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PEDRO GUSTAVO SIQUEIRA FERREIRA

THE COMPREHENSION OF PERFORMANCE MEASUREMENT INDICATORS BY VIRTUAL TEAMS

CURITIBA

2011

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Dissertation presented to the graduate program in Industrial and Systems Engineering (PPGEPS) of the Pontifical Catholic University of Paraná, as partial requirement to obtain the degree of Master of Science in Industrial and Systems Engineering.

Advisor: Prof. Dr. Edson Pinheiro de Lima
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Curitiba, _____ de _____de 2011.

Dedicate this work to everyone that encouraged me during this journey.

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"Coming together is a beginning. Keeping together is progress. Working together is success."

(Ford, Henry)

ABSTRACT

Virtuality has become an integral part of a team's definition and its 'virtual level' affects many variables that are found in its design, implementation and operation. Therefore, new management practices have been developed over the years in order to lead those virtual teams toward companies' goals. This dissertation provides a network analysis of works developed in Performance Measurement applied in virtual teams, analyzing an extract of 3412 articles of 3 scientific databases. Through the use of UCINET, it was created a network for visualization of the *status quo* and provided a vision of future areas to be researched. Through the combination of existing models for performance measurement, it is a proposed and tested methodology to use focus groups for identifying and measuring virtual team's performance perceptions and comprehension. During this research tools such as: questionnaires, focus groups sessions and operations strategy planning techniques were utilized aiming to rank the level of comprehension of such performance measures by different teams and identify factors that may improve their performance towards a higher level. This methodology was applied on 3 case studies, in different countries and under the same management guidelines. The impact of behavior into performance measurement systems is evident. Lack of clear communication, language barriers, miscomprehension of the objectives, Cultural barriers and lack of motivation negatively increase the impact of behavior in performance measurement systems. The identification and correction of these items is crucial for the success of a team.

Key-Words:
Virtual Teams; Performance Measurement; Global; Performance Perception

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1 INTRODUCTION

The nature of teams has changed significantly because of changes in organizations and the nature of the work they do. Organizations have become more distributed across geography and across industries.

A virtual team is a group of people who routinely work interdependently for a joint objective across time, distance, and organization (Serrat, 2009).

Virtual teams are the next logical step in the evolution of organizational structures (Lipnack and Stamps, 1999) and the success in creating a virtual world depends on how clearly the objectives have been defined and to what extent the process necessary for the accomplishment of the objective has been designed (Norton and Smith, 1997).

Globalization and technological advancements have led to an increase in virtual team use over the last decade. Estimates suggest that in the US alone, as many as 8.4 million employees are members of one or more virtual teams or groups (Ahuja and Galvin, 2001).

According to Kimball (1997) managing a virtual team means managing the whole spectrum of communication strategies and project management techniques as well as human and social processes in ways that support the team.

Teams are more effective when members can combine their individual talents, skills, and experiences via appropriate working relationships and processes (Hackman, 1990).

Three elements of virtual teams allow them to achieve their purpose: cooperative goals, interdependent tasks and concrete results. Virtual teams rely upon a clear purpose because of their cross-boundary work. Cooperative goals define the outputs desired, while interdependent tasks connect those desired outcomes to those achieved

Business performance measurement and control systems are the formal, information-based routines and procedures managers use to maintain or alter patterns in organizational activities (Simmons, 2000).

Performance metrics and scorecards scattered horizontally and vertically across a corporation, need to be coherent so that the conversations between people about the strategy is consistent and all the different measurement units contribute to the performance of the corporation overall (de Haas & Kleingeld 1999).

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Organizational and cultural barriers are serious impediment to the effectiveness of virtual teams. Many managers are uncomfortable with the concept of a virtual team because successful management of virtual teams may require new methods of supervision (Jarvenpaa and Leinder 1998). Managing the logistics of communication alone can prevent organizations from developing a common ground.

1.1 THEME AND OBJECTIVES

The theme of this dissertation is perception of Performance Measurement Systems by Virtual teams. This subject is part of Operations Management, focusing in Performance Measurement Systems applying it to another area of study: Virtual Teams.

The general objective of this work is to propose a methodology to measure the level of comprehension of priorities by virtual teams. Virtual teams are units of work distributed around the globe that gather characteristics of associates from diverse cultural and academic background. Due to its global distribution, the teams have members from different cultures and speaking different languages, which make more complicated the communication of such priorities.

The specific objectives are:

- Review the literature about Performance Measurement Systems applied to Virtual teams, analyzing papers from important databases, extracting works with relevance to the proposed field of study mapping the author's that contributed to the science;
- Propose a methodology to measure the adherence of Performance Measurement Systems comprehension by Virtual Teams;
- Test this methodology in a global virtual team environment, obtaining ideas to improve the methodology making it replicable in other companies.

1.2. JUSTIFICATION

A team is a cooperative unit of interacting individuals who are committed to a common purpose on tasks; endowed with complementary skills, for instance, in technical competence, problem-solving ability, and emotional intelligence; and who

share interdependent performance goals (with indicators and deadlines) as well as an approach to work for which they hold themselves mutually accountable.

The main benefit of virtual teaming is that it allows organizations to be more flexible and procure talent from different functions, locations, and organizations without geographical restrictions.

Although the technology that supports these new teams gets most of the attention when we talk about virtual teams, it's really the changes in the nature of teams - not their use of technology - that creates new challenges for team managers and members. Most "virtual" teams operate in multiple modes including having face-to-face meetings when possible. Managing a virtual team means managing the whole spectrum of communication strategies and project management techniques as well as human and social processes in ways that support the team.

Understanding how to work in or lead a virtual team is becoming a fundamental competence for people in many organizations. People who lead and work in virtual teams need to have special skills, including an understanding of human dynamics, knowledge of how to manage across functional areas and national cultures, and the ability to use communication technologies as their primary means of communicating and collaborating.

Business performance measurement has a variety of uses. Bititci, Carrie and Turner (2002) list the following reasons companies measure business performance:
- To monitor and control
- To drive improvement
- To maximize the effectiveness of the improvement effort
- To achieve alignment with organizational goals and objectives
- To reward and to discipline

As the distance between team members' increases, so do differences in time zones. This makes communicating and collaborating at the same time problematic. Working across national boundaries complicates the situation because differences in language, culture, and access to technology impede effective communication and collaboration.

To those teams is given the "authority" to interpret the importance of the competitive dimensions and therefore act accordingly. Therefore, in such environment, increases the possibility of miscomprehension of the strategy

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implemented as well as misuse of its tools, such as performance indicators and metrics.

The lack of alignment between operational metrics and organizational objectives and strategies; and metrics that drive the wrong behaviors and performance (Van Aken and Coleman, 2002).

1.3. RESEARCH METHOD

The Research Method is presented in two aspects: classification of the type of research, detailed description of every phase of the research, techniques and tools utilized.

The work presented in the first article was executed as a theorist-exploratory research, in which a review of the *state of the art* was conducted aiming to identify an area to be developed.

For the second article, it was conducted again an exploratory research in which it was proposed a model to be followed aiming to identify the level of comprehension of some concepts and indicators.

In the third article it was conducted a social-exploratory research using focus group sessions, in order to validate the proposed model and extract conclusions of its use.

In the last stage of this dissertation a conclusion of this work was drawn and suggestion of some works were identified for future researches.

1.4. RESEARCH DELIMITATION

This work was conducted on a global team distributed in 4 main centers (United States, Malaysia, Brazil and Hungary), therefore it was restricted to this scenario. For future research, the methodology followed in this research may be replicated to other companies and proposed adjustments to this methodology aiming to make it applicable to other companies' virtual environment. As well as a long term study to document the evolution of the companies across time, with the ability to point out strategies that would work and create actions linked to the graphs.

1.5. WORK STRUCTURE

This dissertation is structured into scientific articles format. Following a three article structure described in Figure 1.

The first chapter provides a general introduction, theme, general and specific objectives.

The second chapter presents the first article, where a review of the state of the art about Performance Measurement applied to virtual teams. Using UCINET, it was created a network for visualization of the *status quo* and provided a vision of future areas to be researched and the appearance of new authors for such fields, suggesting the next path to be followed by performance measurement researchers

The third chapter presents the second article, this article proposes a methodology to measure the level of comprehension of priorities by virtual teams, through the combination of existing models for performance measurement, it is a proposed and tested methodology to use focus groups for identifying virtual team's performance perceptions and comprehension. Preliminary findings show that virtual teams could express their perception about companies' goals and performance requirements.

Articles	Objective	Contribution	Method	Result
Article 1	Review the literature about Performance Measurement and Virtual Teams in 3 large scientific databases, map the authors that contributed to the science and provide future areas of research	The literature review promote a perspective on the actual research status of Performance Measurement applied to Virtual teams, setting the ground for future articles and justifying the research	Literature research, network analysis and graph analysis.	Identification of GAPs in the performance measurement literature applied to virtual teams and proposition of area for future researches.
Article 2	propose a methodology to assess virtual teams and to measure their level of comprehension of their priorities and test in a pilot environment	Described the methodology aiming to be replicated in a larger environment, other than the pilot one. Provide first findings that would be important for future use of the methodology in larger audience	Literature review, focus group, pilot environment implementation, performance x importance matrix.	Creation and test of the proposed methodology, refining of the methodology for larger teams implementation
Article 3	Test the proposed methodology in a team, distributed in four locations (Brazil, Malaysia, Hungary and United States), working virtually, following the same process and under the same management	Applied the methodology in a larger environment, obtaining good finidngs to make it able to be replicated in other companies. Also created a plan of action to the tested team.	Literature review, focus group, larger environment implementation, performance x importance matrix, graph area analysis	Implementation of the methodology proposed in the article 2 in a larger team, creation of a plan of action to improve communication and comprehension in the tested team.

Figure 1 – Dissertation's article structure

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The fourth chapter presents the third article, in this article the proposed methodology is applied to larger team. The methodology was applied on 3 case studies, in different countries and under the same management guidelines. The impact of behavior into performance measurement systems became evident. In the fifth chapter the main conclusions are presented and the author suggests next steps and future research topics.

2 ARTICLE 1

Overview of performance measurement in virtual teams' literature

Article submitted to:

Management Decision

(also approved a shorter version in ICIEOM 2010)

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Abstract:

This paper provides a network analysis of works developed in Performance Measurement applied in virtual teams, analyzing an extract of 3412 articles of 3 scientific databases. It employs a citation/co-citation analysis of work in the field of performance measurement to explore developments based in a defined set of keywords. Through the use of UCINET, it was created a network for visualization of the *status quo* and provided a vision of future areas to be researched and the appearance of new authors for such fields, suggesting the next path to be followed by performance measurement researchers.

The paper indicates that the link between performance measurement and virtual teams is still weak and identifies the key contributors to the field based on the extracted articles' data analysis and it argues that due to constant globalization of companies and creation of teams in different locations, creating multi-cultural virtual teams, new areas of study must be developed aiming to continue Performance Measurement use improvement. This paper is valuable to anyone that wants to have a present and systematic view of Performance Measurement studies and possible areas for future works when applied to virtual teams.

Keyword: Performance Measurement, Metrics, Virtual Team, Citation analysis, Operations Management

2.1 INTRODUCTION

Neely and Lewis (2005) define performance measurement as the process of quantifying the efficiency and effectiveness of action and also demonstrated that themes as quantification and the impact of lead in performance measurement were still under discussion 30 years after publication.

These recurring themes appear to have resulted in frequent "re-discoveries" of Drucker's suggestion that balanced measurement systems should be developed (Drucker, 1954).

Neely and Lewis (2005) verified that throughout the 1980's and early 1990's, numerous authors suggested measurement frameworks that might be appropriate, such as the performance pyramid (Lynch and Cross, 1991), the results versus determinants framework (Fitzgerald *et al.*, 1991), the performance measurement matrix (Keegan *et al.*, 1989) and of course, the balanced scorecard (Kaplan and Norton, 1992). The result was that a dominant research question in the mid 1990's, at least for Neely's research in the operations management community with an interest in performance measurement, was "How can these so-called "balanced performance measurement systems" be developed and deployed?"

Later on, Pilkington and Meredith (2009) worked on a citation and co-citation analysis. Their work gathered data to show the growth of academic publication of articles related to Operations Management. It also made evident that the most studied disciplines by 2009 were basically the same exposed by Neely and Lewis (2005), as can be seen in exhibit 1. It demonstrated that the search for the ideal methodology to manage through performance is still vivid in the academic society.

Factor name (cum var expl. %)	Overall		By decade[*]					
	Total (%)	Rank	1980–1989		1990–1999		2000–2006	
1. Manufacturing Strategy (25)	44.2	1	39.1	1	52.2	1	40.3	1
2. Quality and its Metrics (35)	11.0	3	4.7	5	9.7	3	11.9	3
3. Statistical Methods (43)	11.2	2	0.4	10	4.1	4	15.5	2
4. Process Design (49)	9.5	4	25.0	2	14.9	2	6.1	5
5. Services (54)	3.8	6	6.3	4	3.8	5	3.7	8
6. Flexibility (59)	3.3	8	0.8	9	3.3	6	3.5	9
7. Qualitative Methods (62)	4.9	5	0.0	11	2.9	8	6.1	4
8. Supply Chains (65)	3.0	9	1.2	8	1.4	11	3.9	7
9. Product/Service Innovation (67)	1.9	11	2.3	7	1.3	12	2.2	10
10. RBV (70)	3.4	7	0.0	12	1.7	10	4.4	6
11. Measures/Balanced Scorecard (71)	2.4	10	3.5	6	3.0	7	2.0	11
12. Inventory Control (73)	1.3	12	16.8	3	1.9	9	0.3	12

Exhibit 1 – Loading of co-citation onto factor/knowledge (Pilkington and Meredith , 2009)

Mesa (2005) indicates that globalization barriers have been reduced over the years. He also gathered data to demonstrate that companies are seeking for globalization at a younger age, resulting in a massive number of new global companies.

Mcbryde and Mendibill (2003) stated that in order to gain a good understanding of the performance of teams, it was required to search and analyze literature from different research disciplines, such as, social psychology, organizational psychology, socio-technical theory, organizational change and strategy and performance management.

According to Grundy and Ginger (1998), it has been shown that something like 7 per cent of the full meaning of our communication is contained in the words we use. Reading (e-mail) can therefore convey only a fraction of the meaning of our communication. Another 38 per cent is conveyed in the tonality of the spoken word, so hearing someone speak, for example on the phone, conveys up to 45 per cent of the meaning. The remainder of the meaning is conveyed by our physiology, or "body language", totally missing from electronic communications like e-mail, phone and fax.

Bejarano *et al.* (2006) researching virtual teams, identified that cultural differences matters, promoting impact in performance result at different levels. It also demonstrated that 50% of workers feel that *tête-à-tête* contact is still necessary for developing a good work environment.

Serrat (2009) defines virtual teams as a group of people who routinely work interdependently for a joint objective across time, distance, and organization (to these three dimensions some add culture).

From the main definitions and concepts (as the ones above), a list of keywords will be extracted in order to base the research for articles that will be part of this spreadsheet from which connections between these theories will be established and diagrams drawn, in order to identify how strong are the links between these theories.

The comprehension of implementation/use of operations strategy by virtual teams can be divided into three different levels: Strategic, Comprehension and Dimensions of Development, and each of these levels will have multiple areas (Figure 2).
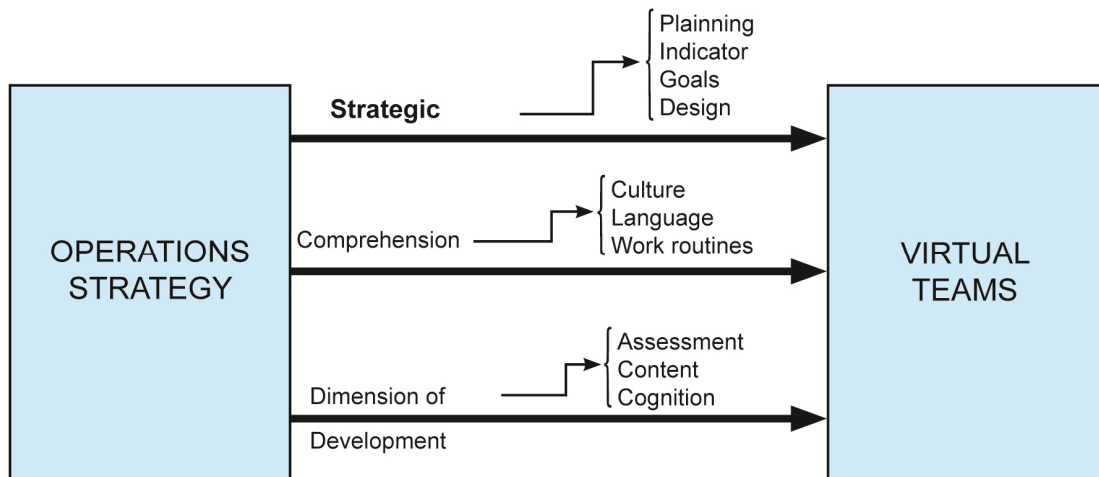
Figure 2 – Link between Operations Strategy and Virtual teams

This research aims to show that the link between Strategic Alignment, Performance Measurement and Virtual Teams is still weak and a deeper research in this area is still valid. Therefore due to constant globalization of companies and virtualization of teams, a theme that we suggest to be included in the researched topics is: The impact of virtual teams in performance measurement results.

As an initial assumption, it will be take as valid that the literature for this specific field would lack of research in this area.

These definitions were used to extract a word list in order to be used as article searching criteria.

Using the software UCINET (Borgatti *et al*, 1999), a social network was created to design and provide a visual analysis of the links between themes, authors and publications. Through the analysis of centrality, proximity and normalization of the actors (most cited authors in the literature review for this paper), areas of knowledge will be defined and distance between these will be calculated aiming to have a better graphic view of the literature approach over Operations Strategy

2.2 RESEARCH METHODOLOGY

In this section it will be described the methodological approach, the methodological strategy and the research planning and development.

Flynn *et al* (1990) argues that there is a gap between operations management theory and practice, and that information derived from actual practice can enhance Operations Management research in a number of ways. Gathering systematic

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information about practices in Operations Management provides information about the state of the art in Operations Management.

The scientific method used in this work is based on the citation and co-citation analysis of the literature review, identifying what are the research themes, representative authors and the most important journals that could characterized the research, which interconnects strategic alignment, performance measurement, 'globalization' and 'virtual teams'.

The methodology should provide an understanding of how the research was organized and conducted. The following topics provide an overview of the studies developed in areas related to the presented work, they also explain the techniques and procedures utilized to capture data, describing how data was collected, processed and analyzed.

The technique used to review the theoretical structure of measurement systems that are being used in virtual global teams is a bibliographic citation and co-citation analysis.

According to Price's classic theory of knowledge growth, scientific researchers constitute a "research front" by focusing their attention, as expressed by their references, to a small select part of the most recent literature (De Solla Price, 1965; Cozzens, 1985).

Bibliographic co-citation analysis is a popular similarity measure used to establish a subject similarity between two items. A co-citation is taken to verify if two references or authors appear in the same bibliography, that is, "if A and B are both cited by C, they may be said to be related to one another, even though they don't directly reference each other" or "if A and B are both cited by many others, they have a stronger relationship". The more items are being cited, stronger their relationship is. It is interpreted as measure of content similarity of two references or authors. The number of co-citations determines the proximity of any two publications in terms of content. Co-citation was first proposed in the fields of citation analysis and bibliometrics as a fundamental metric to characterize the similarity between documents (Gmur, 2003).

Co-citation analysis enables the identification of scientists groups and their publications, and for conclusions to be drawn about the inner structure of research disciplines, schools or paradigms (Small and Griffith, 1980).

Braam *et al.* (1991) consider co-citation analysis as an attempt to identify "high density areas" in a citation network by clustering highly co-cited documents, thus indicating the existence of these research fronts. The citing literature of co-citation clusters is then considered to correspond to the group of publications that can be described as a subject-matter-specialty's published current work (Small and Griffith, 1974; Griffith *et al.* 1974).

Co-citation analysis is based on the premise that heavily cited articles are likely to have exerted a greater influence on the subject than those less frequently referenced (Sharplin and Mabry, 1985; Culnan, 1986) and thus they are indicators of activity or importance to the field. As such, according to White and Grifith (1981), co-citation analysis represents "the field's view of itself", as it is represented in Figure 2.

TERM FREQ		TERM FREQ		
T1	3	T1	2	Words occuring in a 'central' publications citing documents of only one specific co-citation cluster
T3	2	T4	2	
T4	2	T6	2	
T5	2	T7	2	
T2	1	T8	2	
		T2	1	
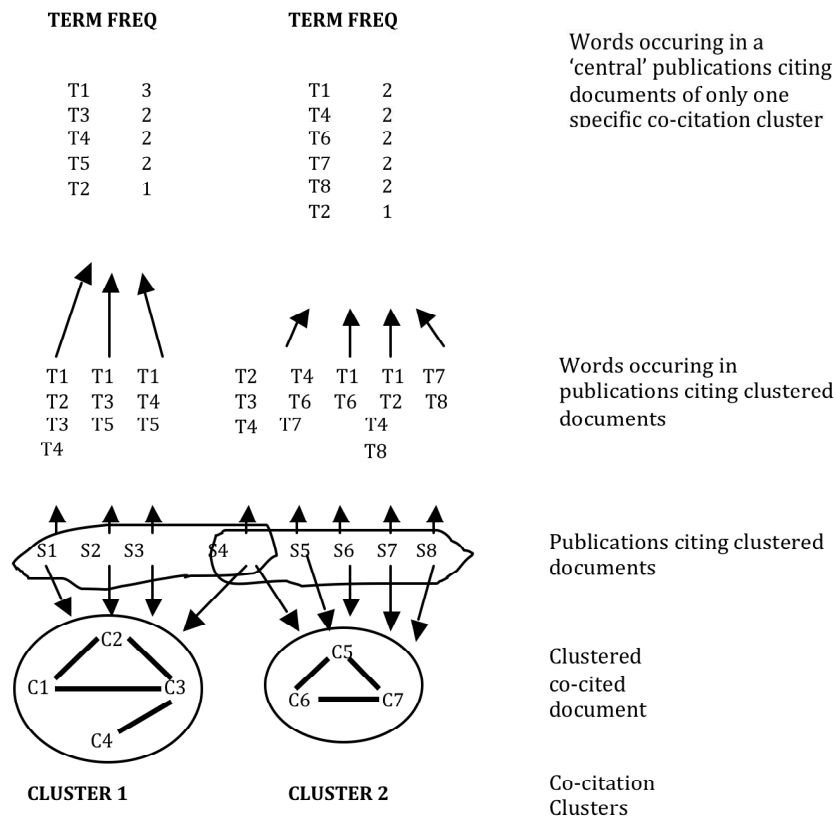
Figure 3 – Research topics in co-citation clusters (source: Braam et al., 1991)

Braam *et al.* (1991) concluded that a combination of content-analysis and co-citation analysis offers a useful instrument to describe, evaluate and compare results of co-citation analysis in a systematic and clear way, particularly when it concerns aspects related to cognitive content of publications.

The approach selected for this theoretical review is to determine the co-citation frequency from a range of articles in selected databases, bounded by an initial disciplinary delimitation (Gmur, 2003).

In order to perform the research in this work, it was organized into steps that accomplished different milestones:

Step 1: Create a selection of entry keywords that provide a complete overview of the researched subject area, identifying databases that can provide good quality articles and representative authors that contributed to the state of the art in such area.

Step 2: Collect citation and co-citation data (author, published institution, year of publication, keywords and references) from selected articles of the results when used the entry keywords in the keyword list, defined in the previous step, using the search engines of the selected databases.

Step 3: The data collected in the previous step is used to prepare a spreadsheet, which contains the counts of citation per author that will be utilized as a model for network analysis in specialized software. For this research it was used UCINET due to its connection with NETDRAW, making possible the visualization of the network and relative simplicity to operate this application. The software provides a network graph that has the appropriate functionalities for a network analysis required in this research.

Step 4: The graphs and network information as centrality and proximity are outputs of UCINET. These outputs were used to understand the graph NETDRAW.

	Step 1	Step 2	Step 3	Step 4
	Selection of Database and keywords	Collection of citation & co-citation data	Social Network graph draw	Analysis of the graph
Description	Selection of keywords and academic databases to gather bibliographical data about Performance Measurement	Collection of citation and co-citation hits from the database search engines when using the wordlist	Insert data into Social Network graph draw application and extraction of two graphs to further analysis.	Analysis of the graph and comparison with mental model in figure 1.
Tool	- Spreadsheet - Selected databases	- Spreadsheet to compile the data	- UCINET - Spreadsheet	- Spreadsheet

Exhibit 2 - Research planning steps

The kick-off for the research is the definition of a keyword list that will come from a literature review of the subjects part of the foundation topics in this research.

2.3 THEORETICAL FOUNDATIONS

Aiming to create a theoretical base for this research, a literature review was conducted on the subjects: Strategic Alignment, Performance Measurement and Virtual Team Management. The goal is to provide an overview which will make possible the comprehension of the theme of this research and the impact of its results.

2.3.1 Operations Strategy

Over time some questions arose in the operations strategy literature, covering areas as:

- Promotion evaluation level (Luftman, 2000; Teo and King,1997);
- Influence of behavior variables (Brodbeck and Hoppen, 2003; Henderson and Venkatraman, 1993);
- Dynamic process versus static process (Brodbeck and Hoppen, 2003);
- Performance Measurement System (PMS) creation for alignment evaluation (Luftman, 2000; Ciborra, 1997).

Despite recent studies about stages and levels of operation's strategic alignment (Luftman, 2000; Teo and King, 1997), maturity levels of operation's strategic alignment (Teixeira, 2003; Luftman, 2000), criticism about the existing models to evaluate the adherence of the operation's strategic alignment (Maes *et al.*, 2000; Ciborra, 1997) and the fact that strategic alignment is ranked as priority to most executives (Pricewaterhouse, 2003; Gartner Group, 2002), the operation's strategic alignment is still misunderstood and most companies do not fully implement it (Brodbeck *et al.*, 2005).

Fortunately, the number of academics who make this mistake is rapidly declining. The number of powerful and increasingly well-articulated arguments that illustrate the contribution of operations to strategic success that have come from authors such as Skinner (1969), Hayes and Pisano (1996) etc., have convinced of the importance of operation's strategic alignment. However, there are many

practitioners and many businesses that either do not fully understand their argument or have to be convinced of such importance around this subject.

Slack *et al.* (2004) attempted to compare the topics covered in papers published in two leading American and European operations management journals between 1990 and 2002 and their relevance for practitioners activities. They found that in most of them the content for academic and practitioners diverge as shown in Exhibit 3, demonstrating that researchers and practitioners are interested in different subjects.

Mean practice contribution score	Ranked practice content MBA Survey 2000-2005	Ranked research content Extract from JOM + IJOPM 2000-2003	Combined mean % papers
4.51	Quality & Improvement	Operations strategy	20.25
4.44	Supply chain	Supply chain	14.93
4.15	JIT/lean	Quality & Improvement	10.45
4.00	MRP/ERP	Performance measurement	7.14
3.97	Planning & control	Process technology	6.63
3.69	Process design	Product/service design	6.45
3.35	Operations strategy	Job design	5.06
3.33	Capacity	JIT/lean	3.97
3.12	Performance measurement	Planning & control	3.75
3.00	Inventory	Process design	2.64
3.00	Product/service design	Inventory	1.86
3.00	Process technology	Failure/risk	1.49
2.85	Job design	Maintenance	0.81
2.58	Failure/risk	Capacity	0.63
1.92	Maintenance	Layout	0.33
1.63	Layout	MRP/ERP	0.31

Exhibit 3 - Practitioner and research priorities (Slack et al., 2004)

According to Slack et al. (2004), it is not difficult to justify the importance of the strategic perspective of 'operations' on business as a whole. No other functional strategy has such a direct impact on both revenue and cost. The popularization of ideas such as TQM and lean production established in both practitioner and research arenas the belief that operations practice must pursue the twin objectives (even if to different extents) of improving aspects of service such as quality, variety, responsiveness etc., while at the same time reducing costs. Given the business maxim that "profit is a very small number made up of the difference between two very big numbers", any subject that claims to increase revenue and reduce costs must demand the attention of companies that can appreciate its potentially disproportionate effect on profitability.

Hrebiniak and Joyce (1984) argued that a successful implementation of strategy depends on this integration and the development of short-term operating

objectives that relate to strategic plans. Therefore, once the importance of Operations Strategy is comprehended, the company must define the performance dimensions.

Bititci *et al* (2001) defined a process to identify tools and techniques to evaluate the performance and sensitivity of alternative strategic choices, aiming to facilitate:

- identification of factors affecting performance,
- identification of the relationship between factors affecting performance,
- quantification of these relationships on one another, and on the overall performance of the business, and
- "what if" analysis on business performance and strategy selection.

Suggesting a three steps approach, displayed in Figure 4.

Step 1
Identification of factor affecting performance and their relationship

Tools: Cognitive maps

Step 2
Structuring the factors hierarchically

Tools: Cause and effect diagrams and structured diagrams

Step 3
Quantifying the effects of factors on performance

Tools: Analytic hierarchy process
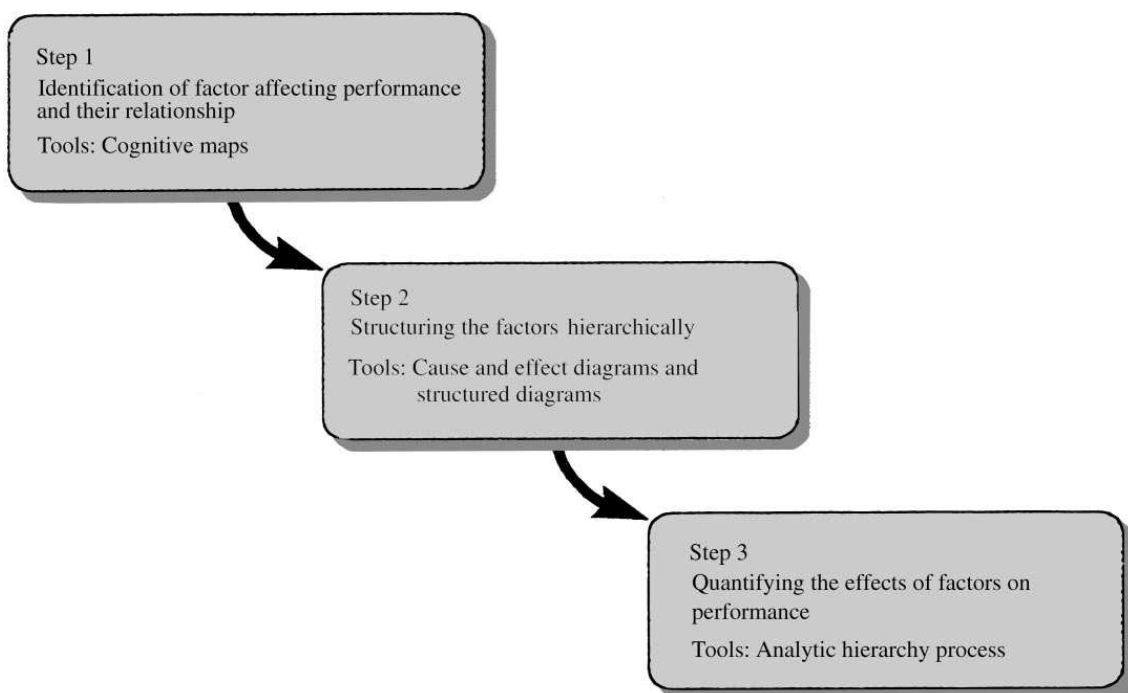
Figure 4 - Framework of the Quantitative Model for PMS approach (Bititci et al, 2001)

According to Roy (2001), minimizing misunderstandings in part involves accurately predicting and explaining our own and other's behavior within the context of the communication that is occurring. Inherent in these definitions are several assumptions. First, individuals hold cognitive notions about what comprises communication competence. Second, individuals form expectations of others' behavior and then use these expectations to judge their own and others'

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communication competence. Third, expectancies vary depending on the cultural and situational context. Finally, the degree to which the ideal meets the expected is the degree to which behavior is judged competent.

There are many variables that affect the understanding of the Operations Strategy by the employees of a company in its implementation/use, as culture, communication, strategic alignment and behavior.

Variables as Culture and Communication (spoken language, mental model, etc), both determined by the external environment and employees' country, therefore influenced by an external environment, can not be controlled by any company and it will have a fixed coefficient when analyzing the level of comprehension of operations strategy by a specific region.

In order to guarantee the strategic alignment and organizational routines, the company executives have to rely on the country executives and managers for such region, since their alignment to the company policy will determine if the impact of this variable will be greater or lower in the overall comprehension of the operation's strategy, therefore these variables suffer influence of the operational environment.

In this paper, these variables will be called contingency variables and will be distributed in different levels of effect to the comprehension of the operations strategy, depending on the level of impact such variable has in the overall goal (Figure 5)

Figure 5 – Distribution of variables that affect the comprehension of strategy

As showed in the Figure 5, if a variable is close to the core (comprehension of the operations strategy), it indicates that this variable has a stronger effect over the core.

The particularity of each indicator must be taken under consideration when constructing the performance measurement system, as well as where and how the management intends to use it (region, language, culture). In order to make these decisions, the PMS builders must know which variable they will have impact on the indicator and create the set of indicators based on these variables.

2.3.2 Performance Measurement

In a competitive market, where customers demand high quality in the services/products, higher efficiency and low cost, companies prepare themselves to develop systems to optimize processes, reduce cost and identify new business opportunities. Performance measurement are processes that through the collection of information and development of indicators help the decision making process, directing it to a more precise strategy, putting the expected and actual result each time closer.

An important requirement of a PMS is that there must be a clear link between performance measures at the different hierarchical levels in a company, so that each function and department strives towards the same goals. One example of how this link can be achieved is the performance pyramid, i.e. the SMART system (Exhibit 4), proposed by Cross and Lynch (1991).
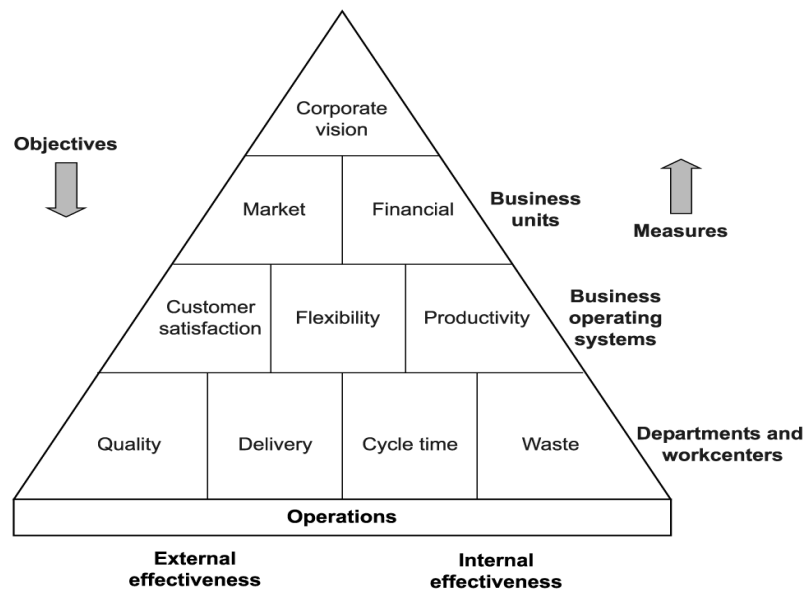
Exhibit 4 - Performance Pyramid (Source: Cross and Lynch, 1991)

Neely *et al.* (1995) described performance measurement as the process of quantifying action, where measurement is the process of quantification and action correlates with performance. They further propose that performance should be defined as the efficiency and effectiveness of action, which leads to the following definitions, that have been adopted in this paper:

- Performance measurement is defined as the process of quantifying the efficiency and effectiveness of action;

- A performance measure is defined as a metric used to quantify the efficiency and/or effectiveness of an action;

- PMS is defined as the set of metrics used to quantify the efficiency and effectiveness of an action.

Folan and Browne (2005) describe as the main requirements for a Performance Measurement System:

- Have top management support;

- Involve employees in their development (particularly customer satisfaction measures);

- Ensure that those measures used are relevant to managers and employees in performing their day-to-day jobs;

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- Be part of a feedback loop that links them to manager and employee performance appraisals.

According to Pinheiro de Lima *et* al (2009) Performance measurement system roles comprehension is a key condition for understanding the entire operations strategic management system dynamics and PMS design recommendations are in constant evolution, therefore it should be reviewed based on measures use and its integrations to operations strategy process.

Maskell (1992) suggests that world-class performance measures should:

- Primarily use non-financial performance techniques;

- Vary between locations;

- Change over time as the company needs change;

- Are intended to foster improvement rather than just monitoring.

According to Neely (1999) the techniques used in Performance Measurement Systems are important to guarantee the alignment of the strategy throughout the company, maintain the company in the market and to present products with more value added to it. The pressure that the environment and its market present, forces the companies to innovate the methodology of their work, in order to keep them competitive in the market. The evolution of the Performance Measurement System will help in the development and improvement of the existing techniques, making possible the application of such systems in a diverse number of different companies.

According to Toni and Tonchia (2001), the main models of PMS can be referred to under one of five typologies:

- PMSs that are strictly hierarchical (or strictly vertical), characterized by cost and non-cost performance on different levels of aggregation, until they ultimately become economic financial;

- PMSs that are balanced scorecard, where several separate performance measures which correspond to diverse perspectives (financial, customer, etc.), are considered independently;

- PMSs that can be called frustum, where there is a synthesis of low-level measures into more aggregated indicators, but without the scope of translating non-cost performance into financial performance;

- PMSs that distinguish between internal/external performances;

- PMSs that are related to the value chain.

Tangen (2004a) defines that a PMS should:

Support strategic objectives. A PMS should be derived from the company's strategic objectives. Otherwise, the PMS may support actions that have the opposite effect of those implied in the strategy (Tangen, 2002a). Furthermore, it is important to remember that strategies usually change over time and when a strategy changes, some performance measures must change too. There is therefore a need for flexibility in the PMS, which provides a mechanism to ensure that the PMS is coherent with the objectives of the company.

Have an appropriate balance. It is vital that performance is not solely seen from a financial point of view. A PMS ought to consist of various types of performance measures covering all important aspects agreed as representing the success of a company. There must in turn be a balance between the various performance measures in the PMS. Unfortunately, it is not possible to give an exact definition of the term "balance", since it includes several types of "balance" and is highly dependent on each individual case. However a PMS should be appropriately focused on short- and long-term results, different types of performances (e.g. cost, quality, delivery, flexibility and dependability), various perspectives (e.g. the customer, the shareholder, the competitor, the internal and the innovativeness perspective), and various organizational levels (e.g. global and local performance).

Guard against sub-optimization. As the performance measures by which employees are evaluated greatly impact their behavior, an improper set of measurements can lead to dysfunctional or unanticipated behavior (Fry, 1995). In other words, employees seeking to improve the measure of their performance often make decisions that are contrary to the desires of management. For example, it is not rare that an improvement in one area leads to a deterioration in another, even resulting in a decline in overall performance. Skinner (1986) termed this phenomenon the "productivity paradox", where dysfunctional behavior results from poor performance measures. A PMS must therefore guard against sub-optimization, possibly by establishing a clear link from the top of the company all the way to the bottom, to ensure that employee behavior is consistent with corporate goals.

Have a limited number of performance measures. To create appropriate action, it is necessary to use a limited number of performance measures (Jackson, 2000). More measurement demands more analysis time. It is a waste to collect data if they are ignored. It is therefore important to pay attention to limiting the data requirements to both the necessary detail and frequency and to consider whether the

data is needed for a specific useful purpose, and whether the cost of producing it is not higher than its expected benefit (Bernolak, 1997). A large number of performance measures also increases the risk of information overload, it becomes difficult to know which performance measures should be prioritized. This is also a good reason to remove "old" performance measures that are no longer of interest from the PMS.

Be easily accessible. A PMS's main goal is to give important information, at the right time, to the right person. An important point to remember is that the PMS must be designed in such a way that information is easily retrieved, usefully presented and easily understood by those whose performance is being evaluated.

Consist of performance measures that have comprehensible specifications. A performance measure should have a clear purpose and be defined in an unambiguous way along with details of who will use the measure (e.g. collect the data, with what frequency, and how to act on the measure). Furthermore, it is also necessary to specify a target for each performance measure and a timeframe within which that target should be reached.

Tangen (2004a) also defines that flexibility is a key factor to guarantee the quality and efficiency of a Performance Measurement System, therefore the methodology can be adjusted to any changes in the scenario.

Due to constant globalization of companies, it is common to work with virtual teams distributed around the globe. To those teams is given the "authority" to interpret the importance of the competitive dimensions and therefore act accordingly. Therefore, in such environment, increases the possibility of miscomprehension of the strategy implemented as well as misuse of its tools, such as performance indicators and metrics.

2.3.3 Virtual Team Management

Serrat (2009) defines a team as a cooperative unit of interacting individuals who are committed to a common purpose on tasks; endowed with complementary skills, for instance, in technical competence, problem-solving ability, and emotional intelligence; and who share interdependent performance goals (with indicators and deadlines) as well as an approach to work for which they hold themselves mutually accountable.

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Managers of small and large organizations have known the importance of facilitation for successful team process, but few people have really grappled with the issues of trying to manage teams that are connected by distance in space and time. With increasing relevance of distributed communications systems (Internet, Intranets, groupware) in a diversity of working groups' everyday lives, innovators in the field will need to integrate these virtual practices into their current team building strategies as well as learn how to continually improve virtual group process.

A virtual team is a group of people who routinely work interdependently for a joint objective across time, distance, and organization (to these three dimensions some add culture.). There are many types of virtual teams, but probably the most important characteristic is that the members cannot always meet face-to-face (for one reason or another): because of that they rely on (an increasingly powerful array of) interactive technologies.

It is possible to define Global Virtual Team and Virtual Team Performance Measurement as:

- Global Virtual Team: group of committed people distributed globally (global team) from different cultures who work interdependently for a joint objective;

- Virtual Team Performance Measurement: process to quantify the efficiency and effectiveness of a Virtual Team, through a set of defined metrics used as indicator of success of group.

In today's business environment, organizations adapt quickly or die. Gaining competitive advantage in a global environment means continually reshaping the organization to maximize strengths, address threats, and increase speed: the use of teams has become a common way of doing this; the formation of teams can draw talent quickly from different functions, locations, and organizations.

The goal is to leverage intellectual capital and apply it as quickly as possible. The methods that organizations use to manage this process can mean the difference between success and failure.

Duarte and Snyder (2009) concluded that understanding how to work in or lead a virtual team is becoming a fundamental competence for people in many organizations. Virtual teams often are formed as a reaction to a business requirement or as a result of programs, such as telecommuting, that introduce new ways of working.

As the distance between team members' increases, so do differences in time zones. This makes communicating and collaborating at the same time problematic. Working across national boundaries complicates the situation because differences in language, culture, and access to technology impede effective communication and collaboration.

Serrat (2009) determines that the main benefit of virtual teaming is that it allows organizations to be more flexible and procure talent from different functions, locations, and organizations without geographical restrictions. The main drawback owes to lost context, which generates feelings of isolation and undermines trust (especially when members are from different cultures).

Usually members of virtual teams work separately and in some occasions it is possible to have only one member in a country. The isolation reaches the management level, that is responsible for alignment in this multicultural environment.

For Serrat (2009), a key critical success factor for virtual teams is Information Management Systems, which indicates that new management, measurement, and control systems must be designed.

Therefore, to review the theoretical structure over this subject, it was created a list of keywords (based in the authors definition of Global Virtual Team and Virtual Team Performance Measurement, in section 1), showed in Exhibit 5 that are related to virtual teams, performance measurement systems, and strategic alignment (operations strategy).

#	Keyword
1	Performance Measurement System
2	Performance Measurement
3	Performance Indicators
4	Metrics
5	Software Services
6	Licensing
7	IT Asset Management
8	Behavior AND Commitment
9	Culture
10	Global Team

Exhibit 5 – Keywords used in the research

Every publication that contained at least one of the entry keywords in its title, keywords or abstract was identified and downloaded. This search identified 3412 articles published in 85 different journals. The earliest paper included in the dataset was published in 1984 and the most recent in 2009.

2.4 RESEARCH DEVELOPMENT

From this list of publications, data will be compiled and a network analysis will be done, aiming to map and classify the study areas around this subject.

Citation data of this research has been taken from leading periodicals of selected databases, based on their size of articles entries, region that they are more used, aiming to extract articles with relevance to the studied theme. Exhibit 6 identifies the selected databases. These databases were selected because of their solid relationship with operations management academic literature that defines the broad scope of this paper.

Name	Website	Region
Scielo	www.scielo.org	Latin American
Science Direct	www.sciencedirect.com	International
Emerald	www.emeraldinsight.com	International

Exhibit 6 – Scientific databases used in this paper

The available literature in databases as Scielo, Science Direct and Emerald, will be used to this study aiming to identify the level of commitment of recent and heritage researches about operations strategy that take under consideration these variables.

All data was checked for errors and adjusted accordingly, with particular care taken to standardize differing forms of citation for the same authors and documents. For the calculation of co-citation networks, the references were reduced to those cited in at least 20 times and cluster formation on the basis of the maximum absolute co-citation counts. The highest 23 counts were selected from the co-citation matrix, since the difference in counts would create a considerable gap between the top 23 group and the rest of the authors.

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The most-cited references within the data set also occupy a central position in the network of co-citation relations. According to Gmur (2003), within this network, differentiation of subfields of research is not possible.

Before the network analysis was conducted, a substantive review of the generated dataset was undertaken through reviews of abstracts to check if the content of the article matched the goal of this research, after the abstract review the list of articles was drafted according to their adherence to this research subject (use of Performance Measurement System in Virtual Teams). After this review the database counted 82 articles distributed according to Exhibit 7.

#	Keyword	# entries after review	# entries initial
1	Performance Measurement System	36	494
2	Performance Measurement	19	1046
3	Performance Indicators	14	698
4	Metrics	1	12
5	Software Services	0	671
6	Licensing	4	275
7	IT Asset Management	1	31
8	Behavior AND Commitment	1	2
9	Culture	6	181
10	Global Team	0	2
		82	3412

Exhibit 7 – Articles before and after the 'substantive review'

After the abstract review, articles were read, to confirm their relevance to the research and the following data gathered in a spreadsheet, recording the following information database: title of article, authors, journal/book/document, year of publication, keywords, References.

Among the 82 articles, the search captured 3191 citations, in 876 papers. The most cited authors in this research can be seen in the Figure 6.
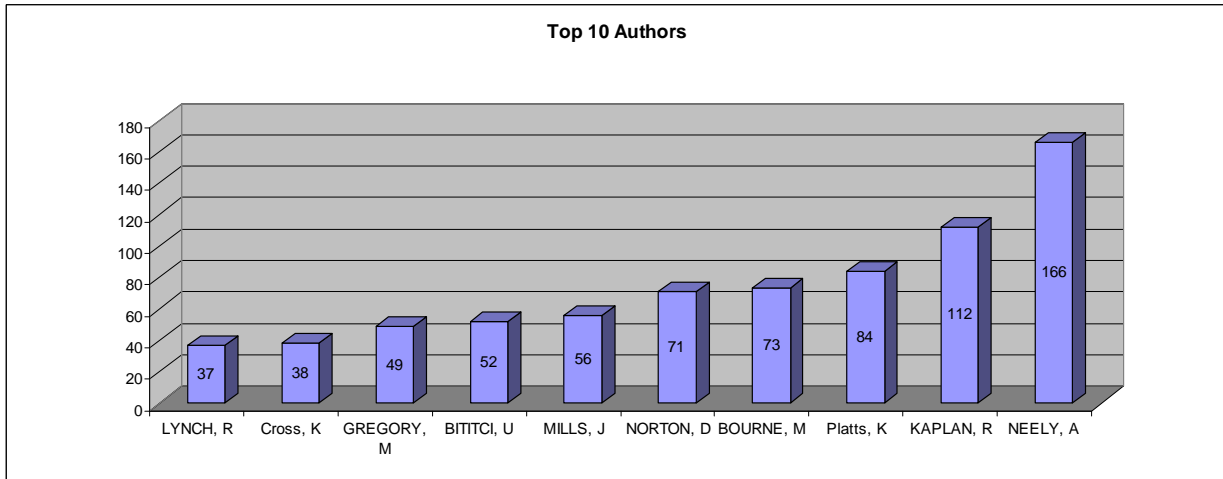
Figure 6 – Graph with top 10 authors cited in the extracted dataset

The spread of journals in from which citations appeared is interesting. In total, the citations were drawn from 85 different journals; the most frequent cited journals are indicated in the Exhibit 8.

Classification	Journals	# citations	Percentage
International	International Journal of Operations and Production Management	203	15.96%
International	Management Accounting Research	142	11.16%
International	Harvard Business Review	132	10.38%
International	Strategy+Business	52	4.09%
International	Organizations and Society	51	4.01%
International	International Journal of Production Economics	45	3.54%
International	Journal of Operations Management	41	3.22%
International	Strategic Management Journal	34	2.67%
International	International Journal of Production Research	29	2.28%
International	Information & Management	28	2.20%
International	Information and Management	28	2.20%
International	Sloan Management Review	25	1.97%
International	Management Science	23	1.81%
International	Supply Chain Management	21	1.65%
International	Measuring Business Excellence	21	1.65%
International	Long Range Planning	20	1.57%
International	Industrial Engineering	20	1.57%
International	Management Decision	19	1.49%
International	Academy of Management Review	17	1.34%
International	The Accounting Review	17	1.34%

Exhibit 8 - Most frequent journals

Most frequent journals from which citation were extracted are international journals, having 36% of it concentrated in three main journals: International Journal of Operations and Production Management, Management Accounting Research and Havard Business Review, after these the percentage drops in 50% to the fourth most cited journal, ranking those as the most important vehicle of information about Performance Measurement System.

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2.4.1 Analysis of the dataset using UCINET

Since the purpose here was to display the results graphically, it was looked for recent techniques that have been developed based on graph theory in social network analysis (Scott, 1991; Wasserman and Faust, 1994) to visualize relationships such as linkages among publications present in the co-citation data (Leydesdorff, 1987).

The resulting graphs were produced using NETDRAW software that comes with UCINET package (Cross et al., 2002).

UCINET is a software used to identify, represent, analyze and visualize nodes from various types of input data through social network analysis.

The visual representation of social networks is important to understand network data and convey the result of analysis in a faster and simpler way than analyzing multiple spreadsheet or tables.

The graphs are representations of the links in the co-citation matrix and are produced by first reducing all the co-citation values to binary zeros and ones, with the strength of the links added later in the form of line thicknesses. The position of the nodes on the graph results from the spring-based algorithm of Kamada and Kawai (1989). This seeks to iteratively reduce the stress in the graph by altering the position of the nodes, co-locating it with strong linkages between them, and dispersing nodes without link between them.

Brandes (2001) defines Centrality as an essential tool for the analysis of social networks. This index is designed to rank the actors according to their position in the network and interpreted as the prominence of actors embedded in a social structure. Many centrality indices are based on shortest paths linking pairs of actors, measuring, e.g., the average distance from other actors, or the ratio of shortest paths an actor lies on. Many network-analytic studies rely at least in part on an evaluation of these indices.

The dataset used in this paper was created through the distribution of hits in the citation and co-citation measures, in which authors were cited in other papers. The result was displayed in a spreadsheet and filtered for entries with more than 20 hits, aggregating 23 top authors.

The density of lines close to an author's name indicates frequency with which this author was referenced in scientific articles. The resultant network (shown in Figure 7) contains three broad groups of authors. The central group consists of

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classic authors, referenced in most articles (Neely, Platts and Kaplan). The second group consists of authors that are leaving this denser center or increasing researches and starting to be cited by others, it can be called as second level author's zone (Bourne, Gregory, Mills, Norton). The third group is the watch list, they have been cited a considerable amount of times, but did not create much literature yet in performance measurement, however are considered candidates to join the emerging zone and possibly becoming a classic author in the future.
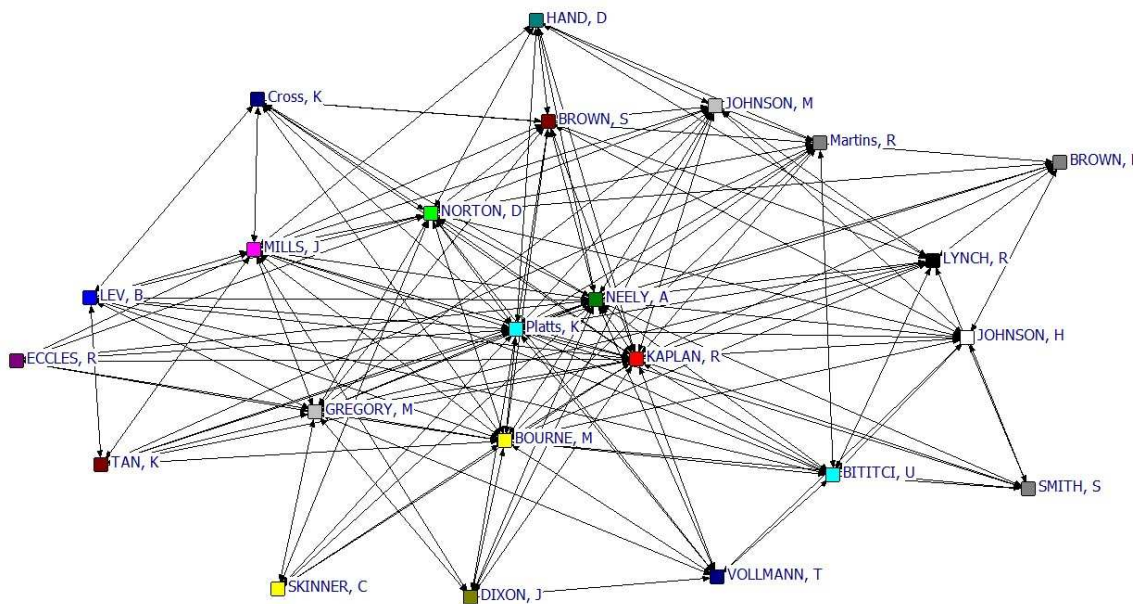
Figure 7 – Network of the 23 top authors in the selected papers

The relatively dense network at the center of the Figure 7, suggests that the main authors are Nelly, Platts and Kaplan. Diverging of Neely and Lewis's (2005) findings in his work "The evolution of performance measurement research" with the inclusion of Ken Platts that developed his studies in a more behavioral approach of Performance Measurement, indicating a new tendency in the literature.

This finding is a good indication that in the future new authors will start appearing in a denser center of this network, but classic researchers as Neely, Kaplan and Norton will continue to be cited due to their importance to the subject. This will make the center denser with more authors making part of the classic group and emerging group.

Figure 8 explores the hypothesis by presenting a social network of keywords for the most frequently cited works (only works with over 20 citations are included in

this analysis). It emphasises that significant associated work has been carried out in the fields of operations management, strategy and performance measurement.
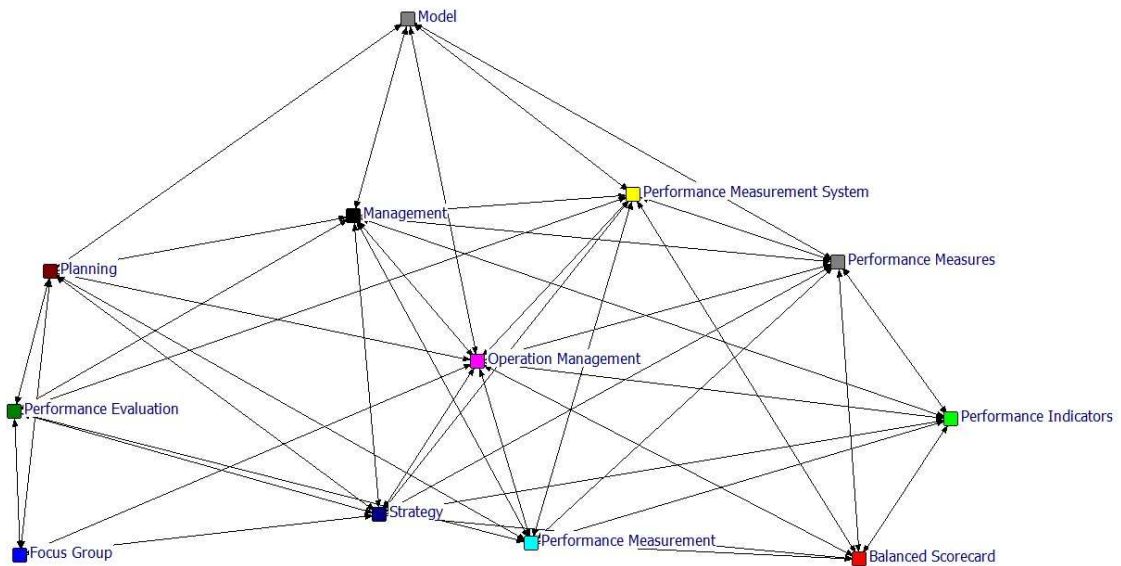
Figure 8 - Keyword analysis for most influential works

This network graph still maintained the dense center with words as: Operations Management, Strategy and Performance Measurement. Although, it can visualized new words as focused groups and management, indicating a increased in the research for subject that contains them.

The concept of node centrality was used to identify subjects were used as keywords in researches most frequently, therefore used as basis for such research.

For the data in the graph of the Figure 8, we have the following numbers presented in Exhibit 9.

Subject	Degree	sum	% relative	% group
Operations Management	10	10	11.63%	11.63%
Management	9	19	10.47%	
Strategy	9	28	10.47%	
Performance Measurement System	8	36	9.30%	
Performance Measurement	8	44	9.30%	
Performance Measure	8	52	9.30%	60.47%
Planning	7	59	8.14%	
Performance Indicators	6	65	6.98%	
Balanced Scorecard	6	71	6.98%	
Performance Assessment	6	77	6.98%	
Model	5	82	5.81%	
Focus Group	4	86	4.65%	100.00%

Exhibit 9 - Degree of centrality for selected keyword list

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Observing the numbers we can compare Figures 7 and 8, by defining certain values, as the subjects that should be placed in the center circle would be subjects that represents alone more than 10% of keyword entries, in the second circle would stay the subjects that alone does not represent more than 10%, but together represents more than 60% of keywords entries, in the third circle would reside subjects all other subjects.

Comparing Figures 7 and 8 (inserting Figure 7 over Figure 8), we will have the graph below:
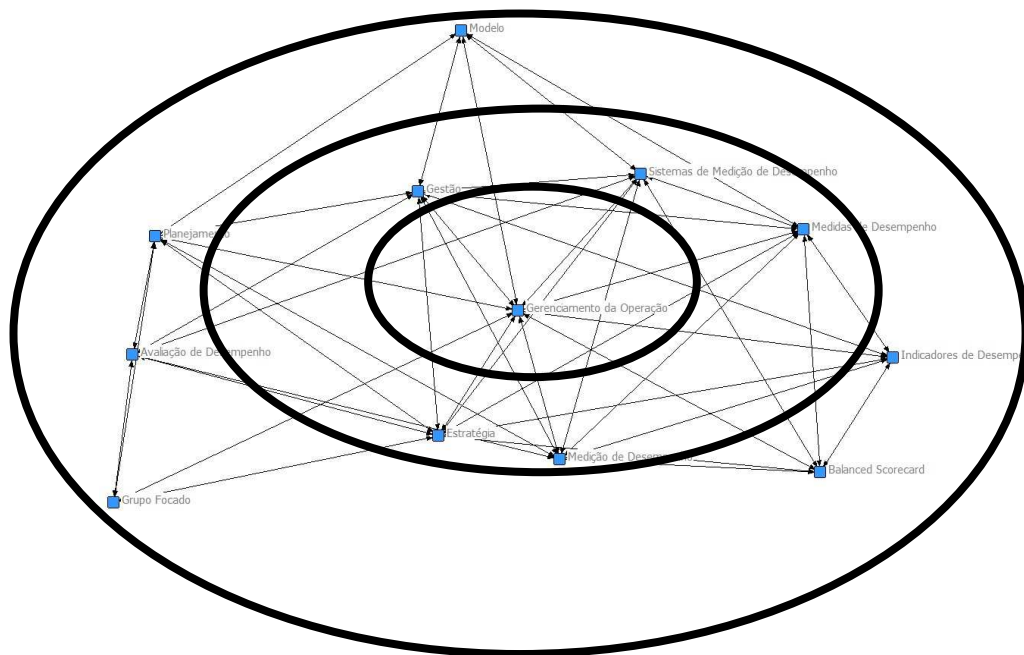
Figure 9 – Comparison of Figures 7 and 8

We would have the following separation:
- Core: Operations Management.
- Operational Environment: Management, Strategy, Performance Measurement, Performance Measurement System and Performance Measures.
- External Environment: Focus Group, Performance Assessment, Planning, Model, Performance Indicators, Balanced Scorecard.

It can be inferred that activities as Planning, generation of indicators, Performance assessment must be addressed locally to a better result, since they are far from the center which implies that they are influenced by Communication and

Culture. Therefore we conclude that the Performance Measurement Systems must have a part to be defined according to the local it will be used or it will not be prepared for Multi-Cultural Global teams.

Activities as Strategy, the performance measurement system itself, must be addressed by the operational management in an upper level than locally, probably a council formed of local management members, trying to gather as much variation as possible.

The Operations Management though, must be addressed in a global management level having the corporate goals as main base and cascading this information to the council formed of local management members, so they can create the strategy and the performance measurement system.

It can be expected that in the near future words as: virtual teams, global companies and global measures, to be included in this network. Because there are raising new areas of expertise and virtual teams management certainly is one of them. For Goldsmith (2000), the leader of the future must have the following characteristics:

- Thinking Globally;
- Appreciating Cultural Diversity;
- Demonstrating Technological savy;
- Building partnerships and alliances;
- Sharing Leadership.

There appears to be a reasonably integrated set of themes that individual researchers are exploring – most particularly those associated with the relationship between organizational strategy and measurement, same result found by Neely and Lewis (2005).

Neely and Lewis (2005) stated that related developments emphasized that it is not just within the organization the future research efforts need to focus on. Given increasing tendencies to outsource (either offshore or onshore) then organizations become ever more dependent on their supply chains and/or networks – hence the rise of research exploring the issue of how to measure supply chain performance (Beamon, 1999).

However the outsourcing observed nowadays is the frequent creation of support centers around the world, using less expensive and more qualified workforce from developing countries.

Exhibit 10 summarizes the number of publications per year on the papers related to the keywords searched.

Number of publications / year
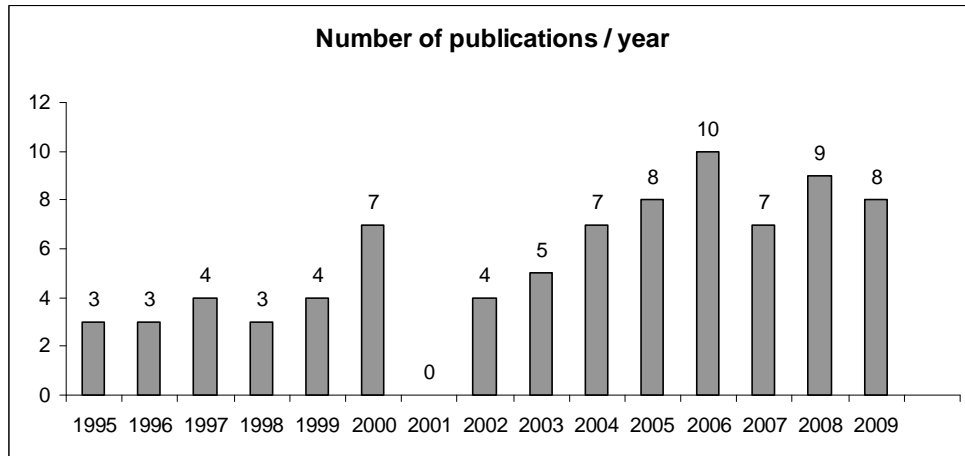
Exhibit 10 - Distribution of publication across the years

These data have to be interpreted with caution for two reasons. First, it was used only 3 databases in this paper; others may contain more information on different publications. Second, there is arguably an increasing tendency in the academic community to publish, since there are more journals, congresses, colleges, researchers. With these caveats in mind, however, it is evident the interest for topics that includes the keywords used in this paper. The number of publications doubled in the last five years, which indicates a growing search for themes related to Performance Measurement and its applications in teams.

2.5 CONCLUSION

Relative to the goals in this study, it was analyzed papers from three important databases, extracting works with relevance to the proposed field of study. In early stages it was supposed that the literature for this specific field would lack of research in this area.

In the section 4of this article, it was made evident, through the network analysis, that a Ken Platts, appeared in the center of the distribution, if compared to Neely and Lewis's work in 2005. Platts usually research for more approach driven

techniques, while others continue to search for improving Performance Measurement System .

The authors expects for the upcoming years that new researchers become part of a denser center of the network distribution, although classic researchers as Andy Neely, Robert Kaplan and David Norton, continue to be cited in future works due to the importance of their research to the theme.

Due to the influence of difference factors, It was evident the division of Operation Management decisions in Global Management level, Management Council (made of different location managers) and local level (*ie.* Indicators). If these division are respected and worked together, through a single process, the management can expect better results of the use of Performance Measurement Systems.

Based on the fast growing field and lack of literatue, It is also expected new keywords as: virtual teams, human factor, behavior and culture, start to Figure in similar network analysis in the upcoming years. This would demonstrate the new path that PMS are going to follow, since each year the number of global companies increases.

It is important to emphasize the limitations of this research, since it was used 3 of the most important databases. It is possible that other databases may have articles that were not used in this research and a different set of words would provide a different result.

In general, the work conducted in this paper can be replicated in future researches with broader dataset to validate the outcome presented in the paper and therefore make evident the need for researches in the proposed field.

Overall the paper aims to show that the link between Strategic Alignment, Performance Measurement and Virtual Teams is still weak and a deeper research in this area is still valid, proposing a methodology to be followed and analyzing the data through network analysis concepts, since this type of analysis is each time more common in the scientific community.

This research contributes to the scientific community by pointing a new area of Performance Measurement that requires more attention due to the constant growth of virtual teams and its impacts in the company's numbers. It also make evident the transition of research areas and researchers through the inclusion of new keywords and researchers, working on modern subjects for this new way of business (virtually and remote managed).

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3 ARTICLE 2

Developing a Methodology For Assessing Virtual Teams Performance Perception

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Abstract:

Virtuality has become an integral part of a team's definition and its 'virtual level' affects many variables that are found in its design, implementation and operation. Therefore, new management practices have been developed over the years in order to lead those virtual teams toward companies' goals. Thus, this guidance process could require a performance measurement system to continuously monitor how close teams are in attaining a set of predefined objectives. Although due to barriers such as language, culture and expertise, objectives are not always fully understood or attended by virtual teams located in different countries and regions, reducing a companies' overall performance. Through the combination of existing models for performance measurement, it is a proposed and tested methodology to use focus groups for identifying virtual team's performance perceptions and comprehension. Preliminary findings show that virtual teams could express their perception about companies' goals and performance requirements, and could also improve their commitment to companies' operations strategy by performance gaps assessment.

Keyword: Virtual Teams, Operation Strategy, Performance Measure, Comprehension

3.1 INTRODUCTION

Organizations have become more distributed across geography and across industries. The nature of teams has changed significantly because of changes in organizations and the nature of the work they do. Relationships between people inside an organization and those previously considered outside as customers, suppliers, and managers of collaborating organizations, among other stakeholders; are becoming more important. Organizations have discovered the value of collaborative work. Aiming to increase the potential of teams and due to the advances in technology, a growing number of organizations are adopting a structure with virtual teams.

Virtual team work is a concept that has matured through a long evolutionary process. While organizations emerge and claim to have adopted the modus operandi of virtual teams, the reality is that conventional face-to-face modes of operation will remain the organizational norm for some time to come (Carmarinha-Matos and Afsarmanesh, 2005; Arnison and Miller, 2002; Maznevski and Chudoba, 2000).

The virtuality level of a team has become an integral part of a team's definition. Many variables are affected by the virtual level of a team such as: commitment to execute a task, team identity, organizational climate and level of stress (Martins *et al.*, 2004).

Face-to-face team members are more cohesive (Huang *et al.*, 2003), have stronger social ties (Warkentin, Sayeed and Hightower, 1997), are more dedicated to the task and to other team members (Olson and Teasley, 1996), have a stronger team identity (Bouas and Arrow, 1996) and have more affection for other team members (Weisband and Atwater, 1999), than in virtual teams.

Strong social ties in virtual teams can be achieved but will take longer time than in face-to-face teams (Burke and Chidambaram, 1996). Many researchers have attempted to find the reasons why virtuality has a negative influence on team output: frequency and distance (Cramton and Webber, 1999), the fact that team members are not familiar with one another (Gruenfeld *et al.*, 1996), the difficulty in sharing information, and insufficient and confusing discussions (Thompson and Coovert, 2003). Another group of researchers compared communication technologies, assuming that technology limits information (Straus and McGrath, 1994).

The comparisons concluded that face-to-face teams are more efficient than teams using video (Andres, 2002), and video communication is more efficient than audio (Burke *et al.*, 2001), adding text into video or audio communication improves performance (Baker, 2002), and satisfaction (Olson, Olson and Meader, 1997). Maruping and Agarwal (2004) show that teams tend to use different sorts of communication technologies for different kinds of interpersonal interactions.

Ferreira *et al* (2010) researched Performance Measurement Systems (PMS) applied to virtual teams and concluded that there are not many studies in this area or models to evaluate the adherence of PMS to such teams.

The need for works that clarify, improve communication of performance measures and that take a more practical approach of performance measurement systems by the academic population was stated by Tangen (2005) who declared that the field is filled with practitioners with no conceptual models and weak operational definitions; the field is filled with academicians with weak conceptual models and no operational definitions. The result has been confusion in literature and in practice with no respect to performance measurement and improvement.

Throughout this paper the goal is to deliver a methodology that aims to measure the adherence (level of comprehension) of Performance Measurement Systems in global virtual environment, for further investigation in order to identify reasons for poor adherence and ways to improve and test in a pilot team. Doing this, will identify the gaps of the performance perception.

3.2 THEORETICAL FOUNDATION

The theoretical foundation of this research is divided into 3 sections: Operations Strategy, Performance Measurement and Virtual Teams, aiming to provide the basis for comprehension and impact of this research, as well as reporting studies in these areas.

3.2.1 Operations Strategy

The strategy of an organization describes the way it will pursue its goals given the threats and opportunities in the environment and its resources and capabilities (Rue and Holland, 1989).

Strategy is broad, long-term, aggregated, and the concern of the most senior management in the business. Operations, on the other hand, are detailed, complex, concerned with day-to-day issues, and carried out by those towards the lower levels of the organizational hierarchy.

The earliest influences on operations strategy (Skinner, 1969; Hayes and Wheelwright, 1984; Hill, 1984) were all essentially manufacturing strategy works. In fact it would have been called 'production' or 'manufacturing' management, and was concerned exclusively with the core business of producing physical products.

According to Slack *et al* (2004), starting in the 1970s and 1980s the term operations management became more common. It was used to reflect two trends. First, and most importantly, it was used to imply that many of the ideas, approaches and techniques traditionally used in the manufacturing sector could be equally applicable in the production of services. The second use of the term was to expand the scope of 'production' in manufacturing companies to include, not just the core processes that directly produce products, but also the non-core production-related processes that contribute to the production and delivery of product.

Slack *et al* (2004) also identified that there is a 'practitioner' trend that tells a different story. This is because products and services are merging. Increasingly, product manufacturers are seeking either to grow or protect their profitability by enhancing the service elements of their customer offerings. Within the manufacturing sector, the lack of serious development in service strategy is impairing operations strategy's contribution.

It is not difficult to justify the importance of the strategic perspective of 'operations' on the business as a whole. No other functional strategy has such a direct impact on both revenue and cost.

The interest in operations strategy has paralleled the growth of interest in resource-based (Wernerfelt, 1984; Barney, 1991; Mahoney and Pandian, 1992) or capability-based (Teece and Pisano, 1994; Teece et al., 1997) models of competitive strategy. The overlaps between operations strategy and resource-based driven views of general strategy are often explicit. Prahalad and Hamel (1990), for example, defined their 'core competencies' as "collective learning…especially how to co-ordinate diverse production skills and integrate multiple streams of technologies".

Organizations face significant constraints and contingencies from their external environments and their competitiveness depends on their ability to monitor the environments and adapt their strategies accordingly (Boyd and Fulk,1996).

According to Tangen (2004), a Performance Measurement System should: support strategic objectives, have an appropriate balance, guard against sub-optimization, have a limited number of performance measures, be easily accessible and consist of performance measures that have comprehensible specifications.

Wall (2006) and Wall and Coevert (2007) states that implementing a performance management system increases organizational results but that certain conditions have to be satisfied to actually achieve this benefit, where one of these conditions has to do with behavioural factors.

Ferreira *et al* (2010) distributed the contingency variables in different levels of effect to the comprehension of the operations strategy, depending on the level of impact such variable has in the overall goal as stated in Figure 10.
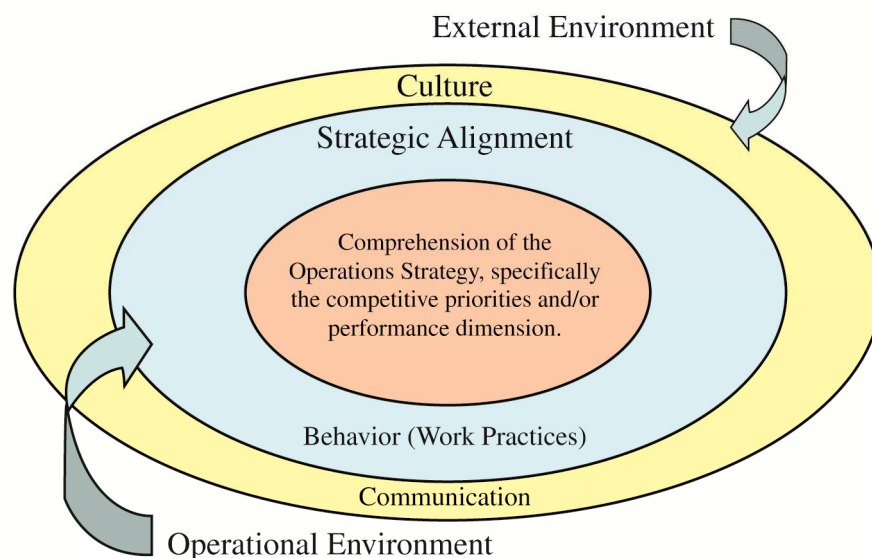
Figure 10 – Distribution of Variables that Affect the Comprehension of Strategy

As showed in the Figure 10, if a variable is close to the core - comprehension of the operations strategy; it indicates that this variable has a stronger effect over the core.

Per Ferreira *et* al (2010), the comprehension of implementation/use of operations strategy by virtual teams can be divided into three different levels: Strategic, Comprehension and Dimensions of Development, and each of these levels will have multiple areas, as it is shown in Figure 11.

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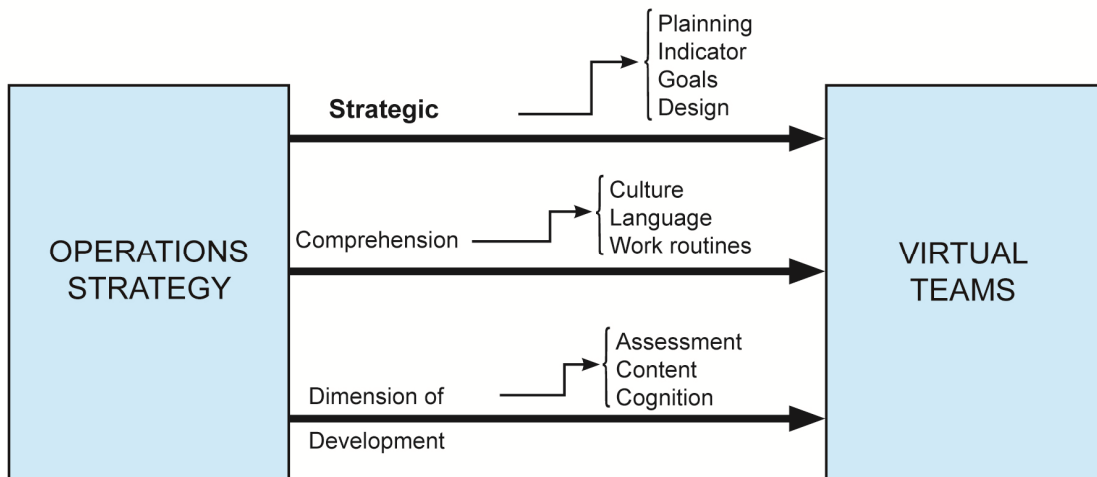
Figure 11 – Link between Operations Strategy and Virtual Teams

Hrebiniak and Joyce (1984) argued that a successful implementation of strategy depends on this integration and the development of short-term operating objectives that relate to strategic plans. Therefore, once the importance of Operations Strategy is comprehended, the company must define the performance dimensions.

3.2.2 Performance Measurement

The re-evaluation of the importance of manufacturing with the aim of achieving competitive advantages and on the other hand, the assertion that the pursuit of excellence requires an equilibrated mix of performances (Kaplan and Norton, 1992) and pressure to continuously improve (Dixon et al., 1990), rather than mere attention to determinate standards of efficiency, suggest that the present day performance measurement and control systems should be reconsidered (Hall et al., 1991; Lynch and Cross, 1991).

Traditional operational measures emphasize variance-to-standards rather than encouraging continuous improvement (Fisher, 1992), and they are hardly ever directly related to company's manufacturing strategy as they are too detailed (White, 1996): they are necessary indicators of synthesis, referring both to single production processes and to the entire production process of the firm (De Toni and Tonchia, 1996), which regard the new manufacturing contexts, where competition is on several issues (Flapper et al., 1996; Ghalayini and Noble, 1996). Thus the logic of "trade-off" has been overtaken (Schmenner and Vollmann, 1994), by the

consideration of a set of competitive priorities to which are linked performances oriented not only towards efficiency (i.e.the productivity of the resources) but also to the dimension of time (time-to-market, reliability, flexibility) (Gerwin, 1993; Kumar and Motwani, 1995) and quality (product performances and product conformance) (De Toni et al., 1995).

There are several frameworks, which encourage executives to pay attention to the horizontal flows of materials and information within the organization, i.e. the business processes, most notably those proposed by Brown (1996) and Lynch and Cross (1991). Brown's framework, which is shown in Figure 12, is useful because it highlights the difference between input, process, output and outcome measures. He uses the analogy of baking a cake to explain this more fully.
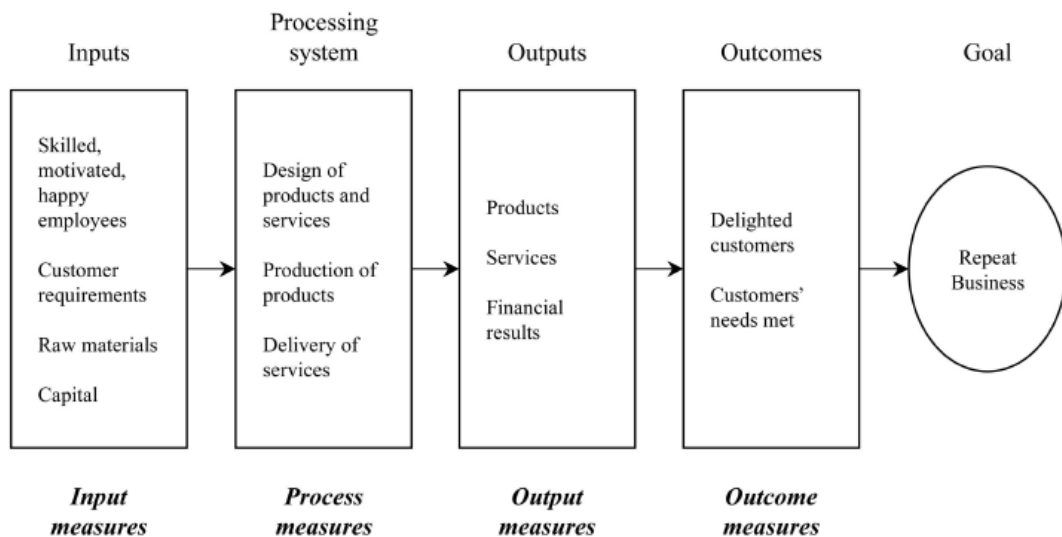
Figure 12 - Inputs, Processes, Outputs, Outcomes (Brown, 1996)

According to Neely et al (2000), the process of deciding which measures of business performance to adopt is a valuable one, not least because it forces management teams to be very explicit about their performance priorities and the relationship between them, thereby exposing, and offering an opportunity to resolve, any hidden differences of opinion.

Stansfield and Longenecker (2006) in their work identified that even though feedback and goal setting have been shown to be effective in changing performance, some specific types of feedback appear to enhance the improvements more than others. This finding supports the theory that communication is key to the development of performance measurement systems.

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3.2.3 Virtual Teams

Globalization and technological advancements have led to an increase in virtual team use over the last decade. Estimates suggest that in the US alone, as many as 8.4 million employees are members of one or more virtual teams or groups (Ahuja and Galvin, 2001)

Virtual teams are the next logical step in the evolution of organizational structures (Lipnack and Stamps, 1999) and the success in creating a virtual world depends on how clearly the objectives have been defined and to what extent the process necessary for the accomplishment of the objective has been designed (Norton and Smith, 1997). With the advent of so many communication technologies, organizations are seizing the opportunities to "work together apart". Like traditional types of teams, virtual teams engage a group of individuals to work independently towards a common goal. Unlike conventional teams, a virtual team works across time, space and organizational boundaries with links strengthened by webs of communication technologies (Lipnack and Stamps, 1997).

The availability of a flexible and configurable base infrastructure is one of the main benefits of virtual teams (Ale Ebrahim *et al,* 2009). As a drawback, virtual teams are particularly vulnerable to mistrust, communication break downs, conflicts, and power struggles (Rosen *et al*, 2007).

Three elements of virtual teams allow them to achieve their purpose: cooperative goals, interdependent tasks and concrete results. Virtual teams rely upon a clear purpose because of their cross-boundary work. Cooperative goals define the outputs desired, while interdependent tasks connect those desired outcomes to those achieved.

Although the collaboration and communication within Virtual Business teams was not traced in detail, the results of Ivens and Sloep (2001) are fairly clear: Learners tend to concentrate on project work and neglect their learning tasks, which provides a negative impact on the knowledge management of virtual teams.

Virtual teams address the issue of distance and time by replacing collocation with a combination of technology and face-to-face meetings. They deal with issues pertaining to hierarchical structures through cross-boundary work. This facilitates double loop learning by creating ways for people to communicate interactively.

According to Tsui et al (1992), reliance on electronic communications also increases the potential for faulty first impressions and erroneous stereotypes. In the absence of visual or audio cues provided by some technologies, team members may develop incorrect stereotypes based on geographic and cultural differences, or differences in functional expertise. These mistaken stereotypes or presumed differences between team members can undermine relationship-building efforts (Cramton, 2002).Shapiro (2002) states that in particular, teams may struggle to form a collective identity that promotes a shared commitment to a common goal.

Organizational and cultural barriers are serious impediments to the effectiveness of virtual teams. Many managers are uncomfortable with the concept of a virtual team because successful management of virtual teams may require new methods of supervision (Jarvenpaa and Leinder 1998). Managing the logistics of communication alone can prevent organizations from developing a common ground.

3.3 RESEARCH DEVELOPMENT AND METHODOLOGY

This paper presents an exploratory research in which the goal is to propose a methodology to measure the adherence (level of comprehension) of Performance Measurement Systems in the global virtual environment of a company with teams distributed in 3 continents (America, Europe and Asia).

The development of this methodology will be based on two frameworks: Literature and Process. From the existing literature it will aim to provide substantial support to the techniques proposed and from the detailed description of the process it aims to make the replication of this paperwork a possible task.

3.3.1 Research Methodology

A focus group is a form of qualitative research in which a group of people are asked about their perceptions, opinions, beliefs and attitudes towards a product, service, concept, advertisement, idea, or packaging. Questions are asked in an interactive group setting where participants are free to talk with other group members.

According to Byers and Wilcox (1991), the first focus groups were created at the Bureau of Applied Social Research by associate director, sociologist Robert K.

Merton. The term itself was coined by psychologist and marketing expert Ernest Dichter.

Morgan (1996) defines a focus group as a research technique that collects data through group interaction on a topic determined by the researcher. This definition has three essential components. First, it clearly states that focus groups are a research method devoted to data collection. Second, it locates the interaction in a group discussion as the source of the data. Third, it acknowledges the researcher's active role in creating the group discussion for data collection purposes.

Focus groups, like other qualitative methods, are used across a wide variety of different fields that include Communication studies (Albrecht *et al* 1993, Staley 1990), Education (Brotherson and Goldstein 1992, Flores and Alonzo 1995, Lederman 1990), Political Science (Delli Carpini and Williams, 1994, Kullberg, 1994) and public health (Basch, 1987).

An important theme that reappears in many of the uses of focus groups is their ability to "give a voice" to marginalized groups. For example, in early HIV/AIDS research (Joseph *et al*, 1984), epidemiologists used focus groups to gain a better understanding of at-risk groups with whom they had little prior experience, such as gay and bisexual men.

Ward *et al* (1991) compared survey and focus group results from three studies on family planning in Guatemala, Honduras and Zaire. For each of their three studies, they matched topic areas where methods contained similar questions, and they judged results from the two methods to be similar when "they would lead to the same conclusions". Based on explicit comparisons across a total of 60 variables, they found that the results from the two methods were: (i) highly similar for 30% of the variables; (ii) similar, but focus groups provided more information for 42% of the variables; (iii) similar, but surveys provided more information for 17%; and (iv) dissimilar for 12% of the variables. The biggest difference found between the methods was the ability of the focus group to produce more in-depth information on the topic at hand.

Morgan and Krueger (1993) argued that the advantages of focus groups for investigating complex behaviors and motivations were a direct outcome of the interaction in focus groups, what has been termed "the group effect" (Carey, 1994, Carey and Smith, 1994). An emphasis on the specific kinds of interactions that occur in focus groups is also an improvement over vague assertions that "synergy" is one

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of their strengths. What makes the discussion in focus groups more than the sum of separate individual interviews is the fact that the participants both query each other and explain themselves to each other.

Focus group research reveals its historical association with marketing research by using the term "segmentation" to capture sampling strategies that consciously vary the composition of groups. This use of segmentation to create groups that consist of particular categories of participants is a longstanding practice, as illustrated by Folch-Lyon *et al*'s (1981) study on family planning, where they composed groups that were as homogeneous as possible by sex, age, marital status, contraceptive use, socioeconomic status, and geographical location.

Segmentation offers two basic advantages. First, it builds a comparative dimension into the entire research project, including the data analysis. For example, Folch-Lyon *et al* (1981) analyzed their data according to the categories described above and found the most wide-ranging differences between groups of men and women. Second, segmentation facilitates discussion by making the participants more similar to each other.

The number of participants who are invited to a focus group is one element of the research design that is clearly under the researcher's control. Morgan (1992) reviewed the basis for determining group size, and concluded that smaller groups were more appropriate with emotionally charged topics that generated high levels of participant involvement, while larger groups worked better with more neutral topics that generated lower levels of involvement.

Variants of focus groups include:

• Two-way focus group - one focus group watches another focus group and discusses the observed interactions and conclusion

• Dual moderator focus group - one moderator ensures the session progresses smoothly, while another ensures that all the topics are covered

• Dueling moderator focus group - two moderators deliberately take opposite sides on the issue under discussion

• Respondent moderator focus group - one or more of the respondents are asked to act as the moderator temporarily

• Client participant focus groups - one or more client representatives participate in the discussion, either covertly or overtly

- Mini focus groups - groups are composed of four or five members rather than 6 to 12
- Teleconference focus groups - telephone network is used
- Online focus groups - computers connected via the internet are used

Traditional focus groups can provide accurate information, and are less expensive than other forms of traditional marketing research. There can be significant costs however: if a product is to be marketed on a nationwide basis, it would be critical to gather respondents from various locales throughout the country since attitudes about a new product may vary due to geographical considerations. This would require a considerable expenditure in travel and lodging expenses. Additionally, the site of a traditional focus group may or may not be in a locale convenient to a specific client, so client representatives may have to incur travel and lodging expenses as well.

The use of focus groups has steadily evolved over time and is becoming increasingly widespread.

3.3.2 Research Strategy

The participants of the focus group session are associates of a company that work in 3 different cities (Kuala Lumpur, Budapest and Curitiba), with management staff located in Houston. The information must be extracted through a questionnaire sent to analysts of each group and through focus group sessions, with discussions on findings aimed at obtaining additional adherence to the concepts indicated as priority by the leadership team.

Once associates of such company participate in this data gathering, it is natural that we also capture the level of comprehension of their respective local administrative leaders. Therefore the sampling must be composed by both analysts and leaders of each location

During the focus group session, the selected group will be involved in a 4 phase's process:

- Questioning: During this phase the participants will be presented to the previous data and they will be required to ask questions on why these results happened.

- Discussion: This phase is dedicated to discussion of the participants about the questions created in the previous phase

- Consensus: In this phase a consensus must be achieved among the participants of the focus group session.

- Identify reason: The last phase is dedicated to identify through a root cause analysis process the reason why the results were achieved and how to improve such result.

The information obtained from the group discussion will indicate gaps in the distribution of objectives to those teams.

Figure 13 is a diagram that represents the stages of this research:
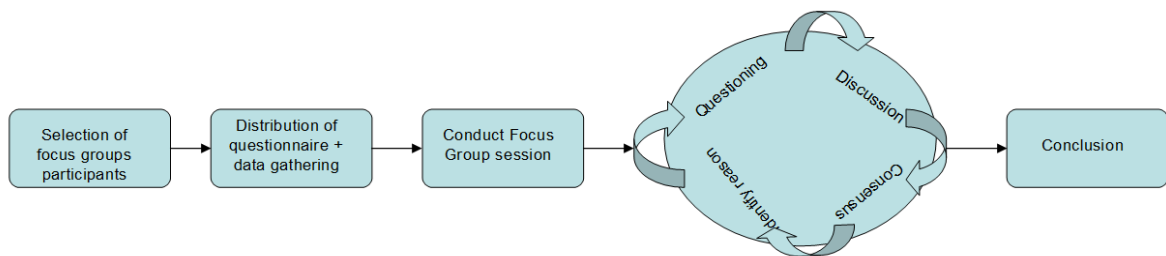
Figure 13 – Research diagram

Questionnaires are useful when gathering information from large groups. They can be targeted to particular groups or sent to a random sample of residents. They can be carried out by doorstep interviews, by telephone, distributed by mail or handed out at special events or locations for self-completion. Questionnaires can be either open, so that the respondent formulates the response in his/her own words, or structured, when set alternative answers are given; they can also be a combination of the two.

Diem (2002) stated that questionnaires are typically used for survey research, to determine the current status or "situation." They are also used to measure the difference in status "before" and "after" to determine changes that may be attributed to an educational program. Before creating a questionnaire, start by asking yourself a few important questions:

- What do I need to know? – Aiming to understand the objective of the questionnaire, what would be the most important information you need to extract?

- Why do I need to know it? – In here you will find the motivation of the questionnaire to understand if it should it worthies to be used.

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- What will happen as a result of this questionnaire? – With this question you will formulate the next steps of the questionnaire, you will create a set of actions based on possible responses.
- Can I get the information from existing sources instead of conducting a survey? – Verify if this research was performed by anyone to avoid unnecessary cost and effort.

As with determining the purpose, this should be based on the objectives of your educational program and the evaluation of its outcomes and impact. Consider which of the following you are aiming to measure: attitude, knowledge, skills, goals, intentions, aspirations, behaviors and practices, and perceptions of knowledge, skills, or behavior.

To ensure that the questionnaire instrument you develop is appropriate for your audience, "field test" your questionnaire with other people similar to your respondents before administering the final version. This will allow you to improve vague questions or procedures and detect errors beforehand. Following these recommendations and wording of questions will reduce systematic "measurement" errors, which will improve the internal validity of your study.

Schwarz and Oyserman (2001) stated that when writing questions for an evaluative questionnaire, it is important to recall the objective of the program delivered, and the information required to measure the success in meeting the objectives. Educators need also to focus on the type of information needed to assess the program impact, deciding whether to include knowledge, attitudes, skills and/or behavior. Good survey design also includes attention to the audience completing the questions (e.g., literacy, language, etc.), and the purpose of the question (outcome data, qualitative feedback, satisfaction with the program and/or audience demographics).

The flow of the entire questionnaire is also critical, and educators need to ensure that each question is clear and the directions are equally easy to understand. Most importantly, remember that the quality of the information gathered from a questionnaire instrument is dependent on the clarity of each question asked. This reinforces the importance of thoughtful design for questionnaires to capture and report the true experience and change of participants in programs.

3.3.3 Research process plan

Initially it will be information gathered through a questionnaire submitted to the members of the organization that aims to prove that the communication being utilized is ineffective. According to Bryman (1989), the survey is a gathering of data from a group, restricted to a time frame, with the objective to collect data related to specific variables.

For this work, an exploratory survey at initial stages was chosen, with the objective of gaining preliminary insight and creating a base for a deeper and more structured survey.

After gathering data using the survey, a focus group session was conducted with select members of the leadership team of this organization.

The research protocol is indicated in the Figure 14:

Step 1 - Send questionnaire to analyts and management

In this step the following activities will be developed:
- Send questionnaire to analysts
- Send questionnaire to managers
- Receive responses
- Handle answer data
- Calculate average os responses, aiming to obtain a single number that represents the whole group.

Step 2 - Results compilation

In this step the following activities will be developed:

- Tabulate all results in standart spreadsheet

Step 3 - Build Importance x Performance graph to analyze the scenario

In this step the following activities will be developed:

- Insertion of numbers from spreadsheet into I x P graph

Step 4 - Analyze of results

In this step the following activities will be developed:

- Observation of results
- Results comparation
-Listing of possible main reasons

Figure 14 – Research's Protocol

Before the submission of the questionnaire, a communication to the participants must be sent in order to make them aware of the material they will receive, and the specific objective of such questionnaire. This step will assist in avoiding any misunderstanding and initiation of unproductive discussion over topics that are not related to this research.

After collecting the data from the questionnaire, averages are calculated per group, rounding up the value, aiming to have only one entry per location/culture.

The outcome will be input in the table described in Table 1:

	COUNTRY NAME								
	1	2	3	4	5	6	7	8	9
Competence									
Access									
Flexibility									
Creativity									
Customer Service									
Consistency									
Speed									
	1	2	3	4	5	6	7	8	9

Table 1 – Input Matrix Utilized in the Research

Utilizing the compiled data from step 2, an Importance x Performance graph, such as the one in Figure 15 will be created.
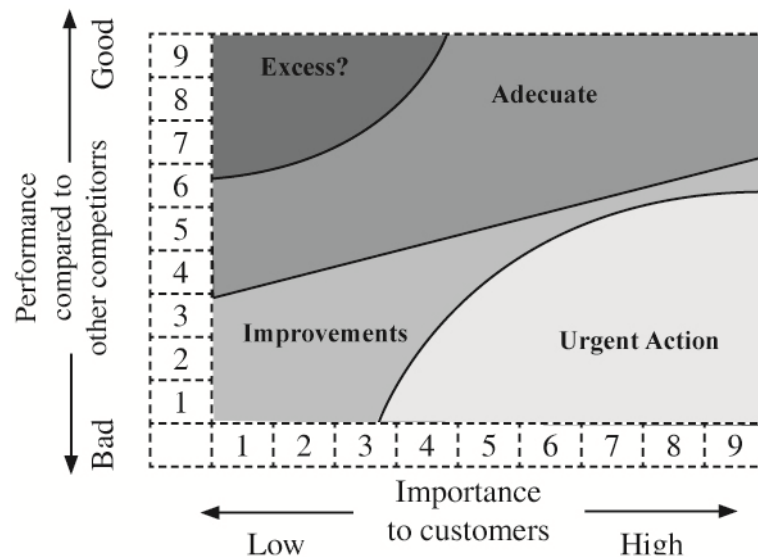
Figure 15 – Importance x Performance Graph

Graphs should be created to compare the results of each team/location involved in this research. The graphs will be then presented to the focus group participants aiming to initiate the discussion.

3.3.4 Data analysis

For this research, the data analysis method described by Hill (1993) was used, which places the competitive factors as: decision makers, qualifiers and less important, comparing the expectations of the customer over the products. Therefore,

instead of customer x company, we will have subordinate x superior and the criteria would be:

- Decision Maker: Factor that highlights a specific characteristic when compared to the others;

- Qualifier: Factor that qualifies a group, justifying its existence;

- Less important: Factor that despite the importance is not taken as seriously as the ones listed above.

The Matrix Importance x Performance, created by Slack (1997), is a tool that demonstrates the position in which processes and corporate dimensions, competitors and clients, find themselves when compared to the company environment. It is a diagnostic of several competitive factors compared to their performance. Therefore, following this rationale, this matrix is proposed for use in order to verify the adherence of management concepts to their teams, aims to report existing communication gaps between the two actors and to realign the strategy to get more efficiency in the process and group goals.

The Table 2 illustrates the structure used to segregate the management's priorities:

Importance to customers of the company
REQUEST WINNER CRITERIA
1. Provides crucial advantage to clients - it is the main competitive impulse
2. Provides important advantage to clients - it is always considered
3. Provides useful advantage to clients - it is normally considered
QUALIFIER CRITERIA
4. Must be at least slightly above the sector average
5. Must be around the sector average
6. Must be at a small distance to the sector average
LESS RELEVANT CRITERIA
7. Normally is not considered by the clients, but can become more important in the future
8. Rarelly is considered by clients
9. It is never considered by clients and probably never will

Table 2 – Segregated Management's Priority

Table 3 illustrates the structure used to segregate the subordinate's priorities:

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Performance compared to competitors
BETTER THAN COMPETITORS
1. Consistent and considerably better than our best competitor
2. Consistent and clearly better than our best competitor
3. Consistent and slightly better than our best competitor
EQUAL TO COMPETITORS
4. Frequently slightly better than our best competitor
5. Aproximatly the same of most of our competitors
6. Frequently, in a short distance to our main competitors
WORSE THAN COMPETITORS
7. Usually slightly worse than most of our main competitors
8. Usually worse than most of our competitors
9. Consistently worse than most of our competitors

Table 3 – Segregated Subordinate's Priorities

After segregating and comparing both the importance to management and the performance of subordinates, it is possible to visualize those areas in which the level of importance given by the managers is different of the level of performance of the staff, which implies that this area needs improvement, alignment and review. After this assessment is possible to identify which value of the Performance Measurement System requires a better communication strategy in order to reach the required audience and consequently obtain the expected performance and commitment by the users of the PMS.

Aiming to adjust the methodology to larger groups, a pilot test (portion of the analyzed team) was conducted.

3.4 PILOT TEST

The methodology described in this paper, Table 4, aims to measure the level of comprehension of priorities by virtual teams.

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Area of the research	Description
- Research protocol	The research must be divided into a four step protocol, aiming to make possible the replication of this research and divide efforts to specific and distinguished tasks.
- Qualitative research methodology	Use focus group methodology because as described by Morgan and Spanish (1984), focus groups not only give us access to certain kinds of qualitative phenomena that are poorly studied with other methods, but also represent an important tool for breaking down narrow methodological barriers.
- Quantitative research methodology	The level of priority must be measured into a 9 points division as described in Tables 2 and 3, aiming to simplify the classification of a priority criticity
- Graphical outcome	For the pilot the graphical outcome of the *status quo* create the performance x importance matrix
- Number of participants in the focus group session	The focus group session must have a participation of 10-12 associates and length of three to four sessions (one hour and half each).

Table 4 – Areas of the research and its description

In order to test the proposed methodology following the protocol in the Figure 8, a team of 10 associates within the group in Curitiba was selected. The goal of the pilot test is to follow the methodology protocol and perform any necessary adjustments when applying this methodology to larger teams.

The steps described in the section 3.3 were followed, with each step being documented and evaluated.

Table 5 and 6 demonstrates the comparison of the ranked priorities defined by the management and the ranking of priorities comprehended by the tested group.

Table 5 and 6 – Comparison of the Ranked Priorities

This result indicates that the comprehension level of the studied group diverges from the idea of priorities listed by the management team in Houston. Showing that the adherence of priorities requires adjustments in order to reach the same ranking from the management.

After the implementation of the steps and measure of the results, a focus group session was help do debate the dynamics of the protocol, providing several learning opportunities, showed in Table 7:

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Protocol step	Pilot Feedback
Step 1: Submission of questionnaire to members of the team	- Types of questions used must be clear and - Size of the questionnaire cannot be lengthy or the quality of answers will decrease
Step 2: Compilation of responses	- Employees and contractors are concerned with the privacy of their answers - A briefing of each value definition is necessary for accurate answers
Step 3: Development of Importance x Performance graph	- Creation of a standard spreadsheet is necessary to simplify the data capture
Step 4: Discussion about the findings of the questionnaire and graph analysis	- Length of focus group sessions should be between 15 and 30 minutes each, with several sessions used to discuss different aspects if necessary - Focus group sessions participants should be restricted to representatives of each group - Only experienced workers should participate in focus group sessions, because they provide better input

Table 7 – Focus session feedback to each protocol step

These changes must be implemented before applying this methodology to larger audience, with an aim towards obtaining a better result.

After this exercise there was noted improvement in the performance of this team (showed in Table 8), reaching acceptable values in all requirements for the first time, and being praised by management during performance meetings, proving the efficiency of the methodology.

BEFORE

Region	Lead time	Number of delayed requests	Number of complaints that reached management
Test team	61 days	47	6

AFTER

Region	Lead time	Number of delayed requests	Number of complaints that reached management
Test team	48 days	31	3

Table 8 – Comparison of the Status before and After Research

The increase of the performance noted during this exercise can improved, since no adjustment was made nor communication was delivered to align the operation strategy. This team improved their performance with only a better idea of what is expected by the management.

If a plan of action is created and implemented, another increase in the performance of the studied team is expected because the team will go through an exercise to comprehend the priorities and the management will adapt their communication to the cognition level of each team.

As result of this pilot, several improvements were added to this methodology, such as: a graphical analysis is needed in order to quantify the distance of the priorities perceived by the virtual team and the priorities defined by the management team, possibly using a polar diagram to create a picture of the *status quo*, a refined selection of knowledgeable participants is needed in the focus group session aiming to improve the participation and level of outcomes and create a set of decisions based on the area calculated in the polar diagram.

Phases	Steps	Procedures	Deliverable	Tips
Group Selection	-	Select a group of 10 - 12 associates in key positions that can contribute to the research with their perspective	List of participants in the focus group session	For large teams select large groups, do not include associates that cant provide valuable inputs
Distribution of questionnaire / Compile data	Step 1 - Send questionnaire to analysts and management	Send questionnaire to a sample of the team, aiming to acquire their interpretation of priorities and compile the data	Create a questionnaire to be distributed to the ones in the research group	Provide a simple questionnaire, with not many questions in a clear language that can be comprehended by everyone in the research group.
Distribution of questionnaire / Compile data	Step 2 - Results compilation	Compile acquired data, following a statistical model	- Calculate the average per team and input data into the matrix created for this research (Table 1)	average was extracted since it is a simple statistic that can provide value to the discussion and all involved in the discussion understand its meaning.
Distribution of questionnaire / Compile data	Step 3 - Build Importance x Performance graph	Build a Importance x Performance graph, inputing the data acquired in the step 2	- Create a Importance x Performance graph (Figure 6) for each team	Create one graph per location that represents the average comprehension of the priorities.
Conduction of Focus Group sessions	Step 4 - Analyze result	Provide a critical analysis of the created graph, presenting it to the focus group participants, in several rounds of questioning, discussion, consensus and identify reason	- Listing of problems identified during the discussions.	It is suggested to have three sessions of discussions, each session must have a maximum length of ninety minutes
Implementation of the result	-	Implemement plan of action to all reason identified in the focus group exercise.	- Root cause analysis for major identified problems. - Plan of action to be implemented aiming to solve the problems identified.	When delivering the plan of action one must focus on the top five problems to be able to implement it and actually solve these problems

Table 9 – Summary of research phases

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3.5 CONCLUSION

Virtual teams are the new trend in global companies, growing everyday and a useful tool to reduce cost for such companies. Work force is now distributed globally in several continents, providing, therefore, multicultural teams. Such teams are becoming the operations of those companies and PMS are being used to guarantee that the productivity is maintained at the same level.

However the comprehension of Performance Measurement Systems may diverge from a management perspective to an operational perspective, as described by Ferreira *et al* (2010). The reduction of such deviation in the comprehension of such an important tool in a globalized world is crucial to keep the virtual organism alive and aligned to the company's objective.

This paper describes a methodology to measure the adherence of Performance Measurement Systems comprehension by Virtual Teams. Following this methodology, one will be able to measure the adherence (level of comprehension) of PMS premises and objectives in virtual teams and as a next step will list reasons and ways to improve such systems, gathering a global perspective that may help management in communicating or creating new metrics for their teams.

The methodology was tested in a small group, in order to prepare it for a larger audience. The preliminary findings (section 4) show that after the use of this methodology, the team reached a better comprehension of the priorities and improved their performance.

The next step for this research is to use the adapted methodology with a larger audience and to validate its impact in the comprehension and performance of the team.

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4 ARTICLE 3

Virtual teams performance perception

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Abstract

Larger companies are beginning to adopt a "virtual teams" strategy, due to the benefits of cost reduction and performance improvement. However, managers are not adapting to this concept, nor measurement systems due to the barriers in managing virtual teams. Barriers such as: language, culture and time zone are starting to become key enablers for high performance teams. Through the implementation of a previous developed methodology for assessing virtual teams performance perception, this paper intends to test such methodology by applying it to a global virtual environment. During this research tools such as: questionnaires, focus groups sessions and operations strategy planning techniques were utilized aiming to rank the level of comprehension of such performance measures by different teams and identify factors that may improve their performance towards a higher level. This methodology was applied on 3 case studies, in different countries and under the same management guidelines. The impact of behavior into performance measurement systems is evident. Lack of clear communication, language barriers, miscomprehension of the objectives, Cultural barriers and lack of motivation negatively increase the impact of behavior in performance measurement systems. The identification and correction of these items is crucial for the success of a team.

Keyword: Virtual Teams, Performance, Measures, Perception, Focus Group

4.1 INTRODUCTION

According to Corvello and Migliarese (2007), as globalization, technological innovation and market turbulence challenge traditional business logic, firms are experimenting with new models for operations organization and design. New labels are continuously introduced in the academic debate: the shamrock organization discussed by Handy (1990), the network organization presented in Miles and Snow (1986) and Nohria and Eccles (1992), the flexible firm of Volberda (1996), the extended enterprise presented in Barbini and D'Atri (2005) and Browne and Zhang (1999), the servitization discussed by Ren and Gregory (2007). All address new organizational models that are able to cope with a competitive landscape requiring flexible productive processes and rapid change. Among these new models, the "virtual enterprise" or "virtual organization" is one of the most popular model (Davidow and Malone, 1992, Mowshovitz, 1994). A virtual enterprise can be described as being given a new business opportunity in which firms can quickly identify the competences needed to exploit it. It is selected from a broad population of potential partners, those which excel in each of the required competences.

Over the recent years, virtual teams have catered to the success of organization in regards to new product development (McDonough *et al.*, 2001; Barczak and McDonough(III), 2003), automobile industry (May and Carter, 2001), in the field of scientific research (Finholt, 2002) and globalizing the innovation process (Malhotra *et al.,* 2001; Santos *et al.*, 2004) among others.

Corvello and Migliarese (2007) defined the term virtual enterprise as an organization that has participants often working from geographically dispersed locations; they may have never worked together in the past and work together only for a brief period. According to Powel *et al.* (2004), more and more organizations are leaning towards the development of virtual teams, which would provide organizations with an unprecedented level of flexibility.

Members of these virtual teams often come from different technical, organizational and national cultures; processes transcend organizational boundaries; people and resources are controlled by different organizations. In their research they pointed out that virtual enterprises have proven to show several advantages in comparison to other models of operations organization. At the same time this model also has disadvantages such as: increased conflict events, lack of trust, difficulties in

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systemic innovation and complex communication. The context of work for Virtual teams relies on the operation strategy, being controlled by the performance measurement system.

One of the definitions for operations strategy compares it to a pattern of decisions, both structural and infrastructural, which determine the capability of a manufacturing system and specify how it will operate in order to meet a set of operations objectives which have been derived from business objectives (Platts, 2007).

The concept of a strategic control system was presented when performance measurement systems were introduced. The measurement system is a part of a wider system, which includes goal setting, feedback, and reward functions (Neely *et al.*, 2005).

The role that performance measurement plays in helping firms achieve and sustain their competitive advantage has been largely acknowledged by management literature in the last decades (Lebas, 1995).

Schmitz and Platts (2004) claim that, although the importance of performance management is widely acknowledged, there are "significant gaps in theoretical and empirical knowledge" and there is no research on any real application of an integrated performance measurement system.

Ferreira *et al.* (2010) reviewed the literature for performance measurement applied to virtual teams. The motivation for such area of study comes from the fact that virtual teams are the next logical step in the evolution of organizational structures and the success in creating a virtual world will depend on how clearly the objectives and processes are defined for the accomplishment of the objective has been designed (Lipnack and Stamps, 1997, Norton and Smith, 1997).

However, according to Ferreira *et al.* (2010), the comprehension of implementation/use of operations strategy by virtual teams can be divided into three different levels: strategic, comprehension and development, and each of these levels will have multiple areas (Figure 16).
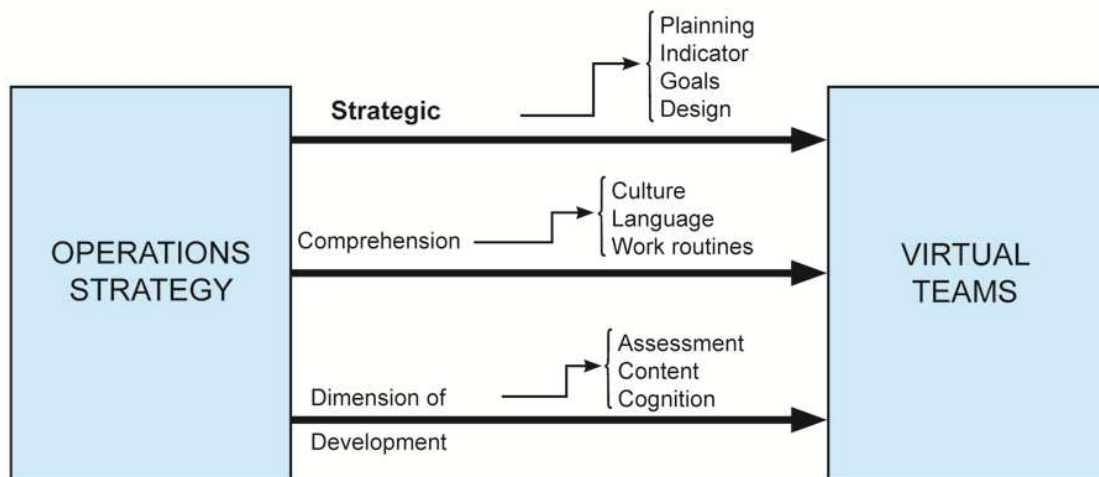
Figure 16 – Link between Operations Strategy and Virtual teams

In order to understand and improve the comprehension level of performance measurement systems by virtual teams, later on, Ferreira *et al.* (2011) proposed a methodology, based on works of Waal (2006) and Hrebiniak and Joyce (1984), that could be followed aiming to measure the adherence, that is, the level of comprehension of performance in global virtual environment.

The benefit of measuring the adherence of performance measurement systems (PMS) in a virtual team operation is to identify opportunities for redesigning the strategic management system redesign as proposed by Gomes *et al.* (2004), which would be a system defined by 'balanced', 'integrated', 'linked', 'flexible', 'multifaceted' and 'multidimensional' features.

Gomes *et al.* (2004) also stated that performance measurement must be grounded on information availability, reliability and responsibility. PMS should be seen as complete organizational system, rather than isolated functional subsystems. They must be evaluated not based only on their integrative features, but also with respect to their capabilities for dynamic managing efficiency and effectiveness performance related factors, which are also key for the success of virtual team management.

Also as organizations become more geographically dispersed, the nature of teams has changed significantly due to changes in organizations and the nature of the work they do. Virtual teams is a concept that has matured through a long evolutionary process (Carmarinha-Matos and Afsarmanesh, 2005, Chudoba and Maznevski , 2000). While organizations emerge and claim to have adopted the

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modus operandi of virtual teams, the reality is that conventional face-to-face modes of operation will remain the organizational norm for some time to come (Arnison and Miller, 2002).

The goal of this paper is to test the methodology proposed by Ferreira *et al.* (2011) that has as objective to verify the adherence of Performance Measurement Systems comprehension by Virtual Teams and verify the benefits that could be extracted from such methodology. The article is organized into several sections that review the literature on performance measurement models and virtual teams, describe the methodology and research protocol, analyze data and provide a synthesis for methodology development.

4.2 THEORETICAL FOUNDATION

Across the years managers have been challenged to manage teams that are inserted in dynamic environments that constantly change. A growing number of flexible and adaptable organizations have explored the virtual environment as one mean of achieving increased responsiveness (Furst *et al*, 2001). Wayne Cascio (1998) suggests that performance management is by far the biggest challenge of virtual teams.

Since the objective of this article is to validate a proposed methodology that verifies the level of comprehension of performance measurement systems by virtual teams, the theoretical foundation of this article is concentrated into two areas of knowledge: performance measurement models and virtual teams, intending to provide a general view and background for further analysis in the article.

4.2.1 Performance measurement models

What is performance measurement? It is useful to start with definitions which have been used in the literature.

To quote Neely *et al.* (1995) "Performance Measurement is a topic often discussed but rarely defined". Following their comment concerning definitions, Neely *et al.* (1998) went on to propose definitions of performance measurement, a performance measure and a performance measurement system:

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- "Performance measurement can be defined as the process of quantifying the efficiency and effectiveness of action."
- "A performance measure can be defined as a metric used to quantify the efficiency and/or effectiveness of action."
- "A performance measurement system can be defined as the set of metrics used to quantify both the efficiency and effectiveness of actions."

These definitions are precise, but their very precision means that they do not convey what is now being labeled in the literature and in practice as 'performance measurement'.

According to Araujo and Martins (2009), there is no single definition of performance measurement system (PMS) in the literature. A comprehensive definition is a "set of processes an organization uses to manage its strategy implementation, communicate its position and progress, and influence its employees' behaviors and actions" (Franco-Santos *et al*, 2004).

Performance measurement and management have been on the research agenda since the late-1980s (Johnson and Kaplan, 1987; Lynch and Cross, 1991; Eccles, 1991; Kaplan and Norton, 1992; EFQM, 1999; Thorpe and Beasley, 2004). Since then, there has been a proliferation of theories, models and tools, to support practitioners' better measure their performance and hence manage through measures. Market and production globalization and the network and knowledge-based economy are triggering continuous changes in the way companies are organized and the way they do business (Franco and Bourne, 2003).

The literature state that there are four main processes related to performance measurement: design, implementation, operation and 'refresh', the latter process being a continuous system redesign or review (Bourne *et al.*, 2005; Neely *et al.*, 2000; Bourne *et al.*, 2000).

Performance measurement models represent one of the most important managerial tools. Innovative performance measurement systems are meant not only to measure and control but, also guide the companies' performance. For the latter purpose the company's strategy is translated into a set of quantifiable cause and effect linkages between financial and non-financial indicators representing value creating activities and their outcomes.

According to the Centre for Business Performance (2004), there are many reasons to measure performance. The roles can be classified in three main categories:

- Strategic: the roles of translating the strategy into performance measures to support the implementation and challenging the assumptions behind the strategy;

- Communication: the roles of checking position, complying with the non-negotiable parameters, communicating direction, providing feedback and benchmarking; and

- Motivational: the roles of evaluating and rewarding behavior and fostering improvement and learning.

Causal performance measurement models are meant not only to measure and control, but also to guide companies' performance. They represent a very popular topic in practitioners' business publications, which expose the anecdotic evidence of astonished success, and "heat" the enthusiasm regarding causal models (see for instance, Eccles, 1991, Magretta, 2002, Crosby and Sheery, 2006). According to Kasperskaya (2006), causal performance measurement movement (PMM) is spreading over the world through numerous practitioners' conferences and seminars and consulting companies actively sell and propagate causal PMM.

Using experimental methodology, Webb (2004) investigates the importance of causal structure in the models of strategic performance measurement. He demonstrates that well-articulated causal links help organizational actors to understand the mechanism by which corporate objectives can be achieved. Better understanding of the goals leads to greater commitment by managers to achieve them. Hypothetically, then, a causal model has advantages over ordinary scorecards.

Empirical studies in balanced scorecard (BSC) implementation document problems with the assumption of causality. Malmi (2001) conducted interviews on BSC implementations with the managers of seventeen companies. The author points out that most of the interviewees misunderstood the cause-and-effect logic.

Specifically, some of the companies replied that "we do not know how much some factors and measures affect other factors and that there might be a chance to establish such relationships in future" and "we are not so far along yet". The interviewed managers perceived the BSC perspectives independently from each other.

Evidence on the successfulness of BSC implementations is scarce and contradictory. Ittner and Larcker (2003) in their extensive survey study of the financial service industries found a positive association between BSC usage and perceived organizational performance but a negative association with its financial performance.

Similarly, Malmi (2001) indicates that all interviewees in his study had positive attitude toward their BSC, however the effects of using the models were not quantified. And yet, Davis and Albright (2004) conducted a quasi-experimental study in a banking organization and found that the bank branches, which implemented BSC, outperformed branches that relied only on traditional financial indicators.

Causal PMM represent analytical tools, which support formulation and implementation of strategy. They can perform as a decision aids within what Minzberg *et al.* (2005) defined as the prescriptive school of strategy, actively promoted in MBA and business schools. Prescriptive school includes the Design (Andrews and Soder, 1987), the Planning (Ansoff, 1965) and the Positioning School (Porter, 1987). The Design School is famous for its SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis technique. The Planning school brought to the managerial agenda the idea of detailed plans with its culmination of Master Plan and quantification of numerous objectives and targets. The Positioning School is based on the industrial analysis and put forward the idea about generic market strategies and value chain. Kaplan and Norton (2004) suggest that SWOT and industry analysis can be used as the first step of BSC design.

The strategic management of PMS enables an organization to develop continuous improvement and organizational learning capabilities through continuous review of the measurement system (Kennerkey & Neely, 2003; Kennerley & Neely, 2002; Johnston *et al.*, 2002; Kaplan & Norton, 2001; Neely *et al.*, 2000; Ghalayaini & Noble, 1996).

Weick (2001) argues, that there are two major organizational solutions for coping with complex and uncertain environments. The first one consists of investing considerable time and effort in evaluating all the possible scenarios and their outcomes. Engaging in rational decision process, organizational actors should consider as many details as possible and carefully evaluate numerous alternatives. However, this approach is costly and could lower the motivation needed for the implementation of the chosen alternative. Another possibility is, neglecting the "subtle

nuances", to simplify the reality, make a crude picture of it and concentrate the efforts on action rather than decision.

Malina and Selto (2004) describe the process of building a causal PMM for a large American manufacturing company specializing in equipment manufacturing. Managers of this company believed in numerous cause-and-effect relationships in their perceived performance model. However, statistical test of hypothesized causal relationships demonstrated that only few of them are significant and overall the model has no predictive ability. The authors are puzzled with their findings because apparently the model is currently being used for strategic communication and setting of the incentives in the company. Thus, according to the authors, it is not clear whether a "valid" causal PMM is a necessity or whether just a convincing story based on prevailing causal beliefs would be sufficient.

Bourne *et al.* (2005) identified in their research that high performing business units were differentiated from the others by their business unit managers' use of simple mental models, they described how they used their own indicators to manage, often using unofficial data sources. These were developed from experience and/or insight into what the true drivers of business unit performance were. One of the factors that differentiated high performing business units was ignoring inappropriate targets. Many targets were set on a company wide basis, and so were more or less achievable at business unit level depending on local circumstances. It was concluded that at the business unit level, communication was the biggest differentiator between high and average performing business units.

The intensity of engagement and interaction with the performance measurement processes has a greater impact than would be suggested from most of the measurement literature (Simons, 1991).

Bititci and Turner (2000), Neely (1999) and Flapper *et al.* (1996) recognized that the identification of factors affecting performance and the understanding of their relationships is one important step in PMS design. Also that much more has to be done in this topic.

To understand processes related to the application of PMS, one may refer to the work of Simons (1991) and Henry (2006). They found two patterns in managing a measurement system: simple feedback control or diagnostic, and "interactive control".

The literature indicates that the intensity of engagement and interaction with the performance measurement processes could have a great impact on the business overall performance (Bourne *et al.* 2005).

According to De Toni and Tonchia (2001), the importance of the human resources to obtain competitive success, compared with the limited use of PMS for the evaluation/involvement of the human resources, calls for a revision of the use of PMS, which are too oriented towards control.

According to Melnyk et al. (2004), the rationale behind relying on performance metrics is to help ensure focused decision-making across managerial levels. Misunderstood performance objectives can lead to uncertainty, cognitive overloads, local biases, misaligned decisions and ultimately poor strategic execution; not something a firm would like to convey to its various stakeholders.

4.2.2 Virtual teams

Cohen and Baily (1997) defined team as "a collection of individuals who are independent in their tasks, who share responsibility for outcomes, who see themselves and are seen by others as an intact social entity embedded in one or more larger social systems, and who manage their relationship across organizational boundaries".

Based on this definition, virtual teams can be defined as a group of geographically, organizationally and time dispersed workers brought together by information technologies to accomplish one or more objectives of the organization (DeSanctis and Poole, 1997; Powell *et al.*, 2004). The term 'virtual' in virtual teams signifies distributed work that is predominantly based on cyber enabled means of communication (Hertel *et al.*, 2005) and the premise of any virtual team lies in their heavy reliance on IT to communicate with each other (as they are geographically dispersed), their flexible composition and their ability to traverse traditional organizational boundaries and time constraints (Jarvenpaa and Leidner, 1999; Powell *et al.*, 2004; Hertel *et al.*, 2005).

In recent years, companies have increasingly turned to virtual teams as a mean of connecting and engaging geographically dispersed workers, lowering the costs associated with global collaboration, and enabling greater speed and

adaptability. These teams have shifted in the way in which organizations form, manage and evaluate team performance (Heller *et al.,* 2010).

Schwab (2008), states that the ranks of transnational and global companies are increasing. Even small and medium-size high-growth enterprises from developing countries have taken the global approach.

It is common to face scenarios such as: a manager that is brought into his boss's office and told he is going to be assigned to a new project. This is not a surprise due to his success in leading previous teams allowing him the opportunity to receive bigger responsibilities for increasingly important and complex projects. He likes a new challenge. He asks who, of the staff in the Boston, MA, office, will be assigned to his team. His boss explains that for this new project, he will lead a team whose members are based in Boston (USA); Buenos Aires (Argentina); Bangalore (India); Beijing (China); and Brussels (Belgium) and, because of a limited budget, his team will come together face-to-face only once during the projected yearlong project.

The manager pauses to reflect on this scenario. He has never led a global, virtual team before but the expectation is that based on his previous roles he will. As someone who closely monitors the work of his team and relies heavily on frequent face-to-face communication, he is not without concerns.

These scenarios are becoming common situations in those emerging global companies.

Each one has a style of leadership that is most comfortable. Often, the leadership style is a reflection of our cultural conditioning, past experiences, and qualities that we admire in the people who lead us. What is surprising to many team leaders is that their management style that has been successful when leading singularly located teams does not necessarily translate to their leading virtual, global teams effectively.

According to Wang and Chan (2009), virtual organizations are seldom formed from the scratch. Most likely, they have to be converted from their legacy systems.

In an empirical study, Lin and Lu (2005) survey more than 300 electronics manufacturers who were asked the degree to which the company had undertaken virtual organizational structuring that was enabled by information technologies. The survey result indicates that information technologies can provide the potential means to implement virtual organization, which they regard as a form of structural innovation.

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With the help of information and communication technology, members in a virtual organization can achieve their common goal by flexible allocation of resources (Hughes *et al.*, 2001).

However, using information technology alone is not a sufficient condition to successfully form a virtual organization. Information technology is merely an enabler for adopting virtual organization. On the other hand, virtual organization is not free from implementation barriers.

When considering the many potential challenges of having and supporting a virtual team, only a handful can compare with the difficulty that comes with monitoring and evaluating performance.

Arguments in favor of virtual teams are that virtual teams often end up facilitating any organization with a huge savings in costs and even increase in job satisfaction among the members as they have more control over their hours, projects, etc. (Mowshowitz, 1997; Marotta, 2006). Additional advantages of virtual teams over their face-to-face counterparts involve collaboration across organizational boundaries and faster response time due to ubiquity (Arnison and Miller, 2002) and a reduction in the time-to-market of the project (Rafaeli and Ravid, 2003), enabling employees to expand their social networks within organizations (Furst *et al.*, 2001).

The limitations that have been cited against virtual teams are the barriers in information flow and knowledge transfer that often deters a virtual team from achieving its desired level of success and efficiency (Miles and Snow, 1986; Cohen and Bailey, 1997; Mowshowitz, 1997; Cramton, 2001; Johnson *et al.*, 2001; Suchan and Hayzak, 2001; Arnison and Miller, 2002; Zigurs, 2003; Gareis, 2006; Rosen *et al.*, 2007). Other researches also indicated the considerable loss in the innovation potential among the virtual teams due to a considerably large geographical, relational and cultural distance among the team members (Lojeski *et al.*, 2006; 2007) and a significant decrease in the team productivity.

When a longer temporal scope is taken into account (Alge *et al.*, 2003), other limitations of virtual teams involves the decrease in productivity due to the lack of face to face communication and interaction and the distrust arising among the members as a result of insufficient communication (Arnison and Miller, 2002), monetary and non-monetary loss due to a downtime arising out of a possible failure of the medium of communication and the stupendous challenge that the leader of a

virtual team faces as a result of not meeting some members of the team face-to-face (Zigurs, 2003).

The ability of virtual team managers to accurately ascertain performance becomes increasingly difficult, when objective, outcome-based measures of performance are unavailable or unclear, considering their reduced capability to observe and measure the process. According to Kurkland and Bailey (1999), if appropriate measures to evaluate performance are not readily available, it may cause frustration in virtual teams.

The possible bottlenecks in the efficient functioning of any virtual team might arise due to a failure to communicate and retain contextual information, the inability to distribute the same information to all members and obscurity in team objective arising out of distance (Cramton, 2001; Johnson *et al.*, 2001; Qureshi and Vogel, 2001).

The appropriate communication of the operation strategy, the complete comprehension of objectives by the team and a concise (and straight) performance measurement system can drive the company towards its success.

4.3 RESEARCH DEVELOPMENT AND METHODOLOGY

Diem (2002) stated that questionnaires are typically used for survey research, to determine the current status or "situation." They are also used to measure the difference in status "before" and "after" to determine changes that may be attributed to an educational program, which can become an outcome of repetitive use of this methodology.

The average of the responded data (obtained from the questionnaires) was plotted into a Slack *et al.* (2007) importance x performance matrix. Importance and performance data are plotted on a two dimensional grid with importance on the x-axis and performance on the y-axis. The data are then mapped into four quadrants (Bacon, 2003; Martilla & James, 1977) as depicted in Figure 3. In the lighter quadrant, importance is high but performance is low. This quadrant is labeled as "Urgent Action", indicating the items require urgent corrective action and thus should be given top priority. Items in the "Excess?" quadrant indicate low importance and high performance, which suggests insignificant strengths and a possibility that the resources invested may better be diverted elsewhere. The adequate zone, indicates

a good balance on importance given by the management and performance of the team, this category may be labeled as "Keep up good work". The "Improvement zone" suggests that the team should improve their performance since the importance of these items are higher than the actual performance, indicating an area to be improved by the team.

The four quadrants matrix helps organizations to identify the areas for improvement and actions for minimizing the gap between importance and performance, providing a graphical view of the status quo, making able valued analysis of the level of comprehension of strategic priorities. This can lead to local strategic adaptation, changes in communication and fast realignment of the team, aiming to reduce the impact of miscomprehension of the strategy.

4.3.1 Research Strategy

The research is composed of three case studies of virtual teams, in different locations: Hungary, Malaysia and Brazil, that are subordinate to a management team located in the United States, who define the strategy plan and delegate the implementation to the leadership team in these locations.

The research protocol is indicated in the Figure 17 below:

Step 1 - Send questionnaire to analyts and management

In this step the following activities will be developed:
- Send questionnaire to analysts
- Send questionnaire to managers
- Receive responses
- Handle answer data
- Calculate average os responses, aiming to obtain a single number that represents the whole group.

Step 2 - Results compilation

In this step the following activities will be developed:

- Tabulate all results in standart spreadsheet

Step 3 - Build Importance x Performance graph to analyze the scenario

In this step the following activities will be developed:

- Insertion of numbers from spreadsheet into I x P graph

Step 4 - Analyze of results

In this step the following activities will be developed:

- Observation of results
- Results comparation
- Listing of possible main reasons

Figure 17 - Research protocol

According to Nof (1999), the questionnaire is a research tool encouraged to be used to develop operations management, since the goal is calculate the deviation between the planned strategy and comprehended strategy, this tool was selected for this research. Preceding the submission of the questionnaire, a group of associates of the studied company was defined following the principles described by Ferreira *et al.* (2011b) to participate in focus group sessions. According to Morgan and Spanish (1984), focus groups not only give us access to certain kinds of qualitative phenomena that are poorly studied with other methods, but also represent an important tool for breaking down narrow methodological barriers. As a qualitative technique, focus groups both add to the available range of techniques in this area and provide yet another chance to demonstrate to more quantitatively oriented researchers the ways in which their work could be improved by using an appropriate qualitative technique, justifying the selection for this research methodology.

The participants of the focus group sessions are associates of such company that work in 3 different locations (Malaysia, Hungary and Brazil), that are under a

management staff located in Houston. Therefore the sampling must be composed by representatives of each location, as described in the Table 10:

Name	Position	Years of service	Graduation
Participant 1	Supervisor - Kuala Lumpur	6	IT Management
Participant 2	Team Lead - Kuala Lumpur	3	IT Management
Participant 3	Supervisor - Budapest	6	System Analyst
Participant 4	Team Lead - Budapest	2	Law
Participant 5	Team Lead - Budapest	2	Tourism
Participant 6	Supervisor - Brazil	13	Economy
Participant 7	Team Lead - Brazil	6	Industrial Enginees
Participant 8	Team Lead - Brazil	3	Social Communication
Participant 9	Business Line Manager	30	Management
Participant 10	Manager line "A"	20	Marketing
Participant 11	Manager line "B"	16	IT Management
Participant 12	Manager line "C"	17	Management

Table 10 – Representatives of each location studied

The questionnaire submitted to the entire team, 76 members from the three sites plus the management located in the United States, was composed of 18 questions (opened and closed), that made the management set the rank of the priorities (used as reference in this paper) that was shared with them team through the strategy plan communication and the analysts rank the areas that they understand are priorities. In order to simplify the data collection, the result of the questionnaire was plotted into the Table 11:

	COUNTRY NAME								
	1	2	3	4	5	6	7	8	9
Competence									
Access									
Flexibility									
Creativity									
Customer Service									
Consistency									
Speed									
	1	2	3	4	5	6	7	8	9

Table 11 – Priorities' Measure

There are questions in one section of the questionnaire regarding their comprehension of the implemented PMM, the level of comfort to work with it, if by only using the PMM they would be certain of what the objective is.

Results were compared with the results from the management questionnaire, aiming to map areas of divergence between the objectives defined by management and priorities comprehended by the staff.

Utilizing the compiled data, an importance x performance matrix such as the one in Figure 18 was created (Slack *et al.*, 2007).
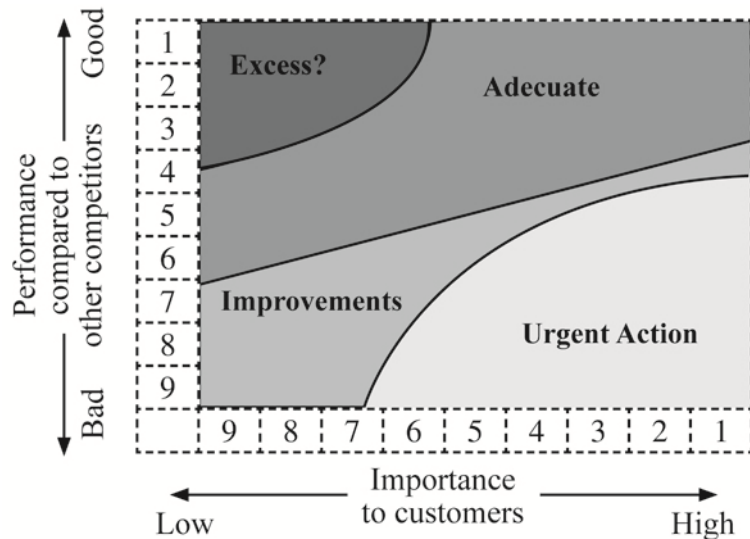

Figure 18 – Performance x Importance matrix (adapted from Slack *et al.*, 2007)

Matrixes should be created to compare the results of each team/location involved in this research. The matrixes were then presented to the focus group participants for discussion.

The focus session was conducted following a script, aiming to map areas of divergence, list possible ways to remove such divergence and improve the communication within the group.

4.3.2 Research implementation Schedule

The research was conducted throughout the year of 2010, the length of time was beneficial for the group to comprehend the principles of this research and get comfortable with it. It is not expected for such research to take that amount of time, in which an optimal length would be 3 to 9 weeks to follow basic steps as described in Table 12:

Step	Name of step	Description
1	Prepare team for research	Ask management to send communication to the staff, informing that this research will be done, letting them know the goal, basic concepts and reinforce the management support fot this initiative.
2	Select methodology to approach the possible gaps	Select among the variety of possible approaches (Ishikawa, Paretto, Focus Group, etc) that matches with the structure and environment of the team.
3	List Management Strategic plan	Meet managemet in order to compile their strategic lan for this team and understand what would be their main goal.
4	Prepare questionnaire	Create questionnaire based on the management priorities interacting with the staff to capture their comprehension.
5	Deliver questionnaire	Management to send out an email preparing the staff to receive and respond such questionnaire, create a deadline for such activity.
6	Compile data	Receive questionnaire responses and compile in a simpler table, aiming to create an existing scenario based on the questions and prepare the data to compare the results.
7	Compare results	Compare results from management and staff, create several areas of divergence and prepare focus group script.
8	Debate results	Deliberate, in the focus group sessions, about the compiled data and get their perception of where and what is the problem.
9	Propose possible solution	Ask the participants of the focus group sessions to propose possible solutions, prepare final ressport and report back to management

Table 12 – Research's 9 week approach

In all cases analyzed in this article, the USA management guidelines (operations strategy plan) was used as reference and base of comparison, aiming to verify the adherence of the strategy plan in the global and virtual teams.

4.4 CASE STUDIES

In this section the three case studies are presented, through a description of the data related to each of the teams and consequent analysis of the data.

4.4.1 Case 1: Malaysia

In order to analyze this scenario by region, the questionnaire responses were separated according to the respondents region, from the created groups an average number was extracted for the sake of analysis and used it as consensus among the staff.

The outcomes are informed in the Tables 13 and 14:

Malaysia	1	2	3	4	5	6	7	8	9
Competence							X		
Access			X						
Flexibility	X								
Creativity									X
Customer Service			X						
Consistency								X	
Speed		X							

X

Management - USA	1	2	3	4	5	6	7	8	9
Competence	X								
Access	X								
Flexibility		X							
Creativity				X					
Customer Service						X			
Consistency						X			
Speed								X	

Tables 13 and 14 – Comparison of priorities between the Management and Malaysia

From the Figure 19, it can be seen that the management located in the United States has a rank of value priorities as follows: speed, consistency and customer service, creativity, flexibility and, access and competence.

This means that their strategy for the studied year was to focus on speed and deliver the work faster, being consistent across all regions, pleasing their customers through creativity and flexibility. According to the management the values for competence and access were 'sedimented' previously and for that reason they were not their priorities for the studied year.

The analysis of the region's priority measures implies that the message delivered by the management was not completely captured by Malaysia since their rank of value's priorities does not match the one that the management was willing to implement.

Only one of the priorities was implemented in the right order in the regions, while in the other hand it can be seen direct opposite positions for values (*i.e.* speed).

From this, it is noted a divergence of priorities between the management in the USA and the supporting staff in Malaysia, therefore the message delivered by the managers are not being received correctly.

Based on the data extracted from the responded questionnaire, an importance-performance matrix was created comparing the management data and the team in Malaysia to obtain a better graphical view of the comparison of value's priorities, showed in Figure 19.
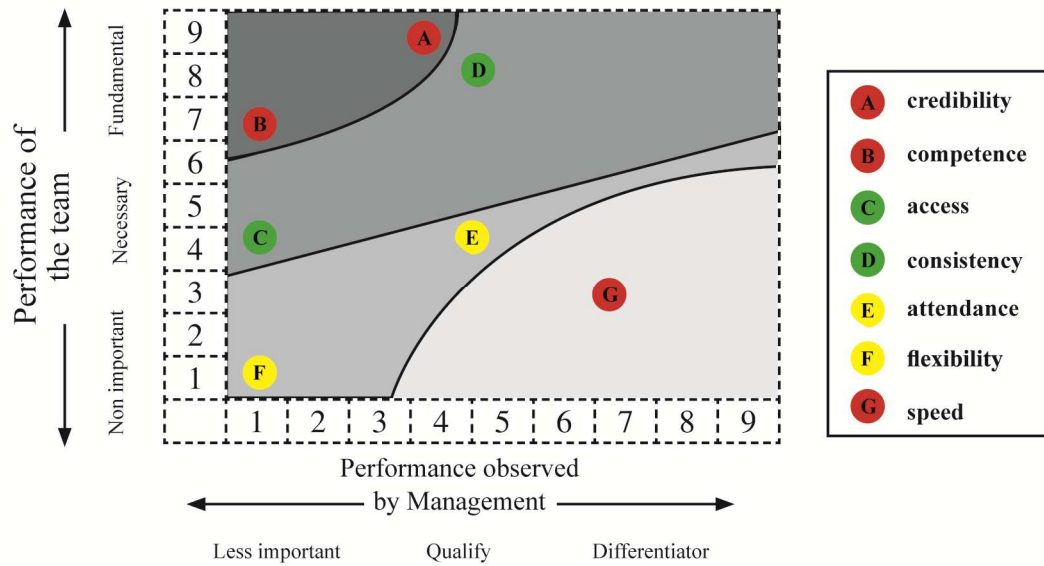

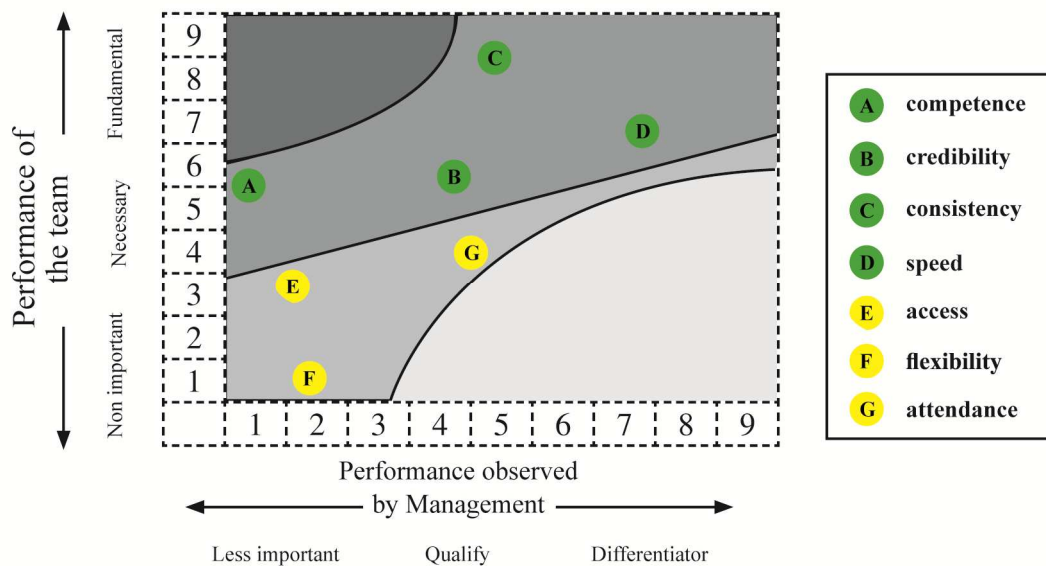Figure 19 – Performance x Importance matrix for Malaysia

For this case, it can be identified two areas that requires improvement (Customer Service and Flexibility), two areas that were identified as excess or were mistakenly perceived by the local staff (Competence and Credibility) and one area that require urgent action by the management (Speed).

4.4.2 Case 2: Hungary

Following the same methodology as in the study realized with the staff in Malaysia, the scenario analysis outcome is presented in the Tables 15 and 16:

Hungary	1	2	3	4	5	6	7	8	9
Competence						X			
Access			X						
Flexibility		X							
Creativity						X			
Customer Service			X						
Consistency								X	
Speed						X			

X

Management - USA	1	2	3	4	5	6	7	8	9
Competence	X								
Access	X								
Flexibility		X							
Creativity				X					
Customer Service					X				
Consistency					X				
Speed							X		

Table 15 and 16 – Comparison of priorities between the Management and Hungary

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The analysis of the region's priority measures implies that the message delivered by the management was not completely captured by Hungary either. Because their rank of value's priorities does not match the one that the management was willing to implement, similar to what happened with the team in Malaysia.

Despite the fact that only one of the priorities had been implemented in the right ranking, in this case one can observe a better adherence due to the reduction of distance between management and actual implementation of the Hungarian team's priorities. This would imply that the comprehension level of the team in Hungary is in a higher level than the team in Malaysia.

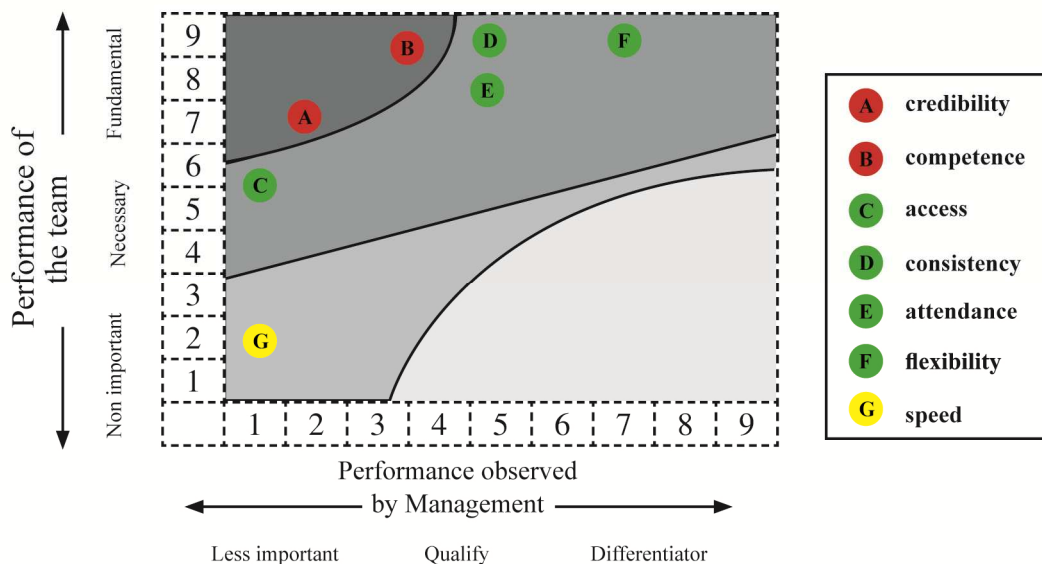The importance-performance matrix for this case is presented in Figure 20:

Figure 20 – Performance x Importance matrix for Hungary

For this case, it can be identified 3 areas that require improvement (Access, Customer Service and Flexibility).

4.4.3 Case 3: Brazil

As in the previous two cases, the scenario analysis outcome is presented in the Tables 17 and 18:

Brazil	1	2	3	4	5	6	7	8	9
Competence					X				
Access		X							
Flexibility							X		
Creativity								X	
Customer Service									X
Consistency								X	
Speed									X

X

Management - USA	1	2	3	4	5	6	7	8	9
Competence	X								
Access	X								
Flexibility		X							
Creativity				X					
Customer Service					X				
Consistency					X				
Speed							X		

Table 17 and 18 – comparison of priorities between the Management and Brazil

The analysis of the region's priority measures implies that the message delivered by the management was not completely captured by Brazil. Yet they present a better alignment with the ranking's priorities, the team in Brazil is focusing and spending energy and work on items that are not considered critical to the management team.

In this case one can observe a much better comprehension level of the management priorities and another reduction of distance between the management will and actual implementation when compared to the previous two cases.

The importance-performance matrix for this case is presented in Figure 21:

Figure 21 – Performance x Importance matrix for Brazil

For this case, it can be identified 1 area that requires improvement (Access) and 2 areas that were identified as excess or were mistakenly perceived by the local staff (Flexibility and Credibility).

4.5 VIRTUAL TEAMS PERFORMANCE

For the sake of the research, performance status was extracted before the start of this research, aiming to compare the results of this methodology to the actual results, in order to validate the research results.

The status of the performance of each team can be seen in the Table 19.

Region	Lead time	Numbers of delayed requests	Numbers of complaints that reached management	Numbers of process change requests	Numbers of exceptions used	Numbers of awards to analysts due to perfomance
Malaysia	79 days	123	17	5	0	1
Hungary	52 days	72	25	1	0	3
Brazil	32 days	38	7	3	2	13

Table 19 – Performance of some indicators per region

This data demonstrate that:

- In Malaysia the staff is the least motivated, developing a not so good relationship with their customers, providing a slow service, with the highest amount of delayed requests, but is 100% consistent.

- In Hungary the staff is not motivated enough (there is a huge difference if compared to Brazil), developed the worse relationship with their customer, providing a service twice slower than the one provided in Brazil, with a lead time that requires 62,5% more time than the Brazilian one.

- In Brazil the staff is more motivated and develops the best relationship with their customers, providing faster service, with the lowest number of delayed requests, although it is the only region that is not 100% consistent with the process due to 2 exceptions in place.

During the focus group sessions in which the participants were exposed to the data gathered, the majority of them did not acknowledge the existence of such diversion of value's priorities and informed that they tried to implement exactly what they comprehended from the management guidelines for that year.

Participants informed that some of the results exposed were due to the frustration of not reaching management's expectations when compared to other regions, impacting in the recovery capacity of each team.

It was identified an exceptional and unique case in Malaysia where the participants informed that the lack of communication (due to time zone issues) could promote impact in their numbers and that they felt neglected by the management,

since most of the alignment meetings occurred during their night shift and they were already tired of the working day, which decreased they cognition level.

Based on the acquired information, a set of recommendations was created:

- More use of written language.

- Increase frequency of meetings.

- Distribute the operations' plan to the operational level.

- Promote more interaction between the groups.

- Use of tips for virtual teams, aiming to increase use of tools.

- Create a clear set of metrics that can be understood by all groups.

The management, in the other hand, demonstrated surprise when exposed to the fact that their communication was not being effective, they informed not to be using data from cultural analysis of each region and that their expectation was that each region adapted to their language since English was selected as communicational language for emails and reports.

4.5.1 Polar Diagram Analysis

From the data acquired during the research, a polar diagram was created to identify which team received a better comprehension of the priorities defined by management.

The polar diagram was created based on managements priorities set by the management of the teams, during the strategy meeting. The priorities defined during the management strategy meeting were plotted in the polar diagram, where each vertex is designated by a priority and graded in 9 grades (as the questionnaire submitted to the managers and teams). The comprehended data is the average of the responses of the teams, which demonstrates the level of comprehension of the ranking of each of these priorities. Also, the box with the names of the priorities is colored according to the area in the importance x performance matrix described in the section 4 and its subsections.

Plotting the data two outcomes would be possible; the first would be that the polygon formed by the vertexes from the comprehended priorities data does not absorb the polygon created by the vertexes of the planned priorities. This scenario

implies that the level of comprehension of the team is reduced and therefore their performance is insufficient when compared to the goals; the second outcome would be that the polygon created by the vertexes created with comprehended priorities data absorb the polygon created by the vertexes of the planned priorities. This scenario implies that the level of comprehension is sufficient and that the performance of the team is on the same level or over when compared to the goals. One thing important to be noted is that the second outcome may have two sub-results which are: 1) the polygon created by the comprehended vertexes absorbs the polygon leaving some space between the two figures and; 2) the polygon created by the comprehended vertexes absorbs the polygon leaving some no space between the two figures.

One way to measure how close to the objective the teams are is to calculate the area of these scenarios: if the polygon created by the planned vertexes is absorbed by the polygon created by the comprehended vertexes, the smaller the area, the closer to the objective the team is; if the polygon created by the planned vertexes is not absorbed by the polygon created by the comprehended vertexes, one will have to calculate the area of divergence and how smaller the area of divergence is, the closest to the objective the team is. However, the teams in scenario 1 already exceeded the expectation and are in a better position than the teams in scenario 2. Following the graphical analysis, management is able to measure and re-direct the teams aiming to reach a harmonic environment where the teams meet the objectives and do not waste time or effort in things that are not priorities.

For the team in Malaysia, the polar diagram is displayed in the Figure 22.
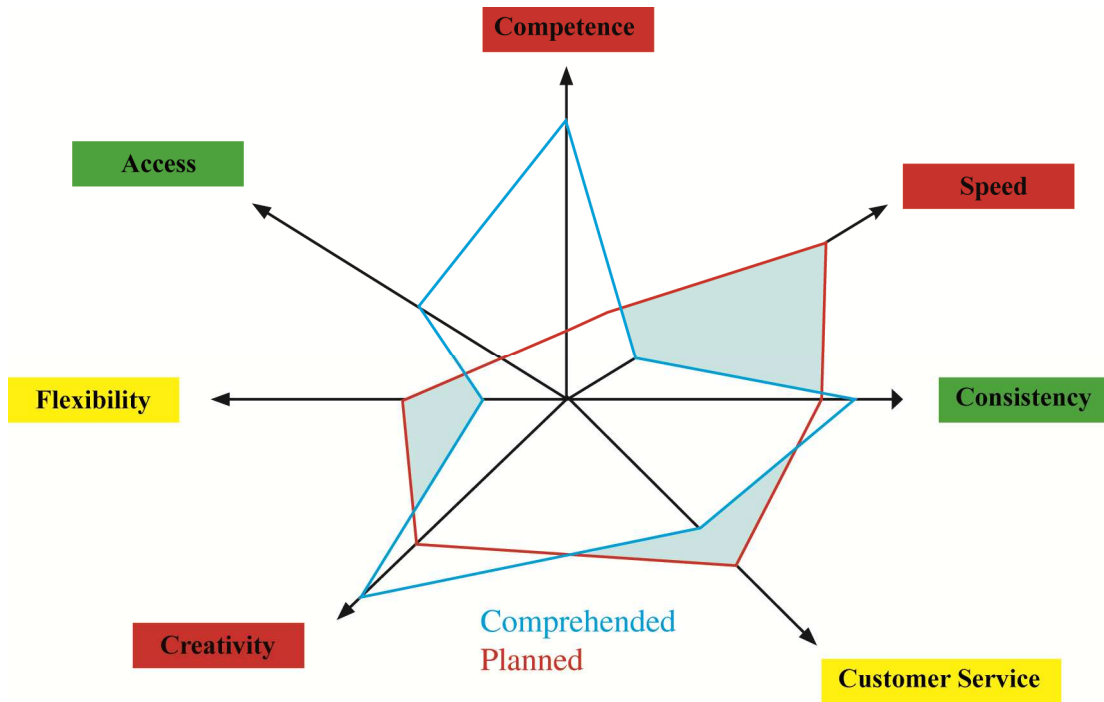
Figure 22 – Polar diagram for the team in Malaysia

The divergence between the planned objectives and comprehended objectives can be calculated as the area in which the polygon designed in red (planned objectives) exceeds the polygon in blue (comprehended objectives), highlighted in the Figure 22.

The area highlighted in the Figure 22 (graphical view of the level of comprehension for the team in Malaysia) can be calculated when the graph is plotted in Autocad, the outcome for the graph of the team in Malaysia is 11.2501.

Following the same rationale and plotting the data for the team in Hungary, the graphical view can be seen in Figure 23.
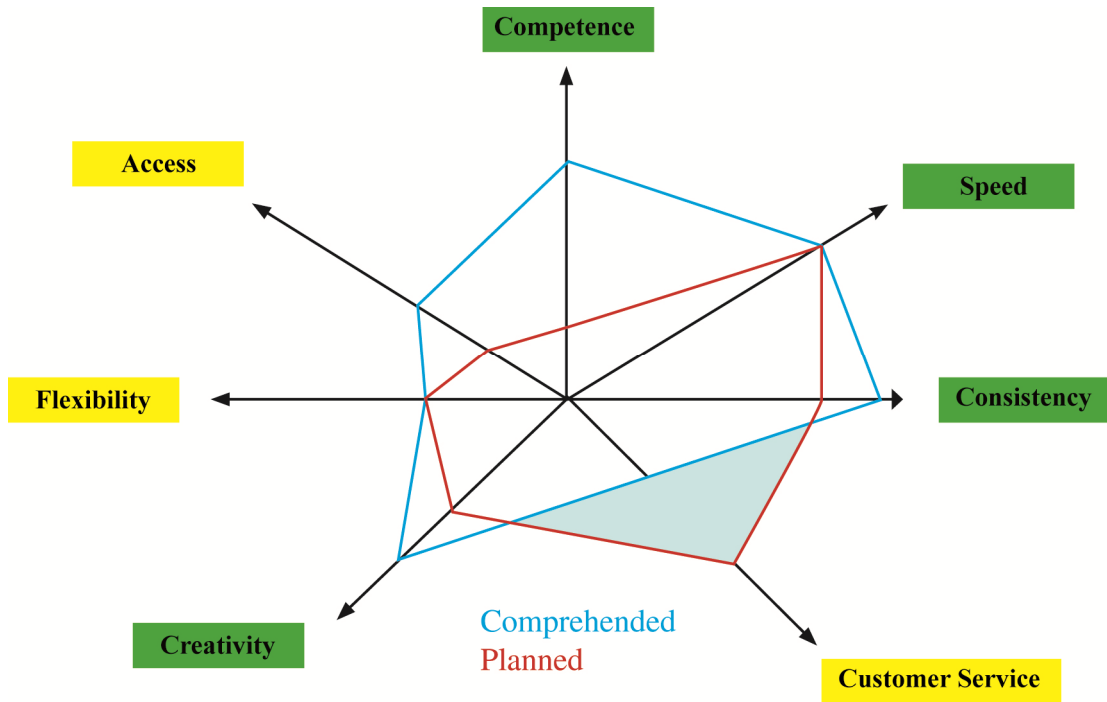
Figure 23 – Polar diagram for the team in Hungary.

Plotting the data in Autocad to calculate the highlighted area would have as outcome for the team in Hungary is 4.7759.

For the team in Brazil the graphical view of the planned and comprehended objectives is presented in the Figure 24.
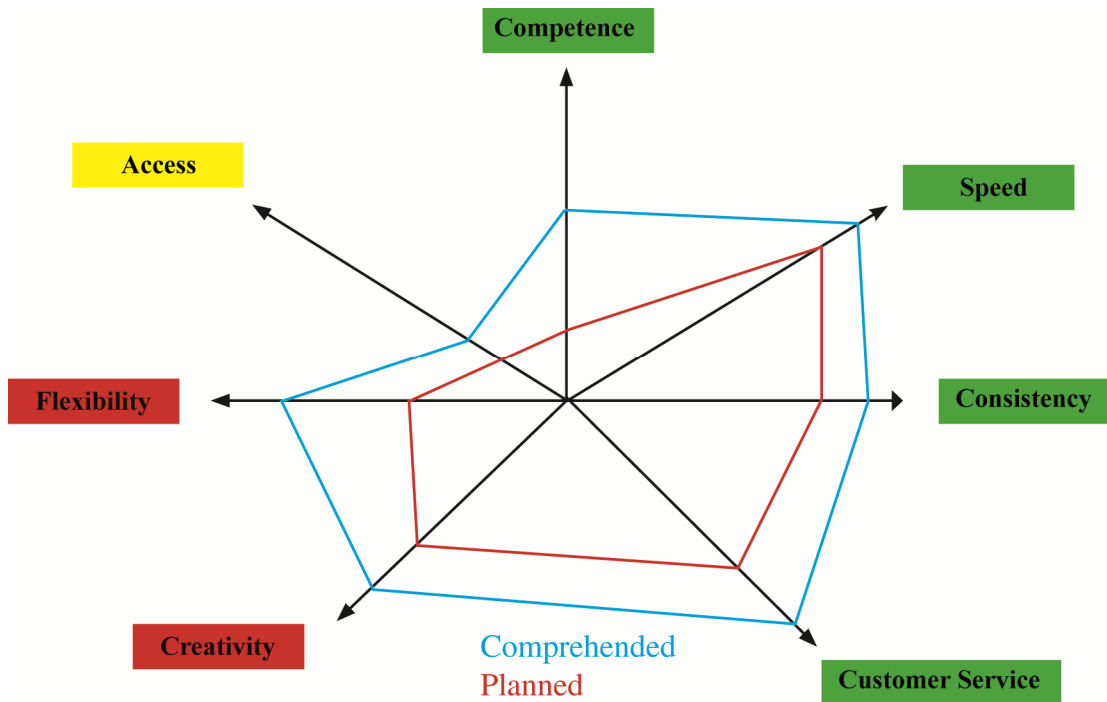
Figure 24 – Polar diagram for the team in Brazil.

As can be seen, there is no area to be calculated, since the polygon of comprehended objectives absorbs the polygon in red (planned objectives).

The order of the teams regarding their level of comprehension of the results would be: Brazil (better level of comprehension, since the graph demonstrates that the objectives are exceeded), Hungary and Malysia (worse level of comprehension, with an area of 11.2501).

This does not imply that the team in Brazil does not need any adjustment, it only means that when compared to Hungary and Malysia, the team in Brazil reaches a better performance, however; there is still room for improvement (get the vertexes of the two images closer and reduce the area between the images).

4.5.2 Lessons learned

During the focus group sessions several problems were identified to justify the miscomprehension of the goals, which are described in the Table 20:

Constraints identified in the focus group sessions	Comments
- Lack of clear communication	The timezone did not provide a overlaping between regions and it reduced the level of communication between teams
- Language Barriers	The different languages (Malay, Portuguese, Hungarian) and the need to communicate in a similar language (English) in which some members may not be fluent causes a reduction of comprehension
- Lack of experience from the team	The on the job experience and familiarity with acronyms, corporate language and metrics impacted negativelly in their comprehension of numbers and objectives
- The team can not comprehend if they ignore the management vision	The reduced access to management and minimum number of employee forums did reach the objective of sharing the management vision
- Lack of motivation	Due to constant salary and conditions comparison, the members of the team
- Cultural barriers	Religion, holidays, customs cause some restriction in members of the team and makes difficult integration exercises among the members of virtual teams

Table 20 - Problems identified to justify the miscomprehension of the goals

Despite the fact that all these teams used the same set of indicators and same type of communication (a single email to all the teams and group meetings), the comprehension of the goal was different.

Ferreira *et al.* (2011), described that the comprehension of implementation/use of operations strategy by virtual teams can be divided into three different levels: strategic, comprehension and development, and each of these levels will have multiple areas. The intersection of these levels will reach the objective of fully implementation/use of operations strategy (Figure 25).
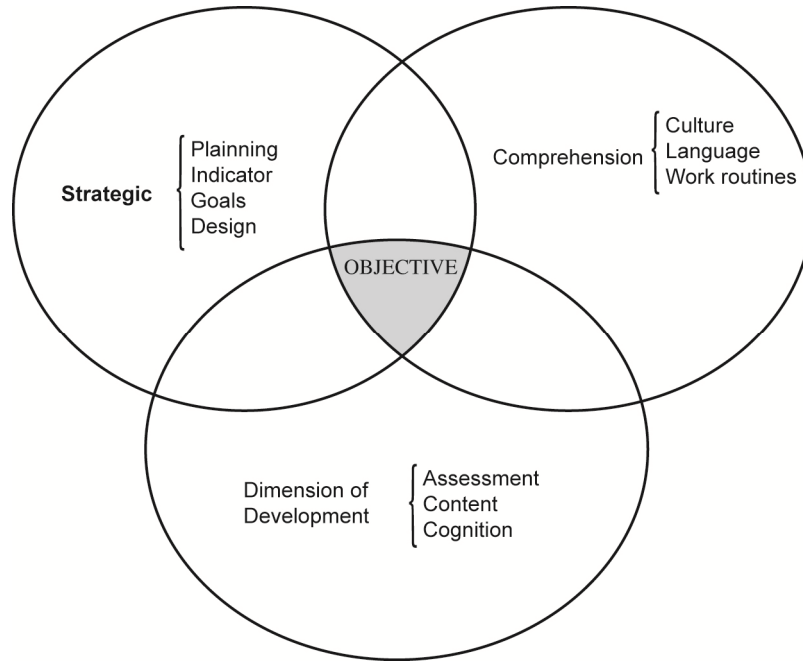
Figure 25 – Objective for full implementation/use of operations strategy

Also, Ferreira *et al.* (2011) called contingency variables as the ones that suffer influence of the operational environment and distributed in different levels of effect to the comprehension of the operations strategy, depending on the level of impact such variable has in the overall goal (Figure 26).
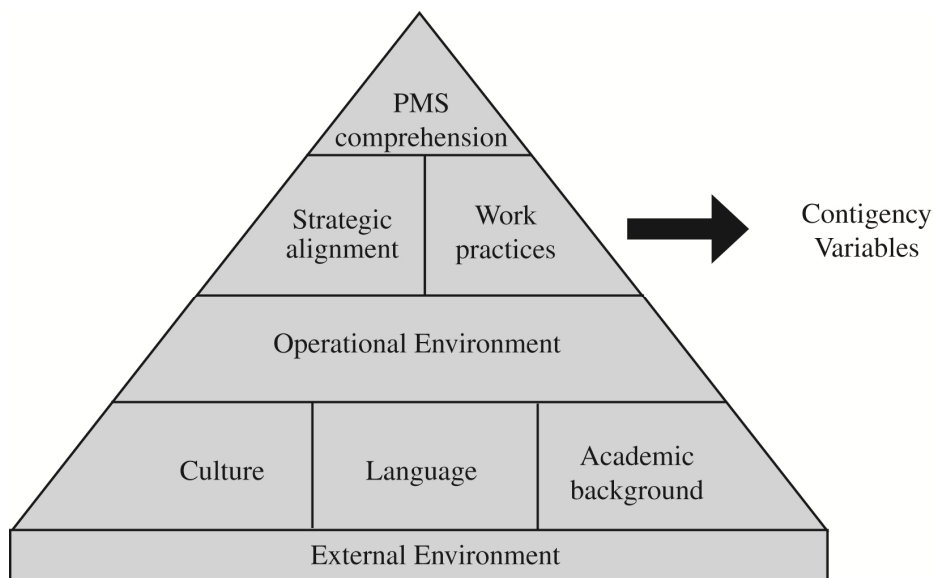
Figure 26 – PMS comprehension pyramid and contingency variables

Comparing the result of the focus group session to the concept described by Ferreira *et al.* (2010), it was identified that the set of indicators only had the first link with the virtual team (Strategy), although the management did not work on the other two links. So the set of indicators did not reach the operational environment which could provoke poor performance result by the teams.

4.6 CONCLUSION

During the focus group sessions in which the participants were exposed to the data gathered, the majority of them did not acknowledge the existence of such diversion of value's priorities and informed that they tried to implement exactly what they comprehended from the management guidelines for that year.

The participants informed that some of the results exposed were due to the frustration of not reaching the expectations of the management when compared to other regions, impacting in the recovery capacity of each team.

According to the acquired data, the miscomprehension of the contingency variables (Work practices and Strategic alignment) and the neglection of the external environment variables (culture, language, academic background) caused confusion on the priorities in each team, implicating in development of work and effort on items that are not priorities for the managers.

When a team misunderstand the priorities, either they will provide a service way better then expected (increasing the cost of the service and providing little impact on clients/managers since this is not their priority) or provide a service worse than expected (decreasing effort and cost on an important priority).

The objective of each team should be re-evaluate the priorities, respond a new survey and verify in the polar diagram if the highlighted area reduced or reached a zero area image (both red and blue lines are alleged.

After the focus group session, the team created a plan of action to be implemented, aiming to get better clarity from management and improve their communication channel.

The management decided to review the set of indicators and promoted forums in order to get all teams aligned, while the local leaders will make sure the teams

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comprehend the set of indicators and goals, and will update this research data aiming to obtain a better alignment with the management goals.

Another assessment will be performed within one year, aiming to check the adherence of the teams to the management principles.

As next steps for this research, a methodology to create a set of indicators to virtual teams should be described, as well as a guide for the management to cover all links between the operations strategy and virtual teams, aiming to establish the connection between the two areas (Figure 16). In this research tools as: Ishikawa, Paretto and Flowchart, described by Slack *et al.* (2003) can be used as facilitator for such exercise.

For future research, the methodology followed in this research may be replicated to other companies and proposed adjustments to this methodology aiming to make it applicable to other companies' virtual environment. As well as a long term study to document the evolution of the companies across time, with the ability to point out strategies that would work and create actions linked to the graphs. This is to the allow management to identify the image of the graph and a set of actions are already defined in order to reconfigure the graph in a desired way allowing them to use as a guide.

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5 RESULTS DISCUSSION

The articles presented in chapters two to four demonstrated that virtual teams are a growing trend in large companies, it is now a reality. Virtual teams enable organizations to combine the talents of their expanded organization to meet the increasingly competitive pressures of the marketplace. Nevertheless, research indicates that these diverse virtual teams, while having the potential to be far more effective in their outcomes than their co-located and more homogeneous counterparts, more often experience a high degree of ineffectiveness.

Leaders of virtual teams often must adjust their leadership styles to build trust and relationships among team members and, at the same time, be able to truly take advantage of working across time zones to meet their business goals more efficiently

In a competitive market, where customers demand high quality in the services/products, higher efficiency and low cost, companies prepare themselves to develop systems to optimize processes, reduce cost and identify new business opportunities. Performance measurement are processes that through the collection of information and development of indicators help the decision making process, directing it to a more precise strategy, putting the expected and actual result each time closer.

The methodology described and tested in this dissertation, proved to add value to virtual teams, in which it will improve the comprehension of priorities and as consequence, increase the alignment of teams to the priorities and reduce the recycle time, as well as the efforts to area that are not important to the management team.

6 CONCLUSION

The first article show that the link between Strategic Alignment, Performance Measurement and Virtual Teams is still weak and a deeper research in this area is still valid, proposing a methodology to be followed and analyzing the data through network analysis concepts, since this type of analysis is each time more common in the scientific community.

After such literature review and research on performance measurement models, it was observed that due to the existing barriers in virtual teams' environment there was a lack of comprehension of the priorities by virtual team members.

In the second article it was described a methodology to measure the adherence of Performance Measurement Systems comprehension by Virtual Teams. Following this methodology, one will be able to measure the adherence (level of comprehension) of PMS premises and objectives in virtual teams and as a next step will list reasons and ways to improve such systems, gathering a global perspective that may help management in communicating or creating new metrics for their teams. The methodology was tested in a small group, in order to prepare it for a larger audience.

The third article presents an application of the proposed methodology in a global team of a selected large company, the team was distributed in 4 countries (Brazil, Hungary, Malaysia and United States).

During the focus group sessions in which the participants were exposed to the data gathered, the majority of them did not acknowledge the existence of such diversion of value's priorities and informed that they tried to implement exactly what they comprehended from the management guidelines for that year.

After the focus group session, the teams demonstrated to be in a better alignment with the priorities validating the methodology. A new assessment will be performed within an year, in order to create a new plan of action to increase the alignment.

This dissertation reached its objective by reviewing the literature in the first article in 3 large scientific databases, mapping the authors that contributed to the science and proving future areas of research. In the second article it was proposed a methodology to assess virtual teams and measure their level of comprehension of

their priorities, the methodology was tested in a pilot environment to improve the methodology to test it in a larger audience. During the third article the proposed methodology was tested in a team, distributed in four locations (Brazil, Malaysia, Hungary and United States), working virtually, following the same process and under the same management, the findings in this article made possible the replication of the methodology to an even larger audience or multiple companies.

The work developed in this dissertation had some limitations in the size of the databases, only 3 large databases were reviewed, the methodology was tested in a virtual team of a single company and the tools used in this work were determined by the author as the most appropriate due to the review of the literature and implications of use of such tools, making it a simple approach able to be replicated without large costs.

As next step for future research, a larger review of databases about the subject studied in this research could be performed aiming to obtain a new perspective on the state of the art of this subject, the methodology can be implemented to a multiple set of companies and results compared to verify if the companies' cultural environment provide any impact to the comprehension of their leadership's priorities and finally create a set of actions that can used in any corporation to increase the comprehension of their performance indicators and priorities.

This research aimed to study a specific area of operations management which demonstrated to have gaps in its publications in an field that is constantly growing in large corporations, gathering distinct set of knowledge and using simple tools to provide a replicable assessment from which the findings can contribute to the reduction of cost of re-work, increase the quality of service and empower this new trend that is arising in large corporation's horizon. This work intended to contribute as a step in a field of a growing area of operations management.

ARTICLE SUBMISSION RECEIPTS

In this section are the receipts for the article submission to the journals.

Receipt for article 1

Receipt for article 2

Receipt for article 3

A number of selected papers presented in the "International Conference of Production Research America´s Region 2010" held in Bogotá, Colombia (21st to 23rd July) will be published in the form of a regular article of the International Journal of Production Economics, with a footnote explaining the conference.

I am pleased to inform you that your paper entitled:

Title: THE IMPORTANCE OF CREATION OF INDICATORS AS AN ALIGNMENT TOOL OF PROCESSES AND STRATEGY OF COMPANIES

Authors: Pedro Ferreira, Juliano Munik, Edson Pinheiro de Lima and Sergio E Gouvea

has been selected for consideration for publication in the Journal. We invited you to submit a full version of your article. We would be most grateful if you could inform all your co-authors of this invitation. Please consider the points below before deciding whether or not to submit.

IJPE is a high quality and highly regarded journal in the fields of Operations, Production and Supply Chain Management, Operations Research and Industrial Engineering. Its current Impact factor is 2.068 (5 year Impact Factor of 2.736). It has a rigorous reviewing process. It is important to note that conference papers almost invariably require significant development before they are suitable for external peer review. We ask therefore that you consider whether or not you can develop your conference paper sufficiently well before deciding to submit it to the Special issue. In particular, please note:

Dear Dr. Quezada,

please find attached our paper No. 80.

Please do not hesitate to contact us if you have any question.

Sincerely yours,

Sergio E. Gouvea da Costa

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Dr. Sergio E. Gouvea da Costa
Industrial and Systems Engineering
Pontifical Catholic University of Parana
Rua Imaculada Conceicao, 1155
Curitiba ☐ Parana ☐ Brazil
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On Mar 25, 2011, at 3:45 PM, Luis Quezada wrote:

Dear Sir:

The due date for submitting the paper to IJPE has been extended until Friday 1st of April.

Please, send the full paper to me (luis.quezada@usach.cl). DO NOT use the on-line system of IJPE.

I look forward to hearing from you,

Your Sincerely,

Dr. Luis Quezada
Department of Industrial Engineering
University of Santiago of Chile (USACH)
Guest Editor
International Journal of Production Economics

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