This paper provides a social network analysis of works developed in Performance Measurement research, analyzing an extract of 3412 articles of 3 major 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, presented either any part of the body of the article. Through the user of UCINET, it was created a network for visualization of the status quo and provided a vision of future areas to be researched and appearance of new authors for such fields, demonstrating the next path to be followed by performance measurement researchers. The paper identifies the key contributors to the field based on the extracted article data analysis and argues that due to constant globalization of companies, new areas of study must be developed aiming to continue success of Performance Measurement use. This paper is valuable to anyone that wants to have a view of Performance Measurement actual studies and possible areas for future works.

Palavras-chaves: Performance Measurement, Metrics, Virtual Team, Evolution, Globalization
1 - Introduction

Neely (2005) 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 1954 suggestion that balanced measurement systems should be developed (Drucker, 1954).

Neely (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-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, Meredith and Pilkinton (2009), worked on a citation and co-citation analysis. This work gathered data to show the growth of academic publication of articles about Operations Management. It also made evident that the areas of knowledge studied until 2009 were basically the same exposed by Neely in 2005. It demonstrated that the search for the ideal methodology to manage through performance is still vivid in the academic society.

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

Oliveira et al (2006), in a research with virtual teams, identified that cultural differences are visible in virtual teams, promoting impact in the final result. It also demonstrated that 50% of workers feel that tête-à-tête contact is still necessary for a good work environment.

This research aims to show that such topics are still valid, although due to constant globalization of companies and virtualization of teams, another theme must be included in the research topics: The impact of virtual teams in performance measurement results.
Using the software UCINET, was created a social network to design and provide a visual analysis of the links between themes, authors and publications.

2 – Methodology and data

The methodology used to review the intellectual structure of Measurement Systems being used in Global teams is bibliographic citation and co-citation analyses.

According to Price’s 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).

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, then, is considered to correspond to the group of publications that can be described as a subject-matter-speciality’s published current work (Small and Griffith, 1974; Griffith et al. 1974).

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 are indicators of activity or importance to the field. As such, according to White and Griffith (1981), citation analysis represents “the field’s view of itself” (figure 1).
Braam et al (1991) concluded that combining word-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, in particular concerning aspects related to cognitive content of publications.

Therefore, aiming to review the intellectual structure over this subject, it was created a list of words that were relative to the impact of virtual teams in performance measurement systems and the alignment of operations strategy within this virtual team.

Figure 1 – Method to describe research topics involved in publications citing documents in co-citation clusters (source: Braam et al, 1991)
Then it was selected important academic databases, based on their size of articles entries, region they are more used, aiming to extract articles with certain relevance to the theme.

These databases were selected because of their solid relationship with Operations Management academic literature and their long history.

Every publication that contained one or combined words of the list 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 the most recent in 2009.

Before the analysis was conducted, a substantive review was of the generated dataset was undertaken, in order to have it drafted according to the relevance with the subject of this research. After this review the database counted 82 articles distributed according to figure 4.
To examine the developments more fully and the basis of empirical a citation/co-citation analysis of research on the database gathered information was conducted.

After the abstract review, articles were read, to confirm relevance to the research and the following data gathered in a database:

- Title of article
- Authors
- Publisher
- Year the article was published
- Keywords
- Co-citation

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 5.

<table>
<thead>
<tr>
<th>#</th>
<th>Word</th>
<th># entries (after review)</th>
<th># entries (initial)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sistema de Medição de Desempenho</td>
<td>36</td>
<td>494</td>
</tr>
<tr>
<td>2</td>
<td>Performance Measurement</td>
<td>19</td>
<td>1026</td>
</tr>
<tr>
<td>3</td>
<td>Indicadores de Desempenho</td>
<td>14</td>
<td>698</td>
</tr>
<tr>
<td>4</td>
<td>Métricas</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>5</td>
<td>Software Services</td>
<td>0</td>
<td>671</td>
</tr>
<tr>
<td>6</td>
<td>Licensing</td>
<td>4</td>
<td>275</td>
</tr>
<tr>
<td>7</td>
<td>Gestão de ativos de TI</td>
<td>1</td>
<td>31</td>
</tr>
<tr>
<td>8</td>
<td>Medicação de Desempenho</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>9</td>
<td>Comportamento AND comprometimento</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>Cultura</td>
<td>6</td>
<td>181</td>
</tr>
<tr>
<td>11</td>
<td>Equipe Global</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

82 3412

Figure 4 – table with numbers of articles before and after review (source: Author)
The spread of journals in which citations appeared is interesting. In total, the citations were drawn from 85 different journals; the most frequent cited journals are indicated in the figure 6.

<table>
<thead>
<tr>
<th>Classification</th>
<th>Journals</th>
<th># citations</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>International</td>
<td>International Journal of Operations and Production Management</td>
<td>203</td>
<td>15.96%</td>
</tr>
<tr>
<td>International</td>
<td>Management Accounting Research</td>
<td>142</td>
<td>11.06%</td>
</tr>
<tr>
<td>International</td>
<td>Harvard Business Review</td>
<td>132</td>
<td>10.38%</td>
</tr>
<tr>
<td>International</td>
<td>Strategy+Business</td>
<td>52</td>
<td>4.09%</td>
</tr>
<tr>
<td>International</td>
<td>Organisations and Society</td>
<td>51</td>
<td>4.01%</td>
</tr>
<tr>
<td>International</td>
<td>International Journal of Production Economics</td>
<td>45</td>
<td>3.54%</td>
</tr>
<tr>
<td>International</td>
<td>Journal of Operations Management</td>
<td>41</td>
<td>3.28%</td>
</tr>
<tr>
<td>International</td>
<td>Strategic Management Journal</td>
<td>34</td>
<td>2.67%</td>
</tr>
<tr>
<td>International</td>
<td>International Journal of Production Research</td>
<td>29</td>
<td>2.28%</td>
</tr>
<tr>
<td>International</td>
<td>Information &amp; Management</td>
<td>28</td>
<td>2.23%</td>
</tr>
<tr>
<td>International</td>
<td>Information and Management</td>
<td>33</td>
<td>2.56%</td>
</tr>
<tr>
<td>International</td>
<td>Sloan Management Review</td>
<td>25</td>
<td>1.93%</td>
</tr>
<tr>
<td>International</td>
<td>Management Science</td>
<td>23</td>
<td>1.81%</td>
</tr>
<tr>
<td>International</td>
<td>Supply Chain Management</td>
<td>21</td>
<td>1.65%</td>
</tr>
<tr>
<td>International</td>
<td>Measuring Business Excellence</td>
<td>21</td>
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</tr>
<tr>
<td>International</td>
<td>Long Range Planning</td>
<td>20</td>
<td>1.57%</td>
</tr>
<tr>
<td>International</td>
<td>Industrial Engineering</td>
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<td>1.57%</td>
</tr>
<tr>
<td>International</td>
<td>Management Decision</td>
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</tr>
<tr>
<td>International</td>
<td>Academy of Management Review</td>
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<td>1.34%</td>
</tr>
<tr>
<td>International</td>
<td>The Accounting Review</td>
<td>17</td>
<td>1.34%</td>
</tr>
</tbody>
</table>

Figure 6 – table with most frequent journals (source: Author)

3 – 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 which comes with UCINET package (Borgatti 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 (2005) 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 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
emerging 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 (source: author)

The relatively dense network at the center of the figure 6, suggests that the main authors are Nelly, Platts and Kaplan. Diverging of Neely’s findings in his work “The evolution of performance measurement research” (2005) 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 9 - Keyword analysis for most influential works (source: author)

Figure 9 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 emphasizes that significant associated work has been carried out in the fields of operations management, strategy and performance measurement.

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.

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 and Walt (2000), the leader of the future must have the following characteristics:

- Thinking Globally
- Appreciating Cultural Diversity
- Demonstrating Technological savvy
- 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 in his research in 2005.
Neely (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.

Figure 10 – distribution of publication across the years (source: author)

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

4 - 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 (impact of virtual
teams in performance measurement results). In early stages it was supposed that the literature for this specific field would lack of research in this area.

In the section 3 of this article, it was made evident, through the network analysis, that a new researcher (Ken Platts) appeared in the center of the distribution (if compared to Neely’s work in 2005). Platts usually research for more approach driven techniques, while others continue to search for the perfect Performance Measurement System (PMS).

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

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 analyze the lack of works studying the impact of virtual teams in PMS results, 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).

5 - References
Borgatti, S.P., Everett, M.G. and Freeman, L.C., *UCINET 6.0 Version 1.00*, Analytic Technologies, Natick, 1999


