IMPROVING CONNECTIVITY AND INFORMATION FLOW IN LEAN ORGANIZATIONS: TOWARDS AN EVIDENCE-BASED METHODOLOGY

Jorge Flores[1], Juan C. Ruiz[2], Daniela Alarcón[3], Luis F. Alarcón[4], José L. Salvatierra[5] and Isabel Alarcón[6]

ABSTRACT

Lean organizations focus on effectively delivering value to their customers, understanding value as defined by their customer's perspective, thus flexibility and fast adaptation to client's demands have become a requirement for competitiveness. This adaptation demands a continuous and coordinated flow of information among processes which in first instance are mediated by people. People and their connectivity play a fundamental role in the success or failure of projects, and should be managed and improved continuously.

Improving connectivity and information flow requires a methodology that allows not only understanding the current state, but also to effectively control and check the actions taken by the organizations based on clear and objective evidence. This paper aims at discussing the initial development of a methodology based on the experience of applying it on five Chilean Construction Companies.

The proposed methodology integrates social network analysis (SNA) as a diagnostic tool, inferential statistics analysis (ISA) to further study the current state and discussion round tables (DRT1 and 2) with key members of the organizations in order to translate SNA and ISA results into the organizations specific context. The initial applications have allowed to carry out complex organizational diagnostics and to achieve simple, localized, quick and inexpensive interventions of information flow improvement based on quantifiable evidence. To enhance performance of this tool

[1] PhD Student of School of Psychology, Social Science Faculty, Pontificia Universidad Católica de Chile, Av. Vicuña Mackenna 4860, Macul, Santiago, Chile Phone +56 2 23544639, jflorese@uc.cl

[2] PhD Student of School of Psychology, Social Science Faculty, Pontificia Universidad Católica de Chile, Av. Vicuña Mackenna 4860, Macul, Santiago, Chile Phone +56 2 23544639, jruizd@uc.cl

[3] Project Consultant, Centre of Excellence in Production Management, GEPUC, Pontificia Universidad Católica de Chile, Av. Vicuña Mackenna 4860, Edificio Mide UC 3er Piso, Macul, Santiago, Chile, Phone +56 2 2354 7050, dalarcon@gepuc.cl

[4] Director and Professor, Department of Construction Engineering and Management, Pontificia Universidad Católica de Chile, Av. Vicuña Mackenna 4860, Edificio San Agustín 3er Piso, Macul, Santiago, Chile, Phone +56 2 2354 4244, lalarcon@ing.puc.cl

[5] Assistant Professor, Department of Civil Engineering, Universidad de Santiago de Chile, Av. Ecuador 3659, Estación Central, Santiago, Chile, Phone +56 2 27182818, jose.salvatierra@usach.cl

[6] Investigatión and Development Manager, Centre of Excellence in Production Management, GEPUC, Pontificia Universidad Católica de Chile, Av. Vicuña Mackenna 4860, Edificio Mide UC 3er Piso, Macul, Santiago, Chile, Phone +56 2 23547249, ialarcon@gepuc.cl

future research should be focused on measuring the impact of these interventions. The continuous focus on people and their connectivity will take the industry one step closer to true adaptable and flexible Lean Organizations.

KEYWORDS

SNA, LEAN Culture, information flow, Organizational Diagnostic, Connectivity

INTRODUCTION

According to Lawrence and Lorsch (1967) as organizations become more complex, they require greater specialization. Furthermore, Phelps (2012) pointed out that increasing specialization requires greater information-knowledge integration and this so called greater integration is not possible to achieve merely by technological tools but by a deep understanding of the information processing throughout the organization members.

It is essential for companies to recognize and understand the conditions through which information processing is developed. Mueller (2004) stated that the most valued information or *individual knowledge transference* is shared in an informal mode, such as personal communication, and not by memos or other formal sources; and this informal communications are mediated by personal relationships. Meaning that in order to be able to improve flow and seek perfection on processes; we need to access informal communications channels. Unfortunately, they often remain invisible and unidentified.

In 2013 (Alarcon et al 2013) published an investigation developed by the Production Management Center of the Catholic University of Chile (GEPUC) using Social Network Analysis not merely as a tool but as a complex diagnostic instrument to access connectivity among people within an organization, a methodology oriented to make explicit an otherwise hidden flow of valuable information. During the same year, Gepuc started a new investigation with an interdisciplinary team in order to work toward a diagnostic methodology of information flow, and applying that model in a pilot intervention with 5 Chilean Lean thinking construction industries. The result of that intervention is presented in the present investigation paper.

BACKGROUND

COMPLEX RELATIONSHIPS AT THE WORKPLACE, FLOW OF INFORMATION AND THEIR STUDY

People management in the construction industry has been more an emerging issue than a deliberated and strategic process (Brandenbur et. al. 2006). Hegar (2001) points out that companies must generate an environment that encourages a culture of information sharing. However, the level at which information is shared and integrated will be given mainly by the information flow of said organization (Dave, Boddy & Koskela, 2010). The formal flow of information is defined by the organization chart and it is carried out through formal documents and other means designed for that purpose. Nevertheless, relevant information may take routes different from those defined by the organization because most of it flows through informal relations networks (Anklam, 2003).

Considering the relevance of studying formal and informal interpersonal relationships, organizational psychology has typically conducted studies with linear analysis methods, such as linear multifactor regression (Pollmann y Finkenauer, 2009) or factorial analysis (Gifford and O'Connor, 1987; McCae and Costa, 1989, Wagner, Kiesel and Schmidt, 1995) However this type of analysis presumes the independency of the data (Stevens, 2009), and secondly it may hide some factors in the measures of central tendency (Field, 2009). With the purpose of overcoming these difficulties, an evidence-based diagnostic model that incorporates three aspects is proposed, namely: social networks analysis (SNA), that allows to study relationships between people in complex contexts; inferential statistical analysis (ISA) regarding metrics established with SNA to issue forecasts of the evaluated factors; and the transference of the results to strategic people within the organization in order to diagnose and change the information flow through discussion round tables (DRT), addressed below.

TOWARDS AN ORGANIZATIONAL DIAGNOSTIC MODEL OF FLOW OF INFORMATION

SOCIAL NETWORKS ANALYSIS (SNA)

Anklam (2003) states that the ability of an organization to fulfill its objectives depends on the relationships between its collaborators. SNA can be used to gather and analyze relationship patterns within an organization. Cross and cols. (2002), on the other hand, highlight the use of SNA in at least three areas of organizational interest: (1) To discover the importance of informal structures that coexist with formal ones within the organization, (2) To move towards a more flexible organizational model team work-oriented and more dependent on knowledge assets (information flow), and (3) To quickly develop close cooperation relationships.

SNA presumes that people are interdependent; therefore it has developed its own set of statistics such as centrality and density. A formal organizational chart is not an adequate guideline to know how an organization actually works (Ehrlich y Carboni 2005), especially if we want to diagnose the information flow, in order to deploy Lean principles in the construction industry.

INFERENTIAL STATISTIC ANALYSIS (ISA)

The multi-factor lineal regression method was implemented with the purpose of issuing forecasts with data obtained from the SNA. This is a mathematical method that models the relation between a dependent variable, different independent factors or variables (in this case an indicator of the social networks that were evaluated) and a random term (error). This model can be expressed as follows:

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_p X_p + \epsilon$$

Where **Y**, is the explained or dependent variable. $\mathbf{X_1, X_2,\ldots X_p}$ are the independent or explanatory variables. $\boldsymbol{\beta_1, \beta_2,\ldots \beta_p}$ are parameters that measure the influence that explanatory variables have over the explained variable. $\boldsymbol{\beta_0}$ is the intersection or "constant" term, and ***p*** is the number of independent variables to be considered in the regression (Field, 2009).

DISCUSSION ROUND TABLES (DRT)

It is important to point out that round tables held in the framework of the study are a technique that is performed from a psychological standpoint in accordance to organizational psychology (OP). This, because once the integration with SNA and ISA analysis is performed, they are finally oriented towards generating changes in the beliefs, values and wellbeing within the organization, with the purpose of improving both its human and productive processes (Mc Lean, 2009).

Discussion round tables represent a technique of oral communication widely used in organizational psychology, sociology and politics (Cassidy, 2007). Round tables in the present investigation consist of meetings between the intervention team Gepuc and key members of the organizations (CEO, human resources manager, CFO, etc.) where the results obtained purely by SNA and ISA analysis are shown. In said meetings, data obtained are addressed in terms of their representation of what is observed in the organizational culture and the real context of interpretation of the information is defined. The ultimate purpose of the DRTs is to offer feedback with a joint interpretation of the data in the shape of suggestions or future change actions.

METHODOLOGY

SAMPLE

Employees of five construction companies took part in this study. Said companies are part of the Collaborative Group [1] I+D+i coordinated by GEPUC. All permanent employees of the company were included, namely: headquarters employees and site employees with fixed term contracts (usually site managers), staff from the technical office, risk prevention, quality control and storage. The inclusion criterion was the participation of the employee in ongoing projects of the company during the period of development of the study. Exclusion criteria were defined afterwards based on information provided by the board during the first feedback meting (termination of employment, relocation of HR, etc.). Thus, the final sample was formed with a total N of 532 employees (146 of Company 1; 61 of Company 2; 144 of Company 3; 101 of Company 4; 80 of Company 5).

PROCEDURE

The procedure used along the investigation with all the intervened companies is described below (figure 1).

Table 1. Procedures, specific objectives and activities

Stage	Specific objectives	Activities
SNA	• Conduct SNA survey in the organization • Generate a network map of	• Contact the company • Define a facilitator for procurement of information from the organization

1 Collaborative Group of GEPUC Initiative is a group of companies involved in construction industry that conduct applied investigation with the purpose of overcoming competitiveness gaps in construction industry in Chile, by encouraging innovation and continuous improvement in order to attain an excellence level.

	the organization	• Gathering of data • Data analysis and organization graphs diagram.
DRT1: ELABORATION OF ANALYSIS CONTEXT	• Offer context for mathematical analysis reflected on networks maps • Generate synergy between the intervention team and upper management in order to enrich the interpretation of data	• Define relevant points of analysis together with high management, regarding topics beyond standard analysis of SNA mapping. • Discuss the interpretation context with upper management, based on data obtained purely mathematically
ISA	• Perform inferential statistical analysis • Generate linear predictive models based on SNA	• Use SNA networks to generate multiple regression analyses. • Obtain predictive statistics models based on multiple regressions
DRT2: FEEDBACK	• Integrate SNA DRT and ISA analysis from the perspective of organizational psychology • Provide pragmatic interpretation feedback to upper management in order to implement changes in the organization.	• Intervention team integrates different analysis previous to feedback to each company • Present specific suggestions in the round table with high management of the organization, based on SNA, DRT and ISA integration.

SNA: Individual information meeting was held with upper management of each of the 5 companies that are part of the Collaborative Group I+D+i with the coordination of GEPUC, in which they learned how the data would be collected and how important it was to appoint a facilitator[1], in order to obtain the information of the largest part of the company in the least possible time. A deadline of 2 weeks was set for all employees to fill the SNA survey[2], with the purpose of collecting representative data. Afterwards, the data were processed using Gephi 0.8.2 beta and the Force Atlas algorithm (Jacomy et al. 2009), with which the maps of the surveyed social networks were created.

FIRST DRT - Elaboration of analysis context: The intervention team met the key members of the upper management of each company at DRTs. The main objective of the meeting was to discuss the relevant analysis points, situations beyond standard analysis (I.e. bottlenecks, teams poorly connected with their superiors in headquarters, isolated projects, etc.), in order to clarify the interpretation context of networks maps, previously processed in a purely mathematical manner, this is, without knowing the specific characteristics of the organization. This first contact of upper management with the intervention team had a secondary objective; to link both and produce synergy, in order to enrich the interpretation of the data.

[1] The facilitator is a key member of the organization aimed at efficiently collect data. Acts as a bridge between the company and the intervention team. He/she will facilitate the gathering of required data within the defined timeframe.

[2] See instruments.

ISA: Several social networks were obtained by identifying interactions with different points of view (information sharing, problem solving, among others), but the relationship between each participants position in these networks and other specific attributes such as age or seniority were evident. The data was analyzed with multiple lineal regressions using metrics of the information network as a dependent variable (y) and multiple possible predictive factors as independent variables in order to find relations to create suggestions based on the obtained data, which could be translated into concrete actions to improve information flows within each company. Independent variables were metrics from other social networks (problem solving, trust network, among others) and fix attributes such as age, years in the company, sex, and in some cases position and profession.

The social network metric used to characterize the relevance of each employee in the networks was a participation percentage. Entry degree metrics were used to indicate how many times the employee was mentioned in each of the established networks. They were divided by total amount of references, this is, the number of times a person was named in a simple interaction network multiplied by 100 to obtain the percentage of interaction in each normalized network.

Second DRT - Integration and feedback to the organization: A second round table was held with upper management in which the intervention team provided feedback regarding the integration of the results of multiple analyses conducted by them, together with their corresponding interpretation from an organizational psychology standpoint. This allowed providing specific, clear, pertinent, representative and inexpensive suggestions for that organizational reality, in order to improve the information flows of each specific company.

INSTRUMENTS

1) SNA survey: The survey included 12 points/parameters: 1) interaction, 2) frequency of interaction, 3) relevant information, 4) efficient problem solving, 5) successful planning, 6) exchange of innovative ideas, 7) leadership, 8) sharing of personal information (trust), 9) reception of feedback. Table n°2 shows established networks and their description.

Table 2. Social networks established in the study.

N°	Social Networks	Exploratory question regarding the network[1]
1	**Interaction network**	*Whom do you interact at work with?*
2	**Network of interaction frequency**	*Whom do you interact more often with?*
3	**Relevant information network**	*Who provides you relevant information?*
4	**Problem solving network**	*Whom do you solve problems efficiently with?*
5	**Successful planning network**	*Whom do you plan successfully with?*
6	**Innovative ideas network**	*Who do you exchange innovative ideas with?*
7	**Leadership network**	*Whom do you consider your leader? (not necessarily your boss)*
8	**Trust network**	*Whom do you trust to discuss personal topics?*
9	**Professional feedback network**	*Who offers you professional feedback?*

[1] Social networks are explored through questions that allow having access to it. Said questions are used in the same survey.

2) SNA metrics used: The following metrics were used to conduct the social networks analysis (SNA).

- ***Density:*** Percentage of real connections as a proportion of potential connections. (real connections/potential connections)
- ***Diameter:*** Longer graph distance between any two nodes of the network.
- ***Medium degree:*** Average of node connections in the graph.
- ***Distance:*** Average of required steps to interconnect all the nodes in the network.
- ***Degree:*** Number of connections of the node
- ***Entry degree:*** Number of connections that reach the node.

3) Statistics packages: Gephi 0.8.2 beta was used to conduct the SNA and R version i386 2.15.3 was used to conduct statistics analysis.

RESULTS

A selection of relevant results is presented below to illustrate the methodology proposed in this article. Through specific examples, the purpose is to highlight how important is the interaction between the intervention team and the companies, as reflected in discussion round tables.

SOCIAL NETWORKS ANALYSIS (SNA)

The metrics obtained for information networks are presented in table 3. The main differences can be found on the item *Density*, which corresponds to the number of real relationships divided by potential relationships; thus, it is possible to see that Company n° 2 is the most interconnected, and can be seen as a company in which there are more ways of sharing relevant information.

Table 3. Metrics related to flow of relevant information.

Metrics used	Company 1	Company 2	Company 3	Company 4	Company 5
Med. degree	9,12	7,8	10,38	9,05	8,6
Diameter:	6	6	6	6	6
Density:	6,3%	13%	7,3%	11,0%	10,9%
Av. distance:	2,84	2,4	2,76	2,93	2,49

The companies with the lowest and highest density are presented in figure n° 1; (companies 1 and 2 respectively).It is possible to understand the reality of the information flow in each company by providing context from a qualitative perspective in the first DRT.

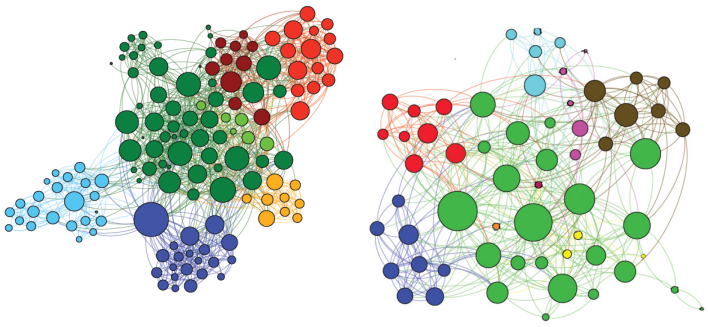

Figure 1: Information flow networks for company 1 and company

Figure 1 shows the difference between the main shapes of each network, being that of Company 1 star-shaped and that of Company 2 circular, which correspond to an informative shape because a circular shape is related to greater integration in the information flow. Likewise, the size of the nodes is informative, which means that their size increases as they are named by a greater number of members of the organization. Lines show the reference to each of the nodes (circles).

First DRT: Elaboration of analysis context.

The value of DRTs in the methodology is the creation of dialog between the intervention team and the organization. It aims basically at creating knowledge and action based on dialogue.

DRT1s had specific functions; (1) to clarify the real interpretation of atypical situations that went beyond a standard mathematical interpretation of the charts. I.e. the existence of a team closely connected to headquarters when they organize the first stages of a project, which was clarified by management to be an initial preparation and support for teams, before their independent work with a project. (2) to allow key members of the organization to learn about situations that were unknown to them, for example: members of a specific team were solving problems with external teams instead of doing it with members of their own team. Or even (3) to learn about problematic situations, for example: a site manager subject to extremely high demands that creates a bottle neck that hinders information flow. The graph of relevant information of Company 2 is presented below.

In figure 2 it is possible to see a specific situation circled in red, which is relevant because it cannot be subject to interpretation only by means of mathematical analysis.

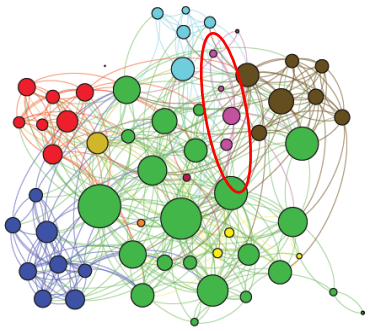

Figure 2: Chart of relevant information corresponding to company 2, where it is also possible to see a situation subject to interpretation addressed during DRT1

Based on the analysis of figure 2, some questions arise related to disambiguation of the interpretation of the information obtained, such as: on the network of personal trust, a specific project showed a chain structure (highlighted on figure 2), relationships are sequential ¿is this desirable for that particular project or is it a situation that affects relationships within the group? Another possible question would be, are the observed trust structure and the corresponding metrics related to that particular project also observed in the problem-solving, planning and information networks?

Inferential statistics analysis (ISA)

Table n° 4 presents the main inferential and correlation results; which means, predictive relations between the factors that have an influence on the information flow of each company, the coefficient and percentage of variance explained by said relation.

Table 4. Predictive factors of information flow[1].

Networks	Company 1	Company 2	Company 3	Company 4	Company 5
Problem solving	R= 0.86**	R= 0.771**	R= 0.71**	R= 0.7**	R=0.829**
	B= 0.76**	B= 0	B= 0.455	B= 0.37**	B= 0.58**
	model= 74.8%	model= none	model= 64.7%	model= 57.2%	model= 75.1%
Successful planning	R= 0.75**	R=0.843**	R= 0.686*	R=0.7**	R= 0.773**
	B=0	B= 0.83**	B= 0	B= 0.515**	B= 0.32
	model= none	model= 71%	model= none	model= 57.2%	model=75.1% (+)
Innovative ideas	R= 0.49**	R= 0.62**	R= 0.663**	R=0.46**	R= 0.628**
	B=0	B= 0	B= 0	B= -0.237**	B= 0
	model= none	model= none	model= none	model= 57.2%	model= none
Leadership	R= -0.16	R= 0.13	R= 0.259**	R=0.174	R= 0.153**
	B=0	B= 0	B= -0.124	B= 0	B= 0
	model= none	model= none	model= 64.7%	model= none	model= none
Trust	R= 0.138	R= 0.027	R= 0.475**	R= 0.295**	R= 0.193**
	B=0	B= 0	B= 0.24	B= 0.21**	B= 0
	model= none	model= none	model= 64.7%	model= 57.2	model= none
Professional feedback	R= 0.66**	R= 0.584**	R= 0.73**	R=0.51**	R= 0.47**
	B=0.14*	B= 0	B=0.5	B= 0	B= 0
	model= 74.8%	model= none	model= 64.7%	model= none	model= none

[1] Note: For each predictor (networks) there is a Pearson (R) correlation: when the coefficient of each network in the model of multiple regressions (B) is 0, it means said network does not predict the information flow. Finally, the percentage of variance is explained by the lineal model (model). Statistical significance: (*) with error lower than 5% and (**) with error lower than 1%. The most relevant results for each company are shown in light blue.

(+) In Company 5, being a site manager decreased the information flow with a coefficient of -5.8. The team was made aware of this situation and they received feedback to talk about the situation of integration of the site managers in the teams, (see the following paragraph).

It is possible to see that the factors that generally better predicted the information flow were:

1. Problem solving and secondly, planning, which happen to be the most formal route maps of the work environment. This is related to the organizational structure in the construction industry, where there are specific teams working in different projects, each of them with their own micro-organization.
2. It is interesting to highlight that less relevant information is shared with those considered leaders (both formal and informal) and the flow of information is slightly mediated by trust only in some companies. Therefore, it is possible to see that there might not be a lot of trust within teams and leaders might be distant. Specifically in Company 5, being a site manager presents a negative coefficient (-5.8), which means that the person who is in that position is less referred as the person with whom relevant information is shared. The same distance is seen in management, both in terms of information flow and the ability to spread innovation.
3. There is a poor relation between the relevant information flow and the sharing of innovative ideas, and in Company 4 they are even inversely related. Said situation could be related to the fact that companies of that industry deal every day with short deadlines to perform their tasks, with innovation as an important but slowly developed characteristic.

Second DRT: feedback to company and suggestions.

DRT2: Before DRT2s the intervention team gathers and present the results obtained from the different analysis in a single coherent result. Thus, **SNA** allows obtaining information from metrics and visualizing relationships within the organization. **DRT1** allows clarifying the context of interpretation of mathematically obtained data, generating synergy between the intervention team and the organization and analyzing relevant details for subsequent analyses. **ISA** allows using the established networks together with a joint interpretation performed with the organization (context) which allows generating predictive models of the networks.

The combination of all the processes allows designing an understandable and specific feedback for each company. The final stage of this meeting is the suggestions, or feasible actions taking into account the specific characteristics of each organization and the level of detail provided by the previously described analysis. Specific and low cost actions relevant to the needs of each organization are detailed in these suggestions.

Three suggestions specifically for Company 5 regarding information flow were the following:

Suggestion 1: To identify and use **closely related people**, identified as such with network metrics. This is, employees that connect more efficiently. The expected result is that this would allow to relief those who are over demanded and reinforce alternative channels to communicate information to distant areas, allowing delegation of tasks.

Suggestion 2: To implement a weekly planning system within the teams. With the purpose of integrating team members in the planning activities and thus avoid that it

becomes a task exclusive to the team leader. On the other hand, this suggestion is based on the results of the obtained correlations, because in this particular case there was a high and meaningful correlation between the networks of planning and problem solving with the network of relevant information.

Suggestion 3: To create instances for mentoring, with the purpose of making key information for problem solving available for the entire team, so that they are not left in a position of vulnerability in case a key member is absent; making sure that the flow of valuable information for problem-solving is not affected. Mentoring would allow the members of the team that are experts in problem solving to help other members to effectively solve specific problems.

DISCUSSION

The proposed objective of this article was to show all relevant and strategic processes of a new methodology for the diagnosis and intervention of organizations of the construction industry that implement Lean methodology to manage the information flow.

This methodology integration rose from the experience of the intervention team that participated in this research. During the research, the team realized that it was not enough with performing the analysis of social networks and delivering it to the companies, because despite being useful information, it was hard to translate it into specific changes within the organization.

On one hand, the information delivered by SNA is useful for upper management and strategic players within the organization to compare the organization chart and formal routes of information flow with the reality of flows and both formal and informal routes. However, during the first feedback meeting, the team realized how difficult it was to interpret results of the complex networks of organizational relationships and translate them into specific actions for organizational changes. This reason justified the elaboration of a methodology that integrated social network analysis with inferential statistics methodologies and relevant concepts of organizational psychology and D.O. to provide feedback with specific suggestions to facilitate overcoming the resistance at the level of upper management and encouraging opportunities of change.

SNA adds value by giving the company a visual comprehensive framework to analyze the organization. ISA analysis of the networks and attributes enhances the comprehension of how each factor affects the others, so that actions can be better aimed. Finally, DRTs create the right environment for decision making supported by the information obtained by combining SNA and ISA results.

In this regard, a comprehensive methodology of global diagnosis at the organizational level is presented here; using qualitative, statistical and mathematical concepts, based on scientific method, that in the future could be regarded as a methodology for organizational consulting in the construction industry, promoting organizational changes through interpersonal relationships. At the same time, it allows making strategic decisions regarding people, organizational structure, planning and encouraging focused interventions where real problems are detected, allowing for the measurement of its impact with global and local parameters of organizational changes.

The methodology is simple and cost efficient despite its scientific base, the research team believes that if focusing in a single company, the complete analysis could be completed in less than 2 weeks, which would allow companies to use the methodology to quickly react to perceived problems and enhance the value created by the company.

REFERENCES.

Alarcón, D., Alarcón, I & Alarcón, L (2013) Social network analysis: a diagnostic tool for information flow in the AEC industry, Proceedings for the 21st Annual Conference of the International Group for Lean Construction.

Anklam, P. (2003). KM and the social network. Case study. Km and the social network. May 2003.

Cassidy, M. (2007). Roundtable Discussion as Oral History: The Legislative Modernization Panel at

The 2003 Pennsylvania Political Science Association. Science Association Annual Meeting Pennsylvania.

Cross, Parker, A. y Borgatti, S.P. (2002) A bird's-eye view: Using social network analysis to improve knowledge creation and sharing. Social network analysis IBM Institute for Knowledge-Based Organizations.

Dave, B., Boddy, S. C., & Koskela, L. J. (2010, July). Improving information flow within the production management system with web services. In Proceedings of the 18th Annual Conference of the International Group for Lean Construction (pp. 445-455). National Building Research Institute, Technion-Israel Institute of Technology.

Field, A. (2009). Discovering Statistics Using SPSS. SAGE Publications, London.

Gifford, R., & O'Connor, B. (1987). The interpersonal circumplex as a behavior map. Journal of Personality and Social Psychology, 52, 1019-1026.

Lawrence, P & Lorsch, J. (1967). "Differentiation and Integration in Complex Organizations." Administrative Science Quarterly, Vol. 12, No. 1: 1-47

McCrae, R., Costa, P. (1989). Different points of view: self-reports and rating in the assessment of personality. In J.P. Forgas y M.J. Innes (Eds.), Recent advances in social psychology: an international perspective (pp. 429-439). Amsterdam. El-servier Science Publichers.

McLean, G. (2005). Organization development: Principles, processes, performance. Berrett-Koehler Publishers.

Mueller, T & Finke, I. (2004) SELaKT - Social Network Analysis as a Method for Expert Localisation and Sustainable Knowledge Transfer. Journal of Universal Computer Science, Vol. 10, No. 6. pp. 691-701.

Hegar, K. (2011). Modern human relations at work. South-Western College Pub.

Pollman, M., & Finkenauer, C. (2009). Investigating the role of two types of understanding in relationship well-being: Understanding is more important than knowledge. Personality and Social Psychology Bulletin, 35, 1512-1527.

Stevens, J. (2009). Applied multivariate statistics for the social sciences. Roudtledge Taylor and Francis Group, New York.

Wagner, C. C., Kiesler, D. J., & Schmidt, J. A (1995). Assessing the interpersonal transaction cycle: Convergence of action and reaction interpersonal circumplex measures. Journal of Personality and Social Psychology, 69(5), 938-949.