Journal of Universal Computer Science, vol. 17, no. 10 (2011), 1412-1429
submitted: 30/10/10, accepted: 15/4/11, appeared: 1/6/11 © *J.UCS*

Performance Management in Collaborative Networks: a Methodological Proposal

Rui Pinto Ferreira
(Institute for Systems and Computer Engineering of Porto, Porto, Portugal
rui@pintoferreira.pt)

Jorge Neves Silva
(Institute for Systems and Computer Engineering of Porto, Porto, Portugal
jnevesilva@gmail.com

Faimara do Rocio Strauhs
(Federal University of Technology – Paraná, Paraná, Brazil
faimara@utfpr.edu.br)

António Lucas Soares
(University of Porto, Faculty of Engineering – DEI and INESC Porto, Portugal
als@fe.up.pt)

Abstract: Performance management in collaborative networks of organisations is a complex process due to the multiplicity of competing perspectives upon it. One of the more sensitive phases of this process is the agreement of the actors in the network regarding the performance evaluation model whose design is considered of great importance in the research literature. This paper proposes a method for the design of performance evaluation systems in collaborative networks through an innovative combination of performance information classification and multi-criteria decision model. The method is implemented in a web-based collaborative platform that enables the members of a collaborative network to efficiently achieve specific performance models that result from a collective and negotiated construction.

Keywords: performance management, collaborative networks, constructivist approaches, framework
Categories: M.0, M.4

1 Introduction

Given the complexity of performance evaluation of an organisations network, it is not trivial to obtain a satisfactory information and knowledge model that is generally accepted by all the network members. This is confirmed by the scarcity of structured models of performance evaluation in literature applicable to collaborative networks. Moreover, as Wognum and Faber [Wognum and Faber, 02] state, the method of performance measurement used for a network, and the selected performance indicators, can seldomly be used unchanged in other networks. Indeed the definition of metrics must consider a number of diverse aspects including the evaluation of objectives, the level on which the evaluation takes place, the choice of criteria, the type of network, the data sources available and more accessible, the network

management model, the power differences between members of the network, the time horizon of evaluation, times of collection of information and the frequency of data collection.

One solution to the above-mentioned problems would be to establish the performance management model in a collaborative and negotiated way between the network members. This solution would be valid for a specific network structure, composition, and time horizon. In this model, taken into account the opinion of [Ollus et al., 06], while recognising that criteria and indicators should be derived from individual and collective goals instead of using a standard set, this choice should be supported by a reference information model, thereby allowing a quick setup of an initial model which would be the basis for a collective construction of a specific model to serve a given network context and situation. Thus, a methodological support to the collaboration and negotiation, centred on the establishment of a shared conceptualization of the specific performance management process, would also be of great importance.

In this paper, both the generic model of network performance information and the method to collaboratively build a shared conceptualization that will result in a network performance management model are presented. The results described here were obtained within the research project Performance Management in Collaborative Networks – pmColNet, funded by Fundação para a Ciência e Tecnologia of Portugal (Science and Technology Foundation of Portugal) and developed at INESC Porto - Institute for Systems and Computer Engineering of Porto

From an epistemological perspective, the approach here presented can be considered as constructivist. There has been significant research concerning the constructivist approach, combining scientific research with practical organisational experience [Busi and Bititci, 06]. Reports on the results of these studies, involving scientific research and business environments, contributed to the development of tools for knowledge explicitation, that are closer to the reality of people and their social networks.

The pmColNet approach was developed along four main activities: (i) creation of a conceptual framework for the evaluation of network performance and a metamodel for the project, (ii) creation of a model for negotiation under multicriteria decision support methods and tools, (iii) development of a prototype of a collaborative platform for network performance management, and (iv) validation of the model. An extensive review of the literature on performance evaluation and management in networks was the first step of this project. The following steps were concerned with the development of practical tools and real models, benefiting from data collected in business environments.

The following sections address performance in networks of organisations, then the construction phases of the pmColNet platform and finally the scenario-based validation of the developed models and method.

2 Performance in Collaborative Networking

Collaborative networks are made up of persons and organisations that unite with a common task, despite geographical, cultural, social or operational diversity, and are

supported in their interaction by computational tools [Camarinha-Matos and Afsarmanesh, 05].

In this type of networks, the collaborative aspect stands out. Collaboration differs from cooperation and coordination by its higher level of integration and interaction between members and organisations of the network. Cooperation includes information exchange, adjustment of activities, splitting of resources and work while aiming at specific targets. The participants of the cooperation process can work independently and the added value is the sum of the individual results [Camarinha-Matos and Afsarmanesh, 05]. Coordination requires, apart from the information exchange, the alignment and change of the activities to achieve efficient results. On the other hand, Collaboration involves mutual trust, in addition to being a process in which participants, working together, share information, resources, responsibilities and risks to achieve common goals [Camarinha-Matos and Afsarmanesh, 05]. Therefore the main outcome is knowledge creation in several formats.

The benefits of effective collaboration include increased market share, gaining new customers, cost reduction, reduction of the development time and risk of failure of new products, increase of quality, and so forth [Bititci et al., 04]. However, despite these benefits, the expansion of these networks is still limited, as confirmed by the results obtained in the Collaborative Networks for High Performance (RCED) project, [Carneiro et al., 07], and supported by the results of the pmColNet project.

Therefore, to adress the issue of performance in collaborative networks (CN) becomes crucial to its success. In particular, it is necessary to address the collaborative networks in which the participating organisations are autonomous and not based on a rigid hierarchy of command. These networks are based on trust and reciprocal relations, restricted to a generally short period of time and are also subject to restrictive issues of opportunism, uncertainty and risks.

In the scope of this article, performance management (PM) is understood as a process that aims at the improvement of the organisation by changing systems and processes which will positively transform organisational culture [Amaturanga and Baldry, 02]. Managing performance involves a process of choosing indicators or metrics of critical success factors as well as definition of criteria and areas of measurement, which can aggregate subcriteria and indicators, where performance measurement is a subprocess of PM.

Identifying the criteria to be used in network performance measurement is a distinctive factor in Performance Management. Such criteria should take a broad approach and should not be limited to financial aspects, but should have a spectrum that meets the strategic, tactical and operational levels, taking into account the tangible and intangible aspects. In this domain, PM and Knowledge Management are becoming closer. Furthermore, network performance management is acknowledged as a complex issue, since it involves tangible aspects like the distributed nature of network partners and intangibles aspects such as culture, trust, participant interests and the actual type of network. Mutuality i..e, the constant interaction with real and transparent communication between partners, is a crucial factor in this process [Zhao, 02]. As such, financial criteria coexist with relational and operational criteria [Zhao, 02] [Parung and Bititci, 06].

In this context, the pmColNet approach proposes that the definition of criteria and indicators to measure performance should follow the constructivist logic and should

consider the vision of members, the individual performance systems (when available) and a common language created by network members, among others.

3 Collaboration in the Construction of a Network Performance Information Model

Performance management within networks of organisations is a complex subject and involves several aspects that influence the choice of metrics, such as performance objectives, evaluation level, criteria choice, network typology, data source and data access, network governance, power relations; evaluation timeframe, data gathering timing and data gathering frequency.

Due to diversity and number of influencing elements, a generic and satisfactory model is very hard to achieve. Therefore, a situational and constructivist approach constitutes a valid option that can be used in a specific network, and its specific timeframe, and constructed in a collaborative manner.

The pmColNet approach addresses the construction of shared network performance information models inspired by a constructivist perspective, which builds on the premise that knowledge creation takes place when acting in a social environment supported by interpretations of the context.

These interpretations are built as actor-environment relations in a negotiation process that continuously builds meaning. Construction of meaning is due not only to the inter-subjective negotiation but also to the active and conscious participation of a person [Pereira, 06], generating knowledge and its products.

The proposed pmColNet approach provides the models and methods for the organisation of performance information and knowledge and for the negotiation of specific models. To create the project metamodel, pmColNet uses the five-phase model of knowledge creation [Nonaka and Takeuchi, 97]. This is a constructivist model consisting of: (i) formation of a field of interaction, (ii) development of a concept, (iii) justification of the concept, (iv) prototyping, and (v) dissemination.

Roughly speaking, the pmColNet approach has two moments, and from an information and knowledge management point of view: firstly the elaboration of an individual ***i*** (the organisation as member of the network) performance information model and secondly the negotiation and synthesis of a shared network N performance information model. Both moments require the adequate tools to support the individual and collective processes of domain conceptualization.

The creation of an interactive field, aggregating all network participants, is of significant importance and must be independent of the sort of technological tools available. Such a field must be put in place from the beginning of the decision-making process and supports the construction of the reference model, built from the individual perception in a relational process.

A reference performance information model (*r_PInfoModel*) was developed, aimed at being used as a structured "catalogue" of perspectives, criteria and indicators to be selected for a performance management information model, illustrated in [Figure 1]. From the reference model, each network member i derives its own performance information model (*i_PInfoModel*). The final network performance information model (*N_PInfoModel*), for a given time frame and network composition

and structure, is a subset of the reference model and is achieved by negotiation under multi-criteria decision support. The *r_PInfoModel* considers aspects such as network typology, stakeholders, the framework (objectives / tasks / periods and ranges of evaluation time), evaluation levels, perspectives, criteria, sub-criteria, and indicators. A list of indicators is suggested, including the way of how to define them, organize them, sort them, and retrieve them through the use of computational tools.

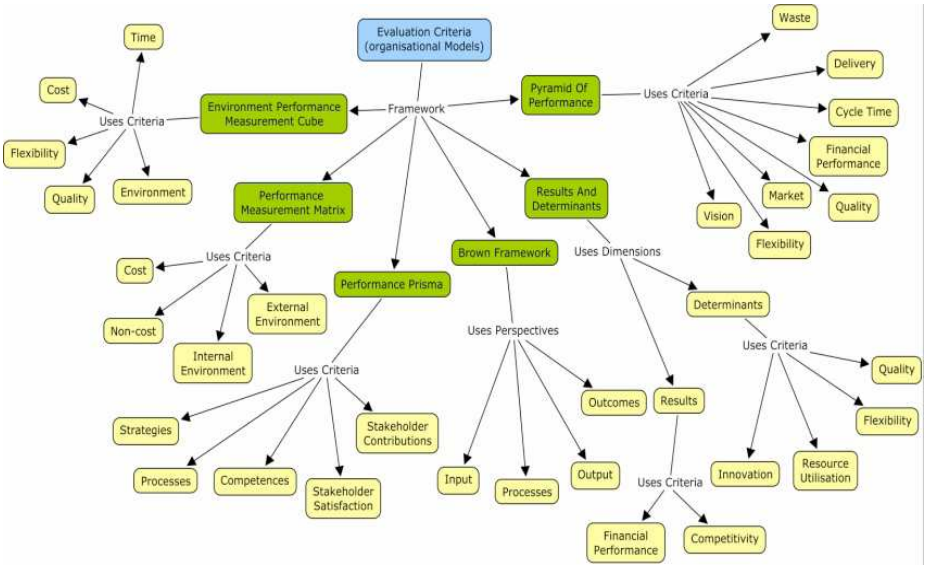

Figure 1: Reference performance evaluation model r_PInfoModel (extract)

For generating an individualized model for a network (*i_PInfoModel*), a two step approach was devised: (i) strategic definition (top-down): the information necessary for the development of the system must be derived from objectives set in advance; and (ii) definition of an information model (bottom-up): the information for modelling the performance evaluation system is determined from discussions and selections.

[Figure 2] presents an example of the interaction of these two steps and the synthesized activity flow between them. In this example, three perspectives are used for the performance evaluation of a given network participant: member contribution, internal perspective, and external perspective. Concerning the member contribution there are three domains: social capital, measured by the indicator I_13, organisational capital, measured by the indicator I_12, and physical resources, measured by the indicators I_11 and I_15.

The internal perspective must consider the criteria of quality (measured by I_36) and time (measured by I_51). The external perspective considers only the client satisfaction, as measured by the indicator I_53. This approach can be adopted to build the performance information model for each of the network participants. The individual models are then integrated, as mentioned before, during the collaborative

network model construction. One should note that the network participants may suggest measurements that are not in the reference model (*r_ PinfoModel*).

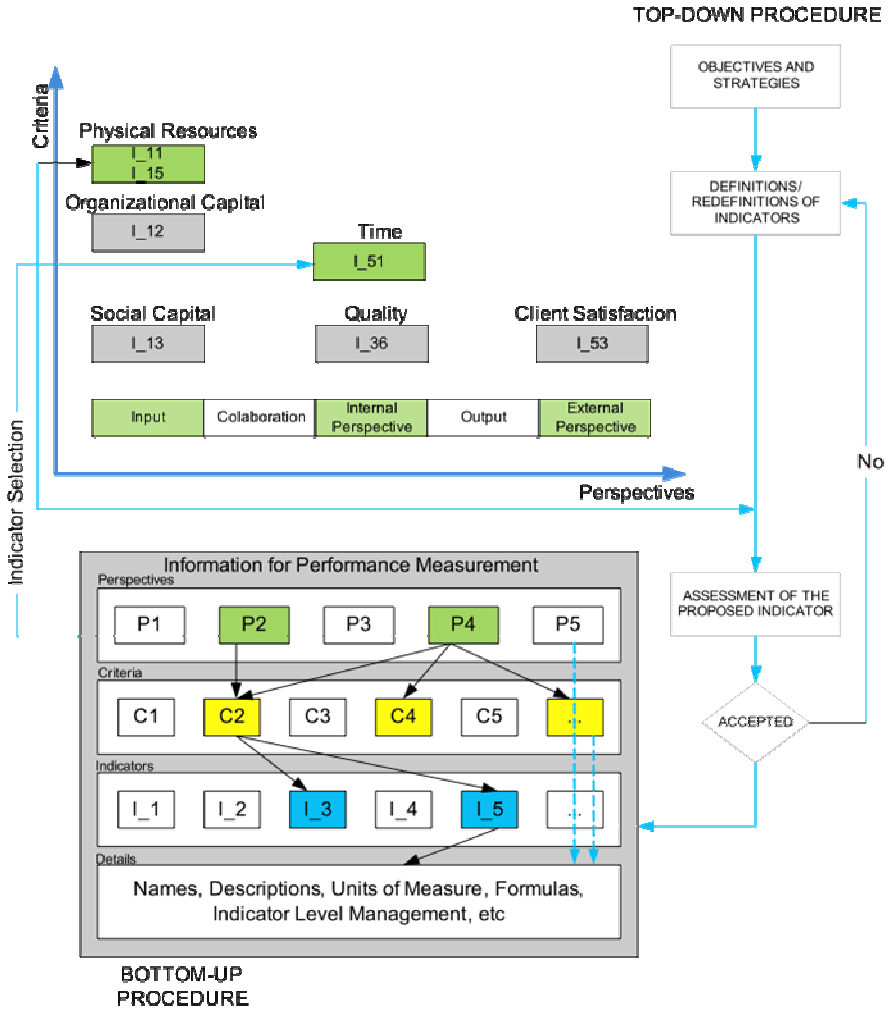

Figure 2: Process for network performance information model elaboration

After the definition of the individual models, begins the definition of the final model, which represents the performance information for that particular network. If there is no agreement among the members concerning the performance information specification to be used and their levels of importance then the members must use a decision-support system. As such, each member proposes alternatives, which are weighted, for evaluation, criteria, and indicators. Each indicator must have maximum and minimum values that indicate success and failure. From these limits, the values can be normalized to aid in obtaining aggregated performance values.

In this model, there are one or many perspectives of evaluation, criteria and indicators, with different weightings, which reflect the importance of members attached to each measure when calculating the network's global performance. To each indicator, limits of maximum and minimum (representing success and failure) are instituted, estimated from member's suggestions.

Establishing those limits allows its normalization, assisting in obtaining aggregated performance values. Once the network model is defined, the members can register this information using a platform for their management. At this stage, apart from the generic information about each indicator, the members must define a specific information set that is related to the context of that particular network, such as maximum and minimum values for the indicators (as mentioned above), measurement rate, the indication of the participant responsible for each indicator, the data source, and so forth. After being implemented, this initial model is then updated through a continuous cycle of proposals for new performance information and/or amending the already existent, depending on both the measurements results and network evolution.

Summarizing the above explanation, from the creation of an interaction field where the participants define their intentions, perspectives and objectives follow the creation of a consensual model of the network performance information (*N_PinfoModel*). This model is achieved through a decision process, which defines, jointly and through dialogue, what are the main elements (conceptual structures) of the model which then will be prototyped and used in the collaborative network to implement the PM system.

A fundamental step in the collaborative development of the model is the retrieval of the required indicators among hundreds, leading to the need of defining a method for organising and classifying the collection of indicators. The purpose of the classification of performance information is thus to organise the set of indicators into categories and to allow research of performance measurement information within the network of organisations.

A faceted classification was used. A feature of this classification system is the orthogonality of each tag on the others, where a number of tags can be assigned to each indicator. In the faceted classification, in turn, choosing an item from one facet limits the choice of other facets for the same resource. This feature differentiates a facet from a group of tags. The term facet can thus be defined as a group of classification items in which the attribution of a facet excludes the use of another for the same resource [Wilson, 06]. This characteristic of the faceted classification allows greater control and less complexity in the classification and research of information. The facets are derived from analysis of collected indicators, the bibliographical research on performance information for the evaluation of organisations, and networks of organisations and consultation of websites related to performance evaluation.

The analysis and the purpose of the classification suggested the definition of the following facets: evaluation perspective, evaluation criteria, type of measure, level of decision. The to be classified resource, as already mentioned, is the performance indicator, which in addition to the attributes corresponding to the classification facets, also has the following general attributes: ID (identification of the indicator), title (indicator title), unit of measurement, direction (maximise / minimise).

The direction attribute, represents a wished change of the indicator value. Sometimes, however, in the process of performance management, it is necessary to make compromises between potentially conflicting indicators. For example, the desired maximisation of a quality indicator might be conflicting with the minimisation of production costs, due to the fact that an increase in quality is normally associated with an increase in costs.

As mentioned before, the choice of measurement indicators is usually made on the basis of the objectives of the network. These objectives define the areas of performance measurement (criteria) and the perspectives to consider in this measurement (contribution of members, internal processes of the network, overall performance, external perspective). The choice of indicators whose measurements are objective or subjective, or the level of the indicator is also important to consider.

According to mutual exclusivity, the elements of a facet must be mutually exclusive to items of other facets. Thus, for each indicator, the attribution of an item within a facet limits the attribution of other items within the same facet. Moreover, the classification in a particular facet should be independent of other facet classifications. Other limitations are that the classification is not exhaustive, given the number of elements of the domain, and the lack of precision, when we have a particular indicator rated at more than one class.

Despite these limitations, this classification revealed a good choice because, on one hand, the results of tests concerning the search and retrieval of indicators using this model, and on the other hand, the practice in searching performance information adopted by users.

4 A Negotiation Method in the Construction of a Network Performance Information Model

As a Group Decision Support System (GDSS), pmColNet is also used as a facilitator in the decision process. It is based on the concepts of the PROMETHEE Group Decision Support System, which is a multi-criteria decision support method that supports the use of the Internet and Web-based environments, as well as the concepts proposed by [Zahir and Dobing, 02] for Multicriteria Group Support System .

pmColNet decision support model has five sequential phases [Table 1]. The model is designed with a special emphasis in partner interaction and “decision overriding” [Ferreira, 09]. This means that pmColNet results, as indicating in a certain way, or using certain performance elements may be contradicted by network members applying any different method at any phase. The pmColNet should have the ability to incorporate this “manual” network decision and carry on to the next phase. In fact, every network decision will be supported by the structured pmColNet suggestion and by an unstructured partner’s meeting, where the partners can freely discuss and achieve a different path of the structured proposal.

Description	Method / characteristics
Phase A - Contextualisation I. Initial setup II. Partner's individual performance model III. Network Typology IV. Defining power vote	Web form / PROMETHEE GDSS framework Tree structure Private folder HFPA Commitment level
Phase B - Partner's proposals HFPA	HFPA
Phase C - Measuring preference intensity	Visual pairwise judgment AHP Veto threshold
Phase D - Negotiating and achieving the commitment package I. Network global commitment level II. Defining success and failure III. Levels of analysis IV. Performance relationships V. Index construction	Weighted Arithmetic Mean Index construction
Phase E - Monitoring performance I. Normalising indicators and achieving the dashboard / tableau de bord II. Ideal performance - TOPSIS III. Relationship between individual and network performance model	Normalization TOPSIS

Table 1: Phases of the project pmColNet

Other aspect of the model resides in its flexibility towards the chosen method to measure partner preferences. We will propose and defend a particular multi-criteria method, but pmColNet will be flexible enough to incorporate a different approach without losing its main objective: to facilitate the performance model design.

4.1 Phase A

The contextualization phase (phase A) provides a private, individual characterization of the network member, made of several standardized questions and stored by Web tools. Network Performance Information of each partner may also be collected and the commitment level of the network member should be set, becoming one of the important elements of the individual's connection to the network and representing a key indicator of performance. Typology, goals, and voting power in the network are also defined at this stage.

In spite of pmColNet's flexibility it is vital to correctly describe the network and its partners, so that the performance model is suitable for that situation and maximizes

the constructivist approach. It is important to define at this stage, as already pointed out the following topics:

i. Initial setup – Each network partner has a folder with private information about the organisation type. A tree structured assistant interface should present the questions so that standard data from organisation typology can be collected and stored (profit or non-profit organisation, number of employers, industry, assets value, revenue value and others). This information should be private and only accessible by the organisation.

ii. **Partner's individual performance models** – Information regarding each of the partners' individual performance models will also be collected. Such information should include performance data and metrics that are used in the organisation's business performance management system. Information must be entered according to the Hierarchical Framework for Performance Analysis (HFPA) described in phase b, capturing each organisation's objectives, criteria and indicators. Besides multiple perspectives are welcome. At this stage, the organisation must choose a metric that represent the level of commitment with the network. The commitment level will be an important element to perform the connection between the individual and the network performance model. Such indicator should represent the resource allocation effort towards the network, for instance:

1. Human resource hours, within the organisation, allocated to the network project / total human resource hours within the organisation;
2. Network investment value by the organisation / total investment by the organisation;

iii. Network typology – Network typology is related with two particular characteristics:

1. Type of interorganisational governance [Todeva and Knoke, 05]: strategic cooperative agreements; Hierarchical relations, R&D consortia; Joint ventures; equity investments; cooperatives; licensing; franchising; cartels; action sets; subcontractor networks; industry standards groups; market relations;
2. Type of network regarding its objective [Carneiro et al., 07]: operational synergies network; technological/ functional synergies network; strategic synergies network.

These characteristics should be listed to each network partner for individual selection within the private contextualisation folder. At this stage, network main objective will also be defined. Supposedly, in real life situations, partners already have discussed the network main objectives. So, partners define the objective at this stage. If there are discrepancies between partner responses, visual pairwise judgment and preference aggregation will be used. Several objectives can be selected. In future projects the decision support platform may advise partners according to network typology and individual

characteristics or even retain some constructivist learning capability. This predictive feature is excluded from this work.

iv. Defining vote power – This particular parameter is very adequate to real situations; nevertheless it is difficult to negotiate it in a transparent and open way. pmColNet will promote vote power definition and negotiation. If this feature is not used, partners will be considered as having equal vote power.
Partners will conduct an anonymous voting procedure to define vote power distribution. Each partner will have 2 votes. The first vote may be attributed to himself or any other network partner. The second vote may only be addressed to other network partners (he/ she cannot vote for himself).

4.2 Phase B

In phase B each partner defines its proposed perspectives, objectives, criteria, and metrics related to the main objectives of the network, as well as their criteria and their performance metrics. Each actor may propose alternatives to the main descriptors of the network. The relevant information provided by the network participants are registered in the pmColNet platform taking into consideration a Hierarchical Framework for Performance Analysis (HFPA). This is a simple framework whose main elements are the objectives, criteria, indicators, and participants perspective [see Figure 3].

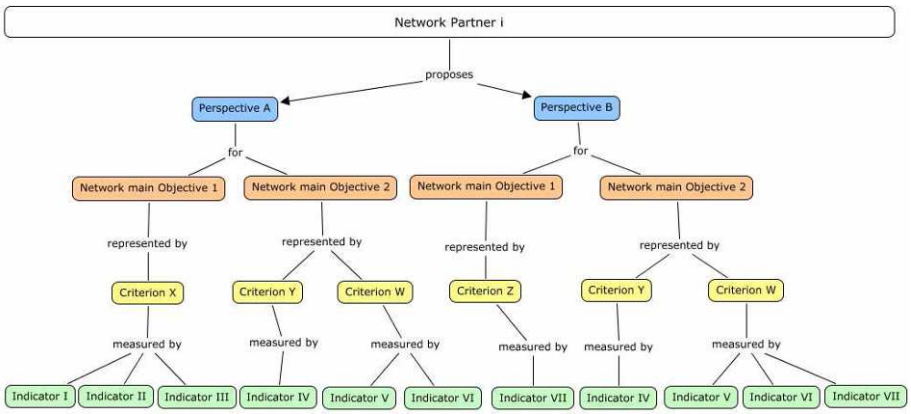

Figure 3: HFPA partner's proposals

These alternatives should generally manifest the partner's perspective of the network's main objective and the best way to measure its performance.

A partner can propose several different alternatives for each of the network main objectives. If he does so, he must evaluate the several alternatives obtaining an ordered list according to its preferences and using the visual pairwise judgments and aggregation methods.

Each HFPA's element may have a description field and indicators must have additional scaling description, so that every partner correctly understands the

proposal. It is desirable that the pmColNet system presents some standard alternatives regardingeach of the HFPA elements.

4.3 Phase C

In phase C, which must be completed by at least two actors, the intensity of preferences is measured by analyzing the combination of parity and aggregation of preferences, producing an ordered list of preferences and the veto threshold. The used approach is based on concepts from the Relational approach methods, mainly the Analytic Hierarchy Process (AHP) [Saaty, 90], and also ELECTRE (ELimination Et Choix Traduisant la REalité).

Multi-criteria decision making is based on comparing different alternatives. pmColNet will use a visual rule to attain preference intensity, based on [Zahir and Dobing, 02] MCGDSS [see Figure 4].

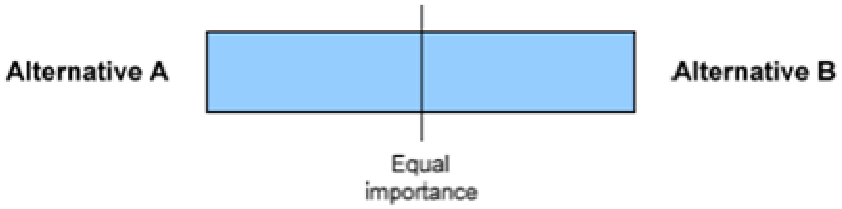

Figure 4: Visual Judgement

pmColNet users will simply click and drag a bar, starting at "Equal importance", dropping it at the exact point they feel the visual relation correctly manifests their importance judgement.

To maximize system consistency and minimize the number of judgments, when comparing Alternative A to Alternative B, users will be automatically comparing (with the inverse punctuation) Alternative B to Alternative A.

Behind the visual system, there is a five degree scale [see Figure 5], which is derived from AHP fundamental scale [Saaty, 90:15]:

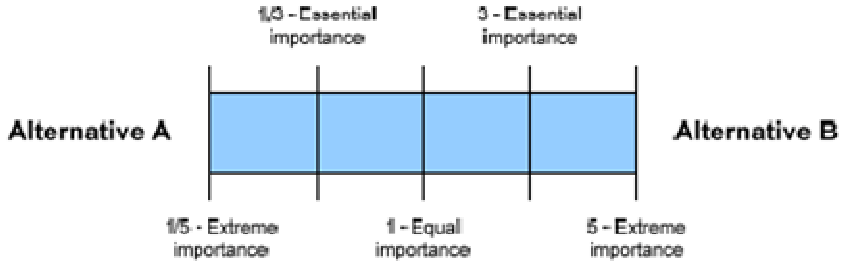

Figure 5: Quantitative visual judgment

This numeric scale will be used to calculate and order partner's intensity of preferences at the aggregation stage. Note that the system will use a continuous numeric scale to compute the pairwise judgment. The left side of the scale is the inverse of the right side of the scale, which means the middle point between "1/5 – Extreme importance" and "1/3 – Essential importance" corresponds to the inverse of 4 (middle point between "3 – Essential importance" and "5 – Extreme importance"), which is 1/4 [see Figure 5].

Resulting from visual pairwise judgments and preference aggregation, an ordered list of perspectives will be obtained. It represents partner's vision towards the network performance model. Example [Table 2]:

Perspectives Order	Global Priorities	Accumulated Preference	Veto threshold
D	0.45	0.45	
F	0.3	0.75	Accumulated preferences reach 75 %. Possible excluded alternatives
A	0.15	0.90	Possibly excluded
B	0.10	1	

Table 2: Example of perspectives order and veto threshold

pmColNet will present the ordered list and identify the veto threshold. Indifferent perspectives will not be ordered, whereas equal global priorities will result in inclusion or exclusion based on the others global priorities.

For the purposes of this work, veto threshold is the level of accumulated preference (resulting from the preferences aggregation ranking) from which all alternatives below are suggested, by pmColNet, to be excluded from the performance model

4.4 Phase D

Phase D involves negotiation to establish a set of commitments within the network. At this stage it is relevant to define the criteria for measuring the performance of the network, taking into account: the general network commitment level, the criteria of success and failure, the levels of analysis, the performance relationships, and the construction of an index or "navigation chart".

Arriving at this phase, network partners have already decided which HFPA best represents the network performance model, note that can be one, two, or several different perspectives and criteria relative importance within the performance model [Figure 6].

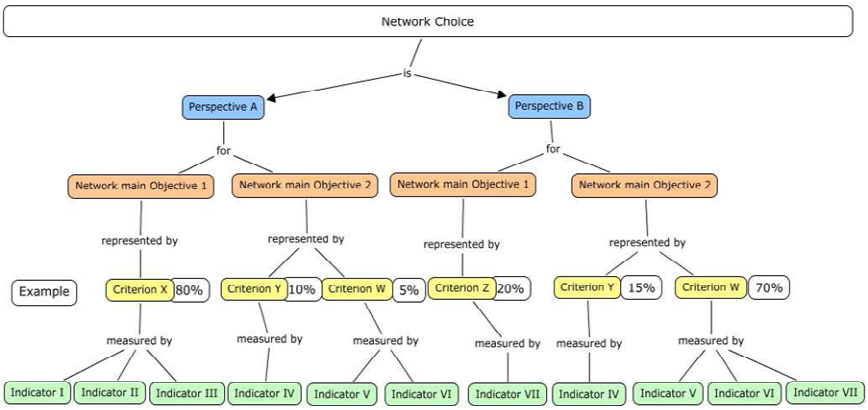

Figure 6: Network HFPA example

4.5 Phase E

In the last phase, E, performance monitoring is done, standardizing indicators and optimal performance. It also establishes the relationship between individual performance and overall network performance. TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) was selected to be the benchmark for monitoring the network performance.

Particularly at this stage are defined: (i) Normalising indicators and achieving a dashboard/ tableau de bord; (ii) Ideal Performance (TOPSIS); (iii) Relationship between Individual and Network performance model; and (iv) scenarios.

The initial validation of pmColNet was on diverse scenarios using data from three companies that already participated in previous projects. Empirical initial studies with entrepreneurs aimed at adjustments of the methodology are also progressing satisfactory.

4.5.1 Normalising Indicators and Achieving a Dashboard/ Tableau de Bord

Applying a normalising expression, participants will obtain all their performance indicators in an equal scale, which present several advantages, for instance direct comparison and index construction.

If the normalised indicator is greater than 1, the network is surpassing the success objective. Otherwise if the normalised indicator is less than 0, the network is performing below failure level. When the normalised indicator is between 0 and 1, network is performing within failure and success limits.

We can then use the previously determined criteria relative importance, to construct indices, using the weighted arithmetic average (see the scenario section for more details).

The dashboard/ tableau de bord is a very useful information management tool. It is very popular in real world businesses because a simple glimpse can rapidly show a

business performance. In collaborative networks and particularly in pmColNet, a dashboard is essential to monitor the network performance.

Dashboard potential can be maximized if the performance relationships previously referred are constructed.

4.5.2 Ideal Performance (TOPSIS)

Suppose network performance was at success limit for all the chosen indicators of the HFPA – this is the ideal situation. Now, suppose network performance was at the failure limit for all the chosen indicators – this is the anti-ideal situation.

TOPSIS stands for Technique for Order Preference by Similarity to Ideal Solution and it is a multi-attribute utility theory method whose concept "is that the most preferred alternative should not only have the shortest distance from the positive ideal solution, but also have the longest distance from the negative ideal solution" [Deng et al., 00].

We are interested, in pmColNet, in the concept to build a benchmark for monitoring the network performance. The objective is similar to the explained use of the normalised indicators and indices, but the calculus are more complex, because weighted Euclidean distances need to be obtained, to capture the distance between each indicator real performance and its ideal / anti-ideal point.

4.5.3 Relationship between Individual and Network Performance Model

It is expected that the pmColNet performance model can manage and integrate a partner's individual performance model, which means some form of relationship between the organisation individual performance model and the network performance model.

The commitment level, as said before, will be an important indicator to perform the connection between the individual and network performance model. Such indicator should represent the resource allocation effort towards the network.

It is also important that network partners negotiate the desirable network commitment level for everyone, which supposedly maximizes the network potential [see Figure 7].

5 Conclusion

The pmColNet premise is that performance management in collaborative networks is a complex and multicriteria problem that benefits from a situational approach whereas all participants propose criteria and indicators to monitor objective completeness. The construction of a shared conceptualization of performance by the network is fundamental for achieving a negotiated performance information model.

The proposed pmColNet approach provides the models and methods for the organisation of performance information and knowledge and for the negotiation of specific models. To create a reference performance information model, pmColNet used the five-phase model of knowledge creation in a true constructivist approach Furthermore, a common language was established to meet the needs of various involved parties, within the constructivist approach, searching for interaction,

mutuality and joint construction of knowledge, in an applied research. pmColNet's potential will only be accessed in real cases application. Detailed scenarios were used but cannot substitute real life interaction.

Meanwhile, an empirical study was conducted in a group of managers involved in collaborative networks. Open-ended interviews resulted in a rich set of data that will enable the fine-tuning and improvement of the pmColNet approach.

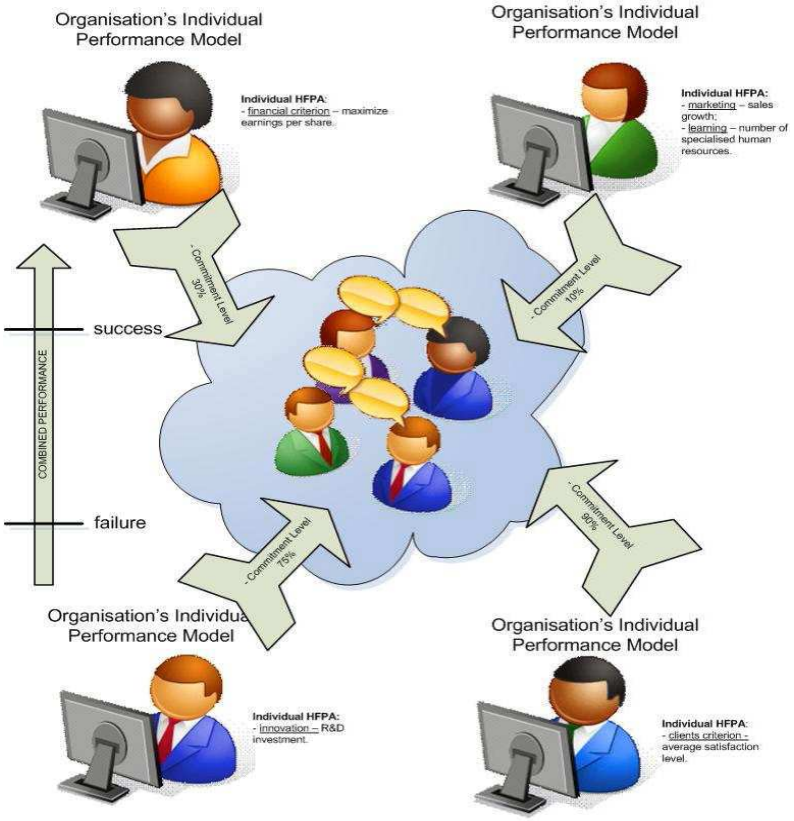

Figure 7: The link between organisation and network performance model

Acknowledgments

To the portuguese Fundação para a Ciência e Tecnologia which funded the pmColNet project under the contract PTDC/GES/71482/2006. To the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - CAPES, for financial support to maintain the scholarship for post doctoral training of Prof. Dr. Faimara do Rocio Strauhs, Process: 1979-09-4, at INESC Porto, Portugal. To colleagues at INESC Porto for support and knowledge sharing, in particular to Mr. Pedro Tiago Alves Castanheira and Mr. Eisse Jan Wiersema, for their ever-present availability.

References

[Amaturanga and Baldry, 02]. Amaratunga, D., Baldry, D.: "Moving from performance measurement to performance management"; Facilities, 5, 6 (2002), 217-23.

[Bititci et al., 04] Bititci, U. S et al.: "Creating and managing value in collaborative networks"; International Journal of Physical Distribution and Logistics Management, 34, 3/ 4 (2004), 251-268.

[Busi and Bititci, 06] Busi, M., Bititci, U. S.: "Collaborative Performance management: present gaps and future research"; International Journal of Productivity and Performance Management, 55, 1 (2006), 7-25.

[Camarinha-Matos and Afsarmanesh, 05] Camarinha-Matos, L. M., Afsarmanesh, H.: "Collaborative networks: a new scientific Discipline"; Journal of Intelligent Manufacturing, 16, 4/5 (2005), 439– 452
http://www.springerlink.com/content/vg4252751586627t/fulltext.pdf

[Carneiro et al., 07] Carneiro, L. et al.: "Redes Colaborativas de Elevado Desempenho no Norte de Portugal"; INESC, Porto (2007).

[Deng et al., 00] Deng, H. et al.: "Inter-company comparison using modified TOPSIS with objective weights"; Computers & Operations Research, 27, 10 (2000), 963-973.

[Ferreira, 09] Ferreira, R.: "Development of a multi-criteria collaborative decision model for performance management in networks of organisations"; Faculdade de Engenharia, Universidade do Porto, Porto (2009).

[Neves Silva, 09] Neves Silva, J.: "Gestão de Informação de Desempenho em Redes Colaborativas de Organizações"; Faculdade de Engenharia, Universidade do Porto, Porto (2009).

[Nonaka and Takeuchi, 97] Nonaka, I.; Takeuchi, H.: "Criação do Conhecimento na Empresa: como as empresas japonesas geram a dinâmica da inovação"; Editora Campus, Rio de Janeiro (1997).

[Ollus et al., 06] Ollus M.: "On the Management of Collaborative Networked Organisations" in Conference Proceedings from IST-Africa 2006; South African Department of Science and Technology, Pretoria, South Africa (2006).

[Parung and Bititci, 06] Parung, J., Bititci, U. S.:"A conceptual metric for managing collaborative networks"; Journal of Modelling in Management 1, 2 (2006), 116-136.

[Pereira, 06]. Pereira, C. E. N.: "A Criação do Conhecimento nas Organizações: uma abordagem construtivista a partir da interpretação da média gerência"; Faculdade de Economia, Administração e Contabilidade, Universidade de São Paulo (2006).

[Saaty , 90] Saaty, T. L.: "How to make a decision: The Analytic Hierarchy Process"; European Journal of Operational Research. 48, 1 (1990), 9-26.

[Todeva and Knoke, 05] Todeva, E., Knoke, D.: "Strategic alliances and models of collaboration"; Management Decision, 43, 1 (2005), 123-148.

[Wilson, 06). Wilson, T.: "The strict faceted classification model" http://www.asis.org/~iasummit/2006/files/46_Presentation_Desc.pdf

[Wognum and Faber, 02] Wognum P. M., Faber E.C.C.: "Infrastructures for collaboration in virtual organizations"; International Journal of Networking and Virtual Organisations, 1, 1 (2002), 32-54.

[Zahir and Dobing, 02] Zahir, S., Dobing, B. "Designing a web-based multi-criteria group support system (MCGSS)"; Journal of Computer Information Systems, 42, 4 (2002), 50-60.

[Zhao, 02] Zhao, D. F.: "Performance Measures for Inter-organisational Partnerships" in 7th International Conference on ISO 9000 and TQM; CMQR (Centre for Management Quality Research), Melbourne, Australia (2002).