	.25	.50	.50	.20	.20	.17	.29	1.0	.43	.29	.71	.57	.60	.20	.57	.53	.57	.63	.75	.75	.29	.80	1.0	.20	.17
E14	.50	1.0	.36	.20	.20	.33	.43	.83	.43	.29	.57	.71	.60	.20	.57	.53	.57	.63	.75	.75	.57	.60	1.0	.40	1.0
E15	.75	.50	.50	.20	.20	.83	.43	.33	.43	.36	.43	.43	.50	.20	.57	.35	.57	.25	.58	.58	.57	.80	.50	.20	.67

	Business process																
	Technical efficiency									Purchase policies				Exogenous changes			
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
E1	.25	.40	.29	.47	.20	.60	.13	1.0	.57	.73	.20	1.0	.86	.20	.20	1.0	1.0	.20
E2	.25	1.0	.57	.07	1.0	.20	.25	.20	.57	.47	.40	.40	.71	.60	.60	.60	.60	.60
E3	.25	.40	.43	.73	.07	.60	.50	.70	.43	.53	.60	.60	.71	.60	.80	.80	.80	.20
E4	.25	.40	.43	.13	.87	.40	.50	.60	.57	.43	.60	.40	.71	.40	.60	.80	.80	.20
E5	.25	.40	.43	.33	.73	.60	.63	.60	.57	.53	.60	.60	.64	.60	.60	.80	.60	.20
E6	.25	.40	.29	.27	.67	.60	.63	.40	.57	.47	.60	1.0	.57	.80	.80	.80	.80	.40
E7	.25	.40	.29	.60	.53	.60	.63	.40	.57	.47	.60	1.0	.57	.80	.80	.80	.80	.40
E8	.25	.40	.29	.53	.60	.60	.63	.40	.57	.47	.60	1.0	.57	1.0	.80	.80	.80	.40
E9	.50	.60	.71	1.0	.13	.60	.63	.20	.43	.47	.60	.40	.71	.80	1.0	.80	1.0	.20
E10	.25	.60	.43	.67	.27	.80	.25	.80	.57	.60	.20	.60	.60	.80	.80	.80	.80	.80
E11	.25	.40	.14	.20	.93	.40	.25	.60	.43	.33	.60	.20	.79	.20	.80	.60	.80	.20
E12	.25	.40	.14	.93	.33	.60	.63	.20	.43	.70	.40	1.0	.71	.60	.60	.80	.80	.20
E13	.25	.40	.14	.80	.40	.40	.63	.20	.57	.57	.40	.60	.71	.60	.60	.80	.80	.20
E14	.25	.40	.29	.87	.47	.60	.63	.60	.57	.53	.40	.60	.57	.60	.80	.80	.80	.20
E15	.25	.40	.29	.40	.80	.40	.63	.60	.57	.53	.40	.80	.71	.60	.80	.60	.60	.20

	Customers perspective														
	Commercial management						Customer satisfaction		Quality and prices			Sectorial evolution			
	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58
E1	.13	1.0	.20	.43	.38	.70	.20	.37	.43	.57	.83	.50	.23	.20	.25
E2	.13	.60	.60	.43	.25	1.0	.20	.31	.43	.57	.39	.25	.33	.20	.25
E3	.13	1.0	.60	.43	.25	.40	.40	.26	.29	.71	.44	.75	.41	.20	.25
E4	.25	.80	.73	.57	.38	.50	.40	.42	.43	.57	.44	.38	.70	.20	.25
E5	.13	.20	.73	.79	.75	.60	.20	.37	.57	.57	.73	.63	.49	.20	.25
E6	.38	.20	.60	.71	.63	.20	.40	.48	.43	.57	.90	.13	.81	.20	.25
E7	.38	.20	.60	.71	.63	.20	.40	.48	.43	.57	.90	.13	.81	.20	.25
E8	.38	.20	.60	.71	.63	.20	.40	.48	.43	.57	.90	.13	.81	.20	.25
E9	.13	1.0	.80	.43	.13	.90	.40	.37	.43	.57	1.0	.75	.51	.20	.25
E10	.63	.60	.60	.57	.25	.40	1.0	.42	.57	.57	.73	.38	.71	.60	.75
E11	.75	.80	.55	.43	.38	.80	.40	.47	.29	.86	.39	.38	.58	.20	.25
E12	.13	.80	.40	.57	.75	.80	.60	.52	.57	.57	.59	.75	.51	.20	.25
E13	.38	1.0	.50	.29	.50	.90	.40	.43	.57	.57	.83	.63	.51	.20	.75
E14	.13	.80	.40	.43	.38	.70	.40	.32	.43	.57	.83	.75	.51	.20	.25
E15	.13	.80	.60	.57	.50	.50	.40	.48	.57	.57	.83	.50	.61	.20	.50

	Finance													
	Use of assets					Risk management				Results of activity				
	59	60	61	62	63	64	65	66	67	68	69	70	71	72
E1	.63	.78	1.0	1.0	.20	.20	.49	.86	1.0	.67	.86	.28	.27	.69
E2	.25	.22	.80	1.0	.20	.20	.36	.14	.33	.33	.57	.48	.27	.67
E3	.88	.22	1.0	1.0	.80	.40	.26	.14	.83	.33	.71	.20	.17	.64
E4	.69	.44	.60	1.0	.20	.40	.55	.14	.83	1.0	.57	.44	.27	.60
E5	.44	.33	.20	1.0	.20	.60	.61	.14	.67	.20	.71	.72	.63	.69
E6	.13	.11	.80	.80	.20	.60	.55	.86	.83	.67	.71	.44	.27	.51
E7	.13	.11	.80	.80	.20	.60	.55	.86	.83	.80	.71	.44	.27	.51
E8	.13	.11	.80	.80	.20	.60	.55	.86	.83	.80	.71	.44	.27	.51
E9	.38	.33	.80	.20	.60	.20	.65	.14	1.0	1.0	.57	.44	.27	.55
E10	.44	.33	.60	1.0	.40	.20	.65	.14	.67	1.0	.71	.40	.27	.56
E11	.81	.33	.80	.80	.40	.60	.75	.14	.83	1.0	.71	.24	.27	.56
E12	.88	.78	.80	.20	.80	.40	.65	.14	.50	1.0	.57	.40	.27	.58
E13	.88	.78	.80	1.0	.40	.20	.35	.14	.83	.33	.57	.40	.27	.69
E14	.88	.78	.80	.20	.40	.40	.59	.14	.83	1.0	.57	.48	.27	.53
E15	.63	.33	.60	1.0	.40	.40	.65	.14	.50	1.0	.57	.48	.27	.65

(*) This matrix is also available at http://fuzzybusinessdiagnosis.blogspot.com.ar/