An Effective Model for Efficiency Evaluation of Strategic Project Based on BSC Model

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ABSTRACT

When analyzing a strategic development project implemented by universities both the system created, as a temporary organization having the participant organizations as distinctive actors and the universities have to be seen as learning organizations. As a consequence, the evaluation of such projects should always be more complex since there are intangible results and outcomes to be considered and an appropriate method for analyze is a must. Such a complex method, initially introduced by Caplan and Norton (1992) as balanced scorecard (BSC) was later on developed based on frequently addressed critics. Nevertheless, more than 40% of the biggest 500 companies in the world, use BSC as an evaluation method for their strategic performance and almost all of strategic development projects analysis includes financial and non-financial perspectives as those of BSC. Although a lot of improvements have been done already, there are still very few steps done in the direction of connection BSC with the social networking analysis. This study reflects our actual research aiming to design a more effectiv system for strategic analysis, that to integrate social network analysis and a system dynamics BSC in a more complex analysis method for efficiency evaluation of the strategic project.

Keywords : strategic development, project management, social networks analysis

JEL:C52;D85;O32,M15

1. INTRODUCTION

Always planned in line with a strategy already designed before, SDPs cannot be described as a one-way cause and effect relation. Most of SDPs entailing a large mass of people may address needs for retraining different categories of people, specific changes of existing rules, may imply various resources in a large geographical area as well as different categories of research activities, aiming at improving the overall competitive capacity of a region or country, based on knowledge diffusion and adoption.

Consequently, such projects needs more complex metrics aiming to better evaluate communication and social networks, the knowledge sources, intensity and specific directions of the knowledge flows, as well as the implementation effects over the financial, internal processes, stakeholders expectations, learning and development of projects participants.

However, for most of management practioners, meeting operational goals quantified by time, quality and budget remain the key consideration, while the strategic project's effectiveness, gaining the stakeholder expectations, efficient using of the lessons learned to better underpin the innovation and the core process development, cannot be assessed, based only on time and results

quality or through the value-for-money approach. For such projects, a systemic approach must be considered and there is a place for balanced score card to be considered.

On the other hand, the systemic approach for SDP offers the necessary holistically view of the project as a working system, which has specific parts (project's participants) acting together to getting the same major scope. The key common aspect for all the parts of the system is the communication. The flow of information send in formal and informal way from one partner to another during the project implementation is the engine working fluid of the system.

In any of the research regarding the strategic project management is crucial to remember that the projects are made by human and the human needs may influence the strategy development over time. These needs are mainly reflected by the organization culture, the learning capability, the willingness to change and the relation with stakeholders. All these needs can be also the link for creating groups, clicks and networks, having close interest to the project implementation…or not. Analyzing the networks evolution inside a system as SDP' are, should offer a holistic view of the project evolution.

However, to analyze such complex systems, as SDPs are, both at the inter-organizational scale and inside the participant organization, there is a need for an effective instrument for research: the social networks analysis (SNA). Using SNA methods mapping and measuring of information flows between people, groups, organizations, computers, URLs, and other connected information/knowledge entities can be done properly. In this approach, people and groups are considered nodes in the network, while information flows between the nodes shows the links and relationships among them.

SNA provides both a qualitative (visual representation) and a quantitative (mathematical model) for analysis of human relationships created during the project implementation. A lot of measures can be implemented through SNA that to offer a static or dynamic image of the system evolution. Most often, when used for a specific organization (as the SDPs are to be here considered) social networks analysis is called organizational network analysis (ONA).

The attractiveness of BSC method, actually used by over 60 % of all big companies over the world, that addresses measures and related weights to four different directions: financial efficiency, internal process effectiveness, stakeholder expectations, and learning and growing, might be the reason for which BSC became the most used assessment model in the world, within the next 20 years after its launching.

Nevertheless, a lot of critics were formulated during the time passed, against information asymmetries, difficulties regarding both measures and related weights allocation, similar priorities of the different measures, and the lack of dynamics found with respect to overall evaluation processes related to the early BSC models. As a response to these critics, later version provided by Caplan and Norton, as well as further development based on data envelopment analysis (DEA) and analytic hierarchy process (AHP) have substantially increased the model ability to better cope both with the research rigors and with the industry necessities for a flexible and reliable performance assessment instrument.

The major scope of the initiated research, of which some preliminary results are here presented, is addressing the possibility to introduce a modified version of BSD , the

organizational network analysis- dynamic BSC (ON-DBSC) as a new method for systemic/strategic projects' efficiency analyze, based on an organizational network analysis (ONA) and system dynamics based balanced scorecards.

2. THEORETICAL APPROACH

An initial remark has to be made to underline the epistemological difference between the project efficiency and the project management efficiency. The efficiency of a project (or project efficiency), refers to processes, their related actions and specific results that a project consist in, while the project management efficiency characterize the specific activities addressing the management of the project (planning, quality control, monitoring, coordinate, evaluate, etc.). The research described in this paper addresses the project's efficiency.

Following the multiple facets of the efficiency concept, some different perspectives should be proposed for the efficiency of a project. Following the Farrell's (1957) definitions for technical-, allocative-, price- and overall efficiency, similarly we should introduce:

- Project Technical Efficiency (PTE) as a project success in producing the expected results from a given set of inputs based on the lesson learned, social capital and innovation;
- Project Allocative Efficiency (PAE) as a project success to produce the most desirable results for the stakeholders and represents one of the most important measures of the welfare analysis regarding the project impact upon the targeted citizens. Allocative efficiency of a strategic project might be seen as a specific indicator (i.e. in time, space or social environment, etc.) , for a strategy or a policy implementation;
- Project Cost Efficiency (PCE) as a project success in minimizing the cost of the beneficiary of the project without a loss in quality and quantity of results based on better employment of the internal processes;
- Project (overall) Economical Efficiency (PEE) as a project success in a cost efficiency and technical efficiency condition. Similar with the Farrell's definition for overall inefficiency, technical and cost inefficiency will generate project inefficiency. Project inefficiency is not similar with the project ineffectiveness. Thus, a project can be seen as finalized instead its total inefficiency, while the ineffectiveness of a project is equivalent with the project failure.

When considering the PTE and the PAE, the classical money-based analysis became useless. It is the scope of our research to evaluate the introduction of social networks analysis (SNA) and system dynamics (SD) methods to model the dynamic processes inside SDPs as a prerequisite for a more effective, SNA and SD based BSC analysis for SDP systems.

No extensive attention has been done for SNA application in project management, although especially research on knowledge networks of project partnerships might need such an approach, which SNA can support. Both static and dynamic analysis of networks, that SNA can offer, provides very useful information for risk management analysis.

Social network analysis uses specific metrics as:

- Degree Centrality – can measure network activity for a node by using the concept of degrees - the number of direct connections a node has. The degree x_i of a node i is defined as

$$d(n_i) = x_i = \sum_{j \neq i} a_{ij} \quad (1)$$

and it the count of the number of ties to other actor in the network. Visually, it shows how many lines are incident to that node. The meaning is that a node has a high degree if it has strong connections to many different nodes in the network.
- Eigenvector centrality – much like degree centrality, it favors nodes that have high correlations with different other nodes (with their own a specific degree centrality). Mostly, it specifically favors nodes that are connected to nodes that are themselves central within the network. Thus it takes into account the entire pattern of the network.
- Betweenness Centrality showing that a node with high betweenness has great influence over what flows - and does not - in the network; The betweeness centrality x_i of a node i is defined as

$$x_i = \sum_{j \neq i \; i \neq k, j \neq k} \partial_{jk}(i)/\partial_{jk} \quad (2)$$

where $\partial_{jk}(i)$ is the number of shortest paths from j to k that pass through the node i and ∂_{jk} is the number of shortest paths from j to k . This measure gives higher values to nodes which bridge clusters taking into account the connectivty of the node's neighbors.
- Closeness Centrality offers the best description about the accessability to a node. The best closeness centrality will alow the greatest visibility into what is happening in the network.

$$Cc(x_i) = (n-1)/\sum_{i \neq k,} (n_i, n_j) \quad (3) \qquad j=1,$$

- Network Centralization -individual network centralities provide insight into the individual's location in the network. The relationship between the centralities of all nodes can reveal much about the overall network structure. A very centralized network is dominated by one or a few very central nodes. If these nodes are removed or damaged, the network quickly fragments into unconnected sub-networks. A highly central node can become a single point of failure. A network centralized around a well connected hub can fail abruptly if that hub is disabled or removed. Hubs are nodes with high degree and betweeness centrality. A less centralized network has no single points of failure. It is resilient in the face of many intentional attacks or random failures -many nodes or links can fail while allowing the remaining nodes to still reach each other over other network paths. Networks of low centralization fail gracefully.
- Network Reach – offers the metrics to characterize networks from their horizons over which one cannot see, nor influence that network. The best connation to a network is done in one single step.
- Network Integration - Network metrics are often measured using geodesics, or shortest paths. They make the (erroneous) assumption that all information/influence flows along the network's shortest paths only. But networks operate via direct and indirect, shortest

and near-shortest paths. Different interpretations arrive via different paths. Therefore, it is important to be on many efficient paths in networks that reach out to various parts of the extended network. Those well integrated in the network of paths have both local and distant information, along with several flavors of it;

- Boundary Spanners - nodes that connect their group to others usually end up with high network metrics. Boundary spanners are more central in the overall network than their immediate neighbors whose connections are only local, within their immediate cluster. A node can be a boundary spanner via the bridging connections to other clusters or via the concurrent membership in overlapping groups. In practice, boundary spanners are well-positioned to be innovators, since they have access to ideas and information flowing in other clusters. They are in a position to combine different ideas and knowledge, found in various places, into new products and services.
- Peripheral Players – are nodes on the periphery of a network that most people would view them as not being very important since they receive very low centrality scores for one network. Since individuals' networks overlap, peripheral nodes are connected to networks that are not currently mapped making them very important resources for fresh information available only from outside the system's network.
- Density is a measure for group cohesion. The cohesion can be calculated as the average standardized degree. For a n number of nodes and l the present number of lines in the network, then the possible number of lines in the network is n(n-1)/2, while the density is

$$D=2e/n(n-1) \qquad (4)$$

For this paper we used only three of the centrality measures, here introduced degree, betweeness and closeness centrality. An eigenvector analysis was too complex to be finalized at this time.

Stock an flows mapping, as system dynamics (SD) method offers, can effectively be used when analyzing the evolution people knowledge regarding to the processes inside the system, which is increased by the participation in training, writing down research papers, participation in conferences and is decreased by individual knowledge decay rate, lack of interest to knowledge adoption, absenteeism, etc. Such an evolution for individual knowledge can be seen in figure 1.

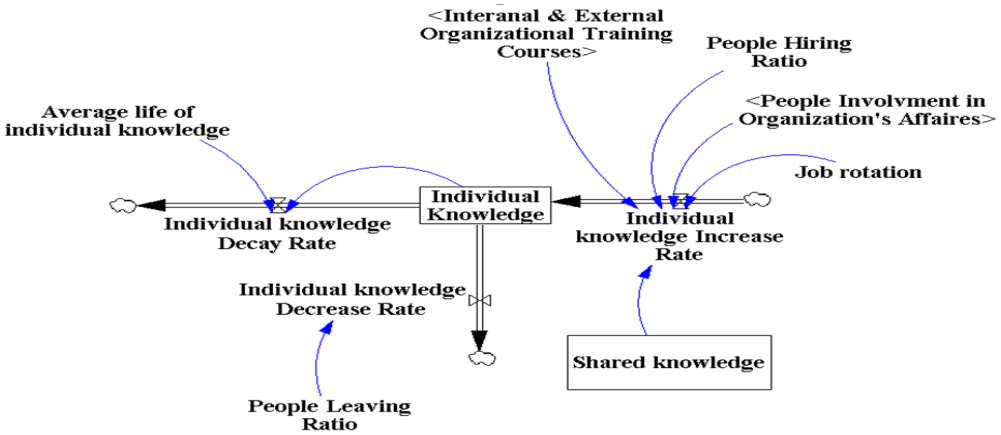

Figure 1. Individual knowledge determinants *(source Azbady and all, 2012)*

As a measure of the knowledge created within a project, the project's efficiency is increased by shared knowledge, while average life of organizational knowledge and organizational knowledge decay rate are the factors to decrease the efficiency (figure 2)

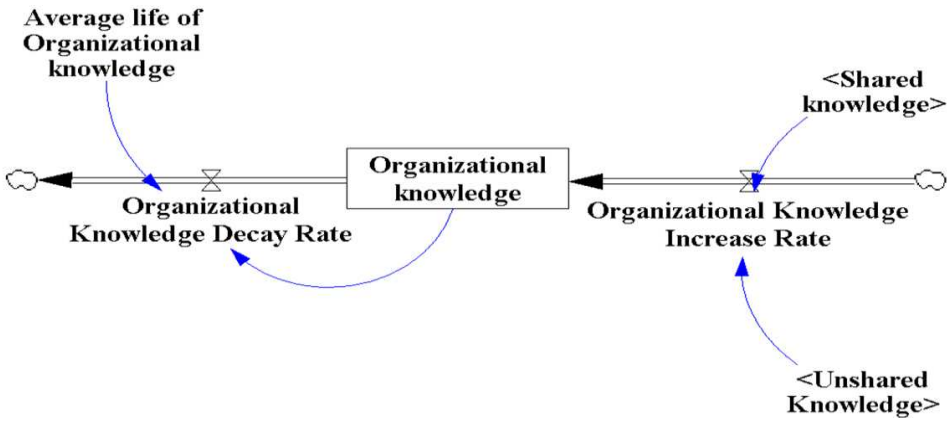

Figure 2. Causal evolution for organizational knowledge. *(source Azbady and all, 2012)*

In terms of a more financial approach, the case of a simple project can be analysed using the Paretto equilibrium analysis. In this case, having one output (Y) which depends on two inputs (X1, X2), should be seen as a linearly, homogeneous function Y=f(X1, X2) and the efficient unit isoquant, Y=1, will contain all technically efficient combinations. A less technical efficient project can produce at Y=1, but only of there will be provided bigger inputs (fig. 9).

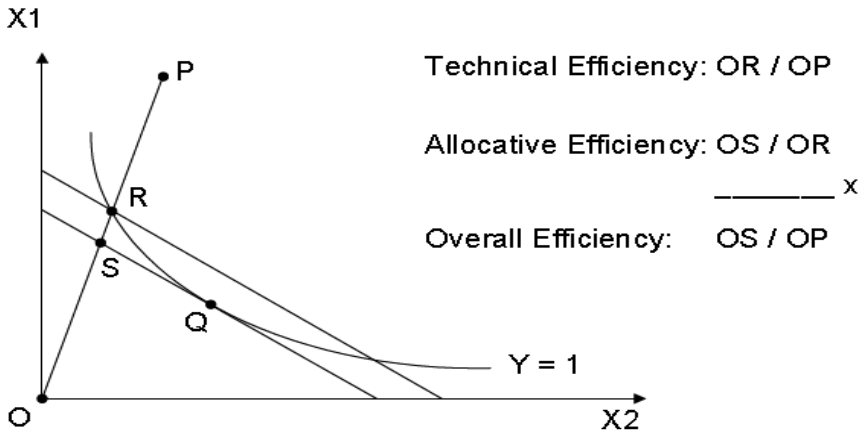

Figure 3: Paretto Equilibrium Analysis (Source: www.ahrq.gov/research/efficiency)

The iso-cost line for Y=1 represent a Paretto equilibrium curve, that can be seen as a model for a two partner project, having a fix allocated budget for one specific result. In the figure 1, the point R (any location on Y curve) represent an optimal approach, but only the point Q

offer technical efficiency at minimum cost, that is often not taken into consideration when planning a project.

In practice, SDPs usually have more than two inputs as well as more than one output and an evaluation for the overall efficiency throughout this method is very much time and IT resources coming. Therefore, such a Paretto equilibrium is for a small interest when there are complex systems to be evaluated.

3. CASE STUDY PRESENTATION

The case study refers to a strategic project (having over 5 mil euro allocated funds) addressing over 9000 participants in all over the country (five regions). Following the so called "standard procedures" of the project assessment, the two projects were successfully ended, having over 96% of the project's objectives obtained within the specific time, using less than 65 % of the allocated budget. The project was initiated in January, 2011 and it was ended in December 2013.

Based on financial and non-financial data from the financial and technical reports delivered to the management authorities, during the implementation time and a light BSC based analyze from financial perspective (Figure 4), *stakeholder's satisfaction* (Figure 5), learning and grow perspective (Figure 6) and internal processes perspectives(Figure 7) was done accordingly. Surprisingly, although the project was closed and considered successful, based on the knowledge transfer processes, the efficiency of this project, was far from their expectation.

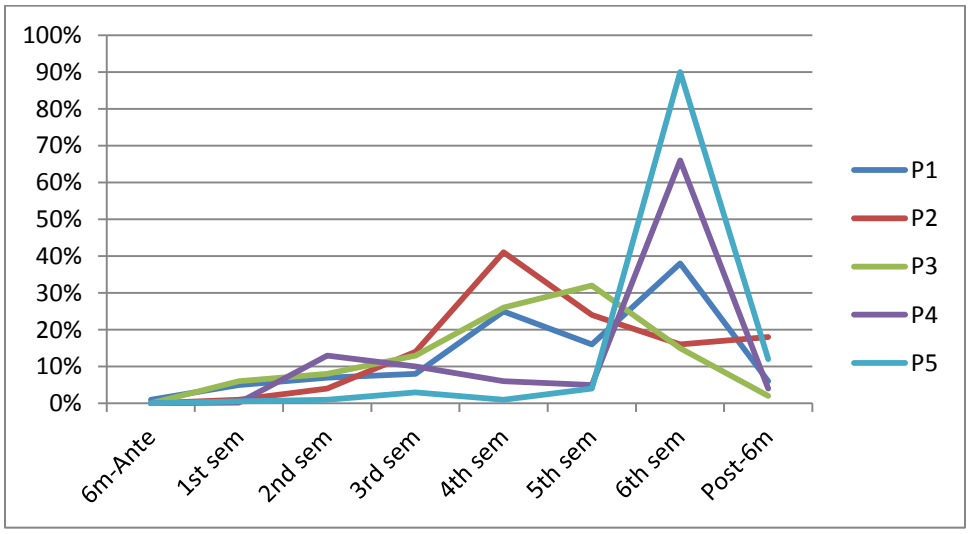

Fig. 4. Financial evolution of the partners allocated budgets.

Financial analyze reveals big disproportionalities among the partners regarding the financial allocation for short term activities, against the excellent overall financial efficiency.

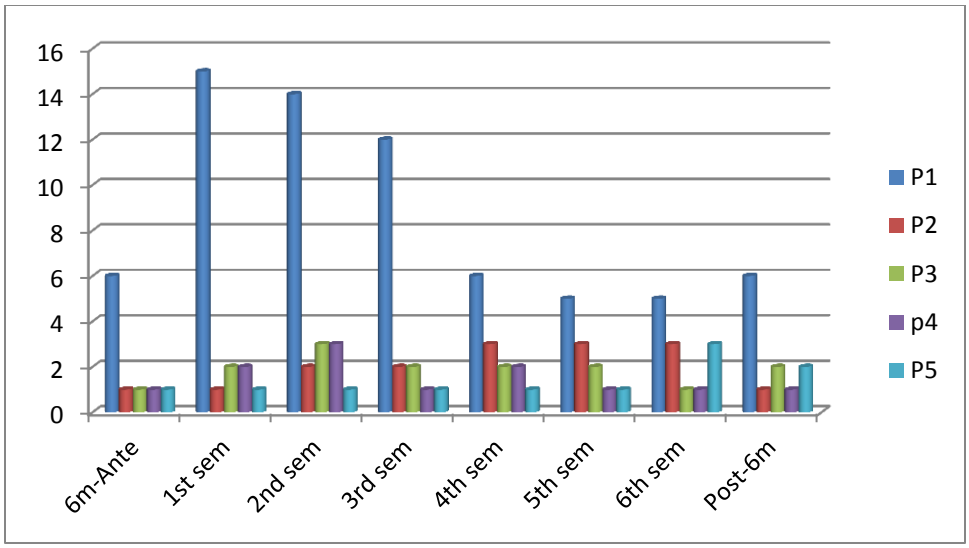

Fig.5 Evolution of the stakeholder's satisfaction

Considering the decreasing number of unsatisfactory results, the stakeholder's satisfaction diagram in figure 5 should be seen as a remarkable evolution within the project. However, if consider the scope of the project, such a representation looks to be completely irrelevant.

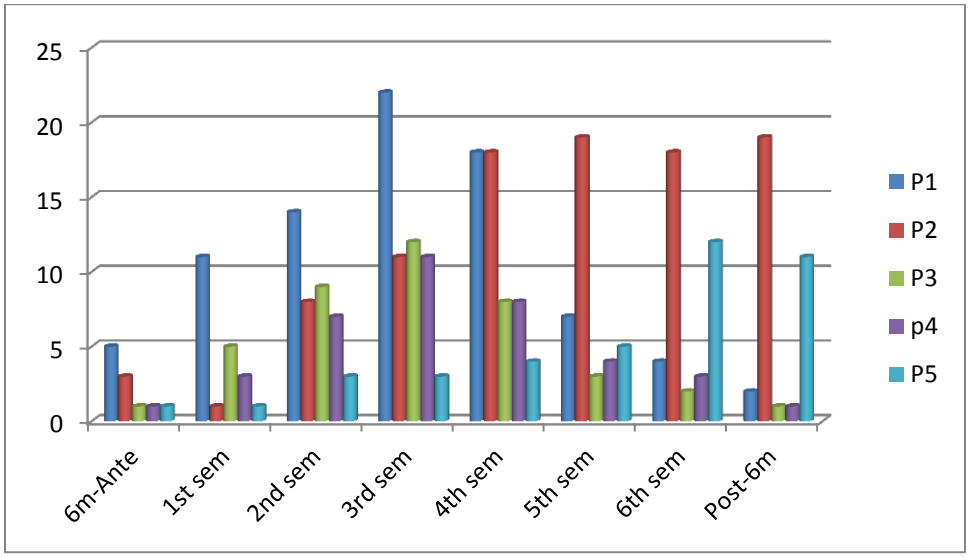

Fig. 6 Training and learning of the participants

From the learning and grow perspective, the project have had an acceptable percent of more than 84% of participants in learning oriented activities. The great disparities among partners in figure 6 should be also seen as an indicator for sustainability of the project at the level of the project's participants.

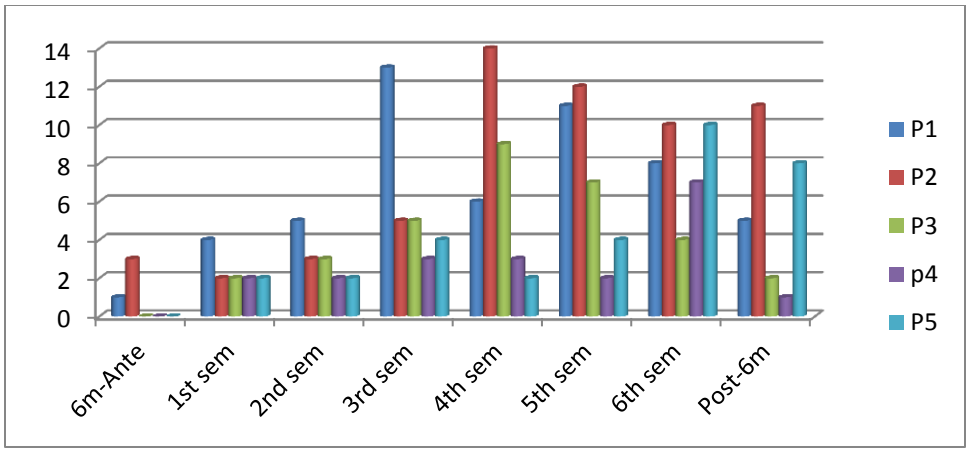

Fig. 7 Core activity evolution

The core activities of the participants, less relevant from the stakeholders perspective, should be seen as very important evolution metrics since, this is significantly linked with the absorptive capacitive of the participants (e.g. less interest for project will reduce the absorptive capacity of the respective participant). A reduced absorptive capacity is reflected both by the individual knowledge and the organizational knowledge evolution.

4. DESCRIPTION OF RESEARCH

Based on SD methodology, main sources, stocks and flows within the system were evidentiated and flows circuits were evaluated, together with their positive and negative effects. These observations enlighten the presence of two major sources of knowledge (KL and PM) and two sources of implementation authority (PL and PM). The evolution of the knowledge flow, evaluated throughout the number of new methods which were adopted by the participants, based on the knowledge created within the system, was represented in the figure 8.

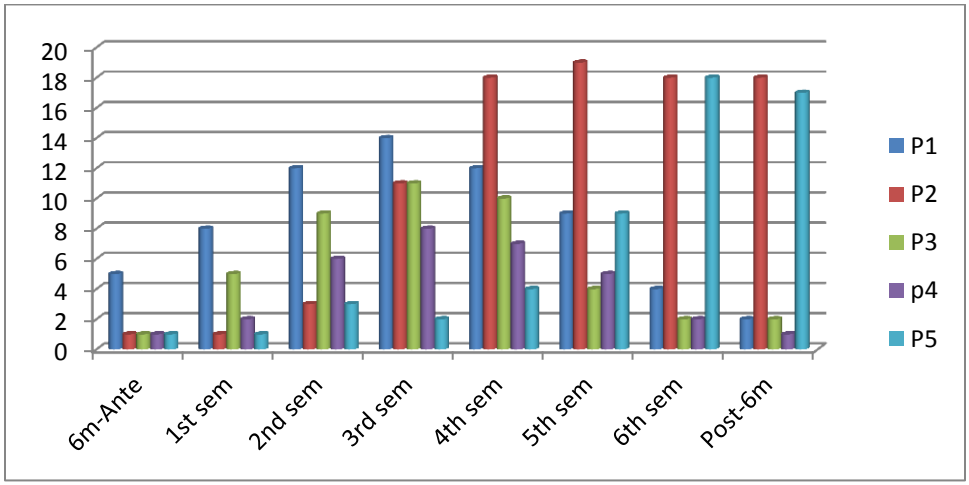

Figure 8 . Knowledge transfer flows evolution

Although the system dynamics approach do not represent the target of this study, it is important to present here the four principles which were considered for creating the SD simulation model:

- because of the complex of the SDPs, causality can not be seen as unidirectional, then feedback loops were considered to be more appropriate to design the system SD model;
- there are delays between cause and effects that are generated by the different level of the system structure having different reaction;
- although SD analysis are mainly oriented to strategic evaluation, some of the operational decisions might be taken into consideration, because of their impact to strategy;

In order to do a SNA based evaluation, a network graph was created (figure 9) and the presence of the three main sources for information was located (e.g. project leader, knowledge leader and the project manager). The initial degree centrality of 23 for PM, confirm their position within the networks, although the only 7 for calculated degree of the PL, was not considered an initial optimistic starting point. Counting the number of e-mails sent within the system and the estimated communication related to formal and informal meeting was considered to be a method to evaluate the social networking activity.

For this research we consider that the calculation of the network density evolution in time (figure 11), which was (not surprisingly) very similar to the overall social networking activity (figure 10) and also reflected by the number of e-mails send and received throughout the implementation time, has a very good connection with the participants evolution within the project. Although, evaluated during all those eight moments of the analysis, the closeness and betweness evolution will be discussed at different time.

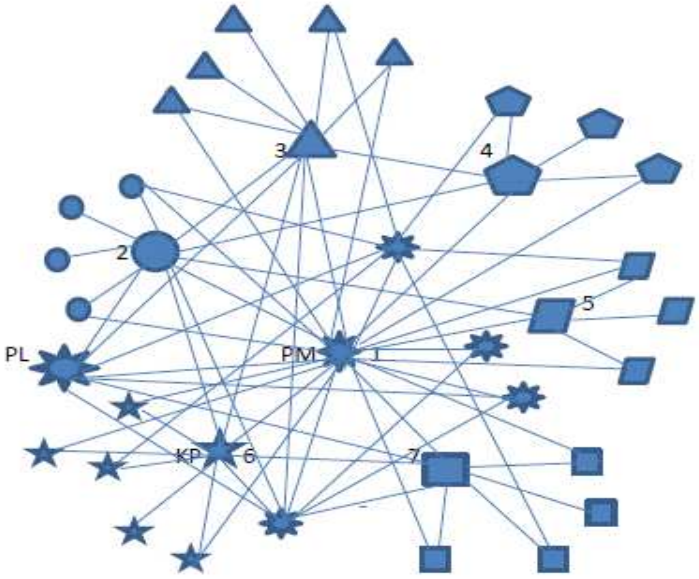

Figure 9. The project's networks graph shown a homogene distribution of ties at the beginning of the project.

One important remark should be done regarding the network structure and the knowledge flow inside the system. Following the evolution of the degree centrality of the major nodes in the system, there was no major modification that to explain the major differentiation in the efficiency of the knowledge transfer to projects participants. The analysis revealed the existence of different flows for knowledge within the same network, depending on the content (interesting/useful or not) and informal/formal specificity type of transfer method. The informal kind of knowledge transfer (closely connected with social networking) was more efficiently done.

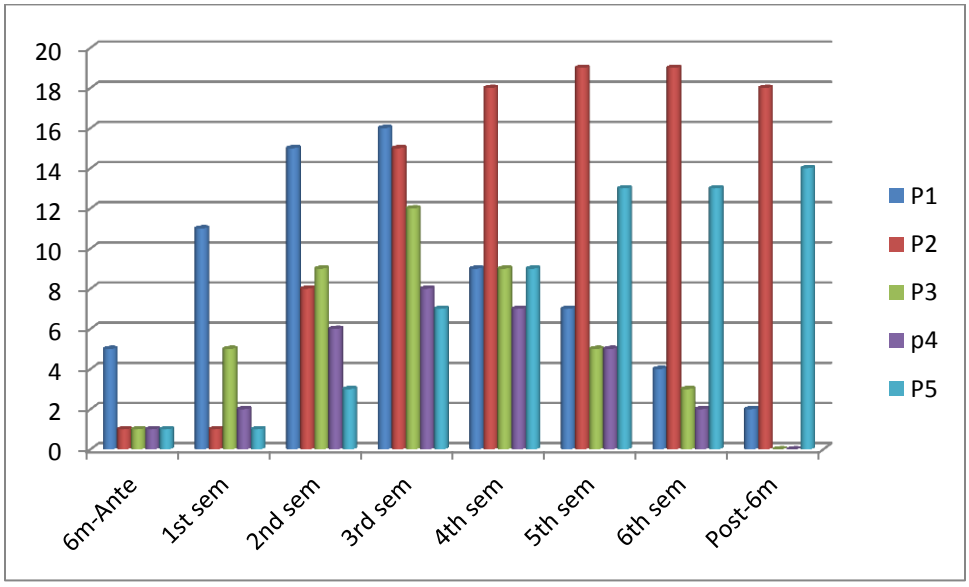

Figure 1o. Social networking evolution within the project implementation time. The two partners P2 and P5 which became more active have also high interest in knowledge transfer.

Although not conducted by surveys, but using the e-mail networks (Aral&Van Astyne, 2007) the analysis shows the very much similarity with the knowledge transfer diagram, the two major actors (P2 and P5) being the best actors for knowledge transfer within the project system.

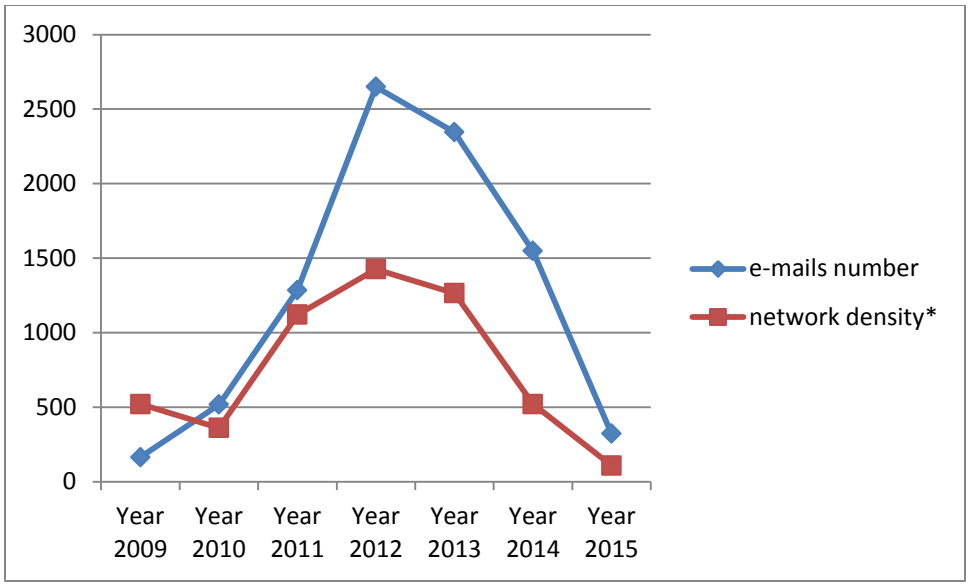

Figure 11. E-mails numbers and the network density evolution.

As a powerful tool for any organizational theory and research analysis (Jack, 2010), SNA allows understanding internal evolution of all kind people connected based system. Similarly to Gloor (2005) we have tried to find the existed correlation (if any) between the efficiency of knowledge transfer and the social network structure.

As can be seen in the previous figures, the social networking increasing activity of the partners P2 and P5 is very much similar with their increasing interest in knowledge adoption, while the very few interest in knowledge adoption of the partner P3 and P4 is simultaneously connected with their lack of social networking. More over, the lack of interest in further supporting the knowledge transfer after the project end, of the partner P3 and P4 is also connected with the dissolution of the network (network density going abruptly to zero, after 2013).

5. RESEARCH LIMITATION

One of the most delicate parts in BSC implementation consists in identifying the targets and respective weights allocations. In practice this should be done through a consensus between strategic management and executives. When evaluating intangibles creation (e.g. knowledge), the weights allocation became more difficult and not a clear methodology was developed into this regards.

More over, the classical BSC allocate similar priority to the different measures that one can define for a system. To avoid this, an analytic hierarchy process (AHP) method is used, offering an effective support when there are both qualitative and quantitative aspects that simultaneously have to be evaluated, based on optimal prioritization (Saaty, 1980).

From the SD analysis point of view, evaluating flows among the networks actors (both human and non human) as well as their evolution in time required a modelling process consisting

in identification and definition of problems, system conceptualization, model formulation, model testing and evaluation, model use, implementation and dissemination and design of learning strategy/infrastructure. Not all of these steps were possible to be done, based on the case study approach of our research.

One of the major limitations for SNA is done by the impossibility to have access to all e-mails sent within the system. Also, the existing bias that the method of counting only the e-mails sent to people having a major role in the project, have to be considered when analyzing the research results.

6. CONCLUSIONS

As an exploratory by nature, this study underlines the conclusion that the higher level of uncertainty, which a partnership based, strategic development project provides, required a multi-facets evaluation, that a simple time-budget-quality analyze can not offer. A more complex analysis as that here presented as ON-DBSC offered clear advantages those future improvements might much better evidentiate.

On the other hand, this study demonstrate that against all of the critics regarding information asymmetries, difficulties regarding both measures and related weights allocation, similar priorities of the different measures, and the lack of dynamics found with respect to overall evaluation processes related to the early BSC models, project's performance analysis based on scorecards also described Barclay (2008) might be improved throughout SNA and SD based research methodology.

The research done, incorporating the basic ideas of Barnes ET all (2006) regarding the R&D project management, should support a further extension to better models of innovative management tools. It was also confirmed also the work of Platts and Kim (2002) that effective communication processes analysis, simulation and visualization techniques can considerable improve the BSC method to provide consistent information about the strategic systems.

The case study presented, underlined the fact that although financial perspectives has created almost fully anticipated problems, the existence of a huge potential of risk from non-financial perspective, mostly unexpected at all, reveal the existent potential for further research as well as the possibility for very useful software applications to create effective knowledge based systems.

REFERENCIES

Aigner DJ, Chu SF. On estimating the Industry Production Function. The American Economic Review 1968;58(4):826-39.

Azabadi., J.H.,Noorossana, R., Jafari, M., Owlia, M.S.,Saryazdi, M.D.,(2012) Knowledge Management Analysis: A system Dynamics Approach; 2012 International Conference In Innovation and Information Management, LACSIT Press, Singapore

Aral,S., Van Alstyne, m. (2007), Networks Structure & Information Advantage, Proceedings of the Academy of Management Conference, Philadelphia, P.A.;

Banker, R.D.,Chang, H.,Pizzini, M. J.,(2004), The balanced scorecard: Judgemental effects of performance measures linked to strategy, Acconting Review, 79(1), 1-23;

Barclay, C. (2008) Towards an integrated measurement of IS project performance: The project performance scorecard. Information Systems Frontiers, 10(May): 331–345

Barnes, T.A., Pashby, I.R.,Gibbons, A.M., (2006), Managing collaborative R&D projects development of a practical management tool, ScienceDirect,pg. 395-404;

Curtis, G., Cobham, D. (2002), Business information systems: Analysis Design and Practice. Harlow: Pearson Education, Limited.

Cooper, W. W., Seiford, L. M. and Zhu, J., 2004. Data Envelopment Analysis: History, Models and Interpretations, In Handbook on Data Envelopment Analysis, Kluwer Academic Publisher, Boston, Chapter 1, pp. 1-39.

De Geus, A. (1994), Modeling to predict or to learn? Protland: Productivity Press;

Dumont, E.J. (1994), Making best use of performance measures and information. International Journal of Operations and Production Management, 14(9), 16-31;

Farrell MJ. The measurment of productive efficiency. Journal of the Royal Statistical Society Series A 1957;120(3):253-90.

Gloor, P.A., Paasivaara, M., Shoder, D, Willens, P (2008), Finding collaborative innivation networks through correlating performance with socil network structure; International Journal of Production Research;

Herath, H.S.B.,Bremser,G. W., Birnberg, G. J. (2010), Joint selection of balanced scorecard targets and weghts in collborative settings, J.Account.Public Policy 29, 45-59

Hrebianak, L.(2005), Making strategy work: leading effective eecution and change, Publishing as Prentice Hall Upper Saddle River, New Jersey;

Huang, H.C.,(2002), Designing a knowledge-based system for strategic planning: A balanced scorecard perspective, Expert Systems with Applications 36 (2009), 209-218, ScienceDirect

Jack, S.L. (2010), Approaches to studying networks: Implications and outcomes; Journal of Business Venturing, 25(1), 120-137;

Kaplan, R and Norton, D.,(1992), The balanced scorecard-measures that drive the performance, Harvard Business Review, 70(1) 71-79;

Kaplan, R and Norton, D.,(1993), Putting the balanced scorecard to work, Harvard Business Review, 71(5), 134-140;

Kaplan, R and Norton, D. (1996), Using the balanced scorecard as a strategic management system, Harvard Business Review, 74(1), 75-78;

Kaplan, R. and Norton, D. (2001), The strategy focused organisation-how balanced scorecard companies thrive in the new business environment, Harvard Business School Press, Boston, USA;

Kasvi, J.J., Vartiainen, M., Hilikari, M. (2002), Managing knowledge and knowledge competences in projects and project organizations, International Journal of Project Management , 21;

Kellen, V.(2003), Business performance measurement, at the crossroads of strategy, decition-making, learing and visualization, http://www.kellen.net/bpm.htm ;

Kennerly, M.P., Neely, A.D., (2002) A framework of the actors affecting the evolution of performance measurement frameworks. International Journal of Operations and Production Management, 22(11), 1222-1245;

Lynn, S.C. (2006). Project Management Methodologies and Strategic Execution. Retrieved from www.asapm.org/asapmag/articles/Lynn12-06.pdf

Pisano, G.P., (1990), The R&D boundaries of the firm: An empirical analysis, Administrative Science Quarterly 35,177-207.

Rietiker, S. (2006) Der neunteSchluessel – vom Projektmanagement zum projectbewussten Management, Hapt Verlag, Berlin
Saaty, T.L.(1980), The analytic hierarchy process, New York, NY: Mcgrow-Hill.

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