

COLLABORATIVE NETWORKS

Value creation in a knowledge society

Luis M. Camarinha-Matos ¹, Hamideh Afsarmanesh ²

¹*New University of Lisbon, Q. Torre, 2829-516 Monte Caparica, Portugal – cam@uninova.pt*

²*University of Amsterdam, The Netherlands – hamideh@science.uva.nl*

Abstract: Collaborative networks show a high potential as drivers of value creation. The materialization of this potential however requires further progress in understanding these organizational forms and the underlying principles of this new paradigm. As a contribution in this direction, the notion of collaboration among organizations is clarified, a taxonomy of collaborative networks is proposed, and the basic elements of value creation are discussed, in the context of a holistic approach to collaborative networks.

Key words: Collaborative networks, virtual organizations, virtual enterprises, virtual communities, collaborative networks taxonomy, value creation

1. INTRODUCTION

Collaborative networks (CN) represent a promising paradigm in a knowledge-driven society. A large variety of collaborative networks have emerged during the last years as a result of the rapidly evolving challenges faced by business entities and the society in general [3]. For instance, the reduction of commercial barriers not only gave consumers wider access to goods, but also led to higher demands for quality and diversity as well as a substantial increase in the competition among suppliers. Therefore, highly integrated and dynamic supply chains, extended and virtual enterprises, virtual organizations, and professional virtual communities are just some manifestations of this trend that are indeed enabled by the advances in the information and communication technologies.

It is a common assumption that participation in a collaborative network has the potential of bringing benefits to the involved entities. These benefits

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include: an increase in “survivability” of organizations in a context of market turbulence, as well as the possibility of better achieving common goals by excelling the individual capabilities. On the basis of these expectations we can find, among others, the following factors: acquisition of a larger dimension, access to new/wider markets and new knowledge, sharing of risks and resources, joining of complementary skills and capacities which allow each entity to focus on its core competencies while keeping a high level of agility, etc. In addition to agility, the new organizational forms also induce innovation, and thus *creation of new value*, by confrontation of ideas and practices, combination of resources and technologies, and creation of synergies.

A particularly relevant issue in this context is to understand how value is created in a collaborative endeavor. Unlike the traditional and well-structured value chains, in new collaborative forms it is not easy to clearly identify the amount of “added value” contributed by each member. Consequently it is not easy either to devise general schemas for distribution of revenues and liabilities. The difficulty increases when the focus of value is moving from tangible goods to intangible, e.g. extended products, services, intellectual properties.

On the other hand, the notion of benefit depends on the underlying value system. In general, the structure of a value system, and therefore the drivers of the CN behavior, includes multiple variables or components. In a simplified view, the goal of a collaborative network can be seen as the maximization of some component of its value system, e.g. economic profit in a business context, or the amount of prestige and social recognition in altruist networks. Complementarily there are other factors that influence the behavior of a network and therefore its value generation capability such as the scheme of incentives, trust relationships, and management processes, ethical code, collaboration culture, and contracts and collaboration agreements.

Understanding these issues is fundamental for the sustainability of a collaborative network. It is important to find balanced ways of combining agility with some sense of stability (life maintenance support, knowing and trusting partners, having *fluid* interfaces, etc.). Therefore, a variety of organizational forms, including a mix of long-term strategic alliances and very dynamic short-term coalitions, shall coexist. As a contribution to better understand the role, behavior, and potential impact of collaborative networks in a knowledge-driven society, this paper first analyzes the main underlying concepts, as well as the specificities of the different organizational forms, and then addresses the issues of CN governance and value creation in a holistic perspective.

2. NOTION OF COLLABORATION

Although everybody has an intuitive notion of what collaboration is about, this concept is often confused with cooperation. For many people the two terms are indistinguishable. The ambiguities reach a higher level when other related terms are considered such as networking, communication, and coordination [6], [9]. Although each one of these concepts is an important component of collaboration, they are not of equal value and neither one is equivalent to another. In an attempt to clarify various concepts, the following working definitions can be proposed:

Networking – involves communication and information exchange for mutual benefit. A simple example of networking is the case in which a group of entities share information about their experience with the use of a specific tool. They can all benefit from the information made available / shared, but there is not necessarily any common goal or structure influencing the form and timing of individual contributions, and therefore there is no common generation of value.

Coordination – in addition to exchanging information, it involves aligning / altering activities so that more efficient results are achieved. Coordination, that is, the act of working together harmoniously, is one of the main components of collaboration. An example of coordinated activities happens when it is beneficial that a number of heterogeneous entities share some information and adjust the timing of for example their lobbying activities for a new subject, in order to maximize their impact. Nevertheless each entity might have a different goal and use its own resources and methods of impact creation; values are mostly created at individual level.

Cooperation – involves not only information exchange and adjustments of activities, but also sharing resources for achieving compatible goals. Cooperation is achieved by division of some labor (not extensive) among participants. In this case the aggregated value is the result of the addition of individual “components” of value generated by the various participants in a quasi independent manner. A traditional supply chain based on client-supplier relationships and pre-defined roles in the value chain, is an example of a cooperative process among its constituents. Each participant performs its part of the job, in a quasi-independent manner (although coordinated with others). There exists however, a common plan, which in most cases is not defined jointly but rather designed by a single entity, and that requires some low-level of co-working, at least at the points when one partner’s results are delivered to the next partner. And yet their goals are compatible in the sense that their results can be added or composed in a value chain leading to the end-product or service.

Collaboration – a process in which entities share information, resources

and responsibilities to jointly plan, implement, and evaluate a program of activities to achieve a common goal. This concept is derived from the Latin *collaborare* meaning “to work together” and can be seen as a process of shared creation; thus a process through which a group of entities enhance the capabilities of each other. It implies sharing risks, resources, responsibilities, and rewards, which if desired by the group can also give to an outside observer the image of a *joint* identity. Collaboration involves mutual engagement of participants to solve a problem together, which implies mutual trust and thus takes time, effort, and dedication. The individual contributions to the value creation are much more difficult to determine here.

A collaboration process happens for instance in concurrent engineering, when a team of experts jointly develop a new product. From this example it can be noticed that although some coordination is needed, collaboration, due to its joint creation facet, involves seeking divergent insights and spontaneity, and not simply a structured harmony.

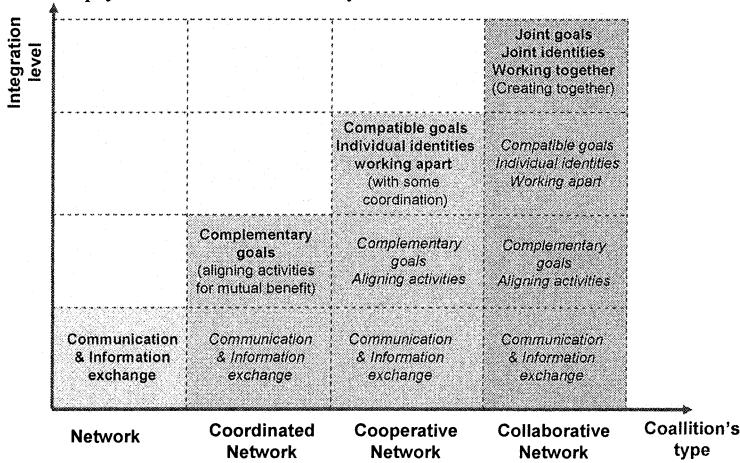


Figure 1. Examples of joint endeavor

As presented in the given definitions and depicted in Fig. 1, each of the above concepts constitutes a “building block” for the next definition. Coordination extends networking; cooperation extends coordination; and collaboration extends cooperation. As we move along the continuum from networking to collaboration, we increase the amounts of common goal-oriented risk taking, commitment, and resources that participants must invest into the joint endeavor. In the rest of this paper we focus on collaborative networks which subsume all other forms.

3. CLASSES OF COLLABORATIVE NETWORKS

A **collaborative network** (CN) is a network consisting of a variety of entities (e.g. organizations and people) that are largely autonomous, geographically distributed, and heterogeneous in terms of their operating environment, culture, social capital and goals, but that collaborate to better achieve common or compatible goals, and whose interactions are supported by computer network.

In today’s society, collaborative networks manifest in a large variety of forms, including the production or service-oriented virtual organizations, virtual enterprises, dynamic supply chains, professional associations, industry clusters, professional virtual communities, collaborative virtual laboratories, etc. [3], [5].

Although not all, most forms of collaborative networks imply some kind of *organization* over the activities of their constituents, identifying roles for the participants, and some governance rules. Therefore, these can be called manifestations of **collaborative networked organizations (CNOs)** (Fig.2).

Other more spontaneous forms of collaboration in networks can also be foreseen. For instance, various **ad-hoc collaboration processes** can take place in virtual communities, namely those that are not business oriented – e.g. individual citizens contributions in case of a natural disaster, or simple gathering of individuals for a social cause. These are cases where people or organizations may volunteer to collaborate hoping to improve a general aim, with no pre-plan and/or structure on participants’ roles and how their activities should proceed.

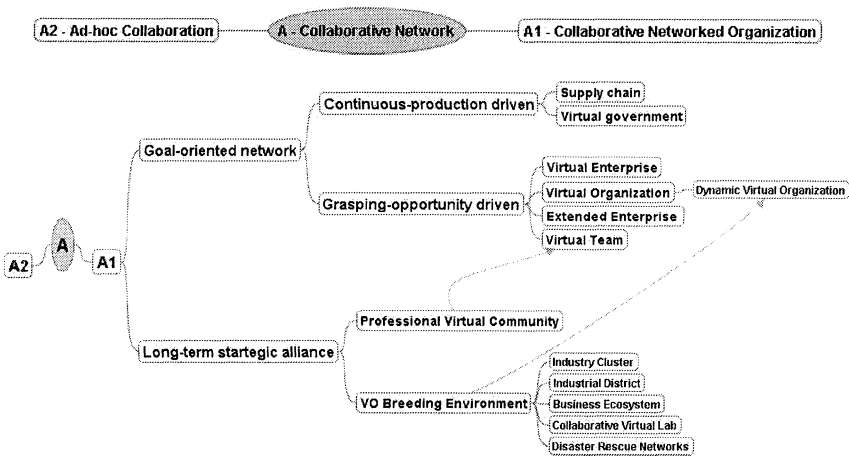


Figure 2. Examples of Collaborative Networks

Among the CNOs, some networks are goal-oriented in which intense **collaboration** (towards a common goal) is practiced among their **partners**, as opposed to longer term strategic alliances described below, where in fact

not collaboration but **cooperation** is practiced among their **members**.

Goal-oriented networks can themselves be either driven by continuous production / service provision activities, or driven by the aim of grasping a single (collaboration) opportunity, as described below:

In Goal-oriented networks, the first case of CNOs labeled as *Continuous-production driven* in Fig. 2, includes those networks that have a long-term duration and remain relatively stable during that duration, with a clear definition of members' roles along the value chain. Typical examples include:

Supply chains – a stable long-term network of enterprises each having clear roles in the manufacturing value chain, covering all steps from initial product design and the procurement of raw materials, through production, shipping, distribution, and warehousing until a finished product is delivered to a customer.

Virtual government – an alliance of governmental organizations (e.g. city hall, tax office, cadastre office, and civil infrastructures office) that combine their services through the use of computer networks to provide integrated services to the citizen through a common front-end.

The second case of CNOs within the Goal-oriented networks are labeled as *Grasping-opportunity driven* CNOs in Figure 2, and are dynamically formed to answer a specific collaboration opportunity and will dissolve once their mission is accomplished. Examples in Fig. 2 and Fig. 3 include:

Virtual enterprise (VE) – represents a temporary alliance of enterprises that come together to share skills or core competencies and resources in order to better respond to business opportunities, and whose cooperation is supported by computer networks.

Virtual Organization (VO) – represents a concept similar to a virtual enterprise, comprising a set of (legally) independent organizations that share resources and skills to achieve its mission / goal, but that is not limited to an alliance of for profit enterprises. A virtual enterprise is therefore, a particular case of virtual organization.

Dynamic Virtual Organization – typically refers to a VO that is established in a short time to respond to a competitive market opportunity, and has a short life cycle, dissolving when the short-term purpose of the VO is accomplished

Extended Enterprise (EE) – represents a concept typically applied to an organization in which a dominant enterprise "extends" its boundaries to all or some of its suppliers. An extended enterprise can be seen as a particular case of a virtual enterprise.

Virtual team (VT) – is similar to a VE but formed by humans, not organizations, a virtual team is a temporary group of professionals that work together towards a common goal such as realizing a consultancy job, a joint

project, etc, and that use computer networks as their main interaction environment.

The term “virtual” in the above organizations comes from the fact that these networks act or appear to act as a single entity, thanks to their organized communication and coordination mechanisms enabled by computer networks, although they are (usually) not a single legal entity, they may not have a physical headquarter, and are typically geographically distributed.

Besides the Goal-oriented networks, another class of CNOs is the *long-term strategic alliances* (see Fig. 2) aimed at offering the conditions and environment to support rapid and fluid configuration of collaboration networks, when opportunities arise. *VO breeding environments* and *professional virtual communities* exemplify these kinds of networks.

VO Breeding environment (VBE) – represents an association of organizations and their related supporting institutions, adhering to a base long term cooperation agreement, and adoption of common operating principles and infrastructures, with the main goal of increasing their preparedness towards rapid configuration of temporary alliances for collaboration in potential Virtual Organizations. Namely, when a business opportunity is identified by one member (acting as a broker), a subset of VBE organizations can be selected to form a VE/VO.

Earlier cases of VBEs were mostly focused on a regional basis, e.g. industry clusters, industry districts, and business ecosystem. Besides the production / services focus, a large number of more recent VBEs focus in new areas, e.g. science and virtual laboratories, crises management. Some examples include:

Industry cluster – is one of the earliest forms of VO breeding environments, consisting of a group of companies, typically located in the same geographic region and operating in a common business sector, that keep some “binds” with each other in order to increase their general competitiveness in the larger area. These binds may include sharing some buyer-supplier relationships, common technologies and tools, common buyers, distribution channels or common labor pools, all contributing to some form of cooperation or collaboration when business opportunities arise. Earlier forms of clusters did not require a strong ICT infrastructure but more and more collaboration resorts to such support.

Industrial district – is a term mostly used in Italy that represents a concept quite similar to an industry cluster. It can be focused on one single sector or cover a number of sectors in a given region.

Business ecosystems – is inspired by the mechanisms of the biological ecosystems, these networks try to preserve local specificities, tradition, and culture, and they frequently benefit from (local) government incentives. A

business ecosystem, also sometimes called digital ecosystem, is similar to a cluster or industry district, although it is not limited to one sector but rather tends to cover the key sectors within the geographical region. In most aspects business ecosystems simply represents a renaming of the industrial district concept. Namely, differences are subtle and can perhaps be found only in a clearer emphasis on the involvement of a diversity of their actors – the *living forces* of a region – in addition to companies, and a more intense use of advanced ICT tools to support collaboration.

Virtual Laboratory (VL) networks – represent the alliance of autonomous research organizations, each having their own resources (equipments, tools, data and information related to their past experiments, etc.), enabling their researchers, located in different geographically-spread centers to be recognized and considered for taking part in potential opportunity based problem-solving collaborations (forming a kind of VO for each problem solving). During a problem-solving collaboration process, it is typical that some expensive lab equipments owned by one or more organizations is made available for (remote) use by the other collaboration partners.

Disaster rescue networks – a strategic alliance of governmental / non-governmental organizations specialized in rescue operations in case of disasters is another recent form of VBE aimed at facilitating a rapid and well-coordinated response in case of a disaster. This VBE could have a local / regional coverage or a global geographic span.

VBE is thus the more recent term that was coined to cover these cases and clearly extends their scope to both regional / global coverage, single / multi-specialty sector, and for-profit / non-profit organizations. Complementary views and coverage of these organizational forms are shown in Fig. 4.

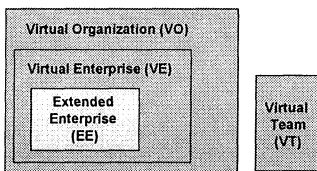


Figure 3. Single-opportunity CN

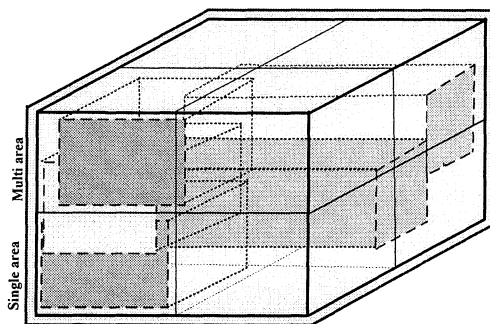


Figure 4. Long-term strategic alliances

Professional virtual community is an alliance of professional individuals, and provide an environment to facilitate the agile and fluid formation of Virtual Teams (VTs), similar to what VBE aims to provide for the VOs.

4. ISSUES ON COLLABORATIVE VALUE CREATION

What will my organization **benefit**, if embarking in a collaborative network? Will the benefits compensate for the extra overhead, loosing some control, and even taking the risks that collaboration implies? These are the main questions that many small and medium enterprise (SME) managers ask when the issue of collaboration is brought up. In fact, effective collaboration involves considerable preparation costs / time, in addition to the operational overheads and risks, which represent barriers to the rapid formation of dynamic coalitions in response to business opportunities. As a basic rule, in order to support rapid formation of collaborative networks, e.g. a VO, it is necessary that potential partners are *ready in advance and prepared to participate* in such collaboration. This readiness includes compliance with a common interoperable infrastructure, common operating rules, and common collaboration agreement, among others. Any collaboration also requires a base level of trust among the organizations. Therefore, the concept of **VO breeding environment** has emerged to provide the necessary context for the effective creation of dynamic virtual organizations.

The main aims for an organization's participation in a VBE would include: Agility for opportunity-based VO creation; effective common ICT infrastructure; mechanisms and guidelines for VO creation; general guidelines for collaboration; and increase chances of VO involvement.

Therefore, in this context, Table 1 illustrates some of the main reasons that can motivate an enterprise to join a VBE.

Table 1 – Examples of reasons to join a VBE

| Market-related reasons | Organizational reasons |
|--|---|
| <ul style="list-style-type: none"> ● Increase activities / profit ● Coping with market turbulence ● Increase chances of survival ● More chances to compete with larger companies ● Lobbying & market influence (branding / marketing) ● Easier access to loans ● Cheaper group insurance ● Better negotiation power (e.g. Joint purchasing) ● Prestige, reputation, reference ● Access /explore new market /product (e.g. Multidisciplinary sector) ● Expand geographical coverage ● Increase potential for innovation ● Economy of scale | <ul style="list-style-type: none"> ● Management of competencies and resources ● Approaches to build trust ● Improve potential of risk taking ● Support members through necessary re-organization ● Learning & training ● Shared bag of assets (e.g. shared tools, lessons learned, legal information, sample contracts) ● Organize success stories & joint advertisement ● Help in attaining clear focus / developing core competencies |

| | |
|--|---|
| <ul style="list-style-type: none"> • Develop branding • Achieve (global) diversity | <ul style="list-style-type: none"> • Sharing costs of branding / marketing |
|--|---|

But another relevant question is “What keeps the current VBE members happy and loyal to the VBE?” Table 2 illustrates some of these potential reasons.

Table 2 – Reasons to stay as a VBE member

| |
|--|
| <p>Motivation to stay</p> <ul style="list-style-type: none"> • Profit from businesses • Benefiting from the existing infrastructure • Better marketing possibilities (fairs, cheaper admission costs, better publicity/visibility (better location) ...) • Better strategic position through the VBE • Easy access to complementary skills • Explore new market / new product (multi-disciplinary-sector), expand geographical coverage • Potential for innovation • Continue profiting from the opportunities only available through the VBE • Fight against a common enemy • Better negotiation power • Existing success stories and advertising • Gain higher rank (Gold, Silver, Bronze) for more opportunities |
|--|

The initial attracting factors are not exactly the same that keep members happy in the long run! A company might have been attracted by the opportunity of getting access to new knowledge but after a while, once this objective has been achieved, different reasons are necessary to keep it involved in the VBE.

A number of other barriers have also been identified when interviewing running VBEs [1]. A challenge here is the identification and development of remedy measures to overcome these fears (see examples in Table 3).

Table 3 – Reasons to fear being a VBE member

| Fear | Possible remedy |
|--|---|
| <ul style="list-style-type: none"> • Return on time / cost investment – fear of not having ROI | <ul style="list-style-type: none"> - Proactive opportunity brokerage in the market / society - Building success stories |
| <ul style="list-style-type: none"> • Loosing decision making power – a <i>collaboration side-effect</i> | <ul style="list-style-type: none"> - Creating flexibility in decision making - Transparent rules/regulations - Different levels of membership |
| <ul style="list-style-type: none"> • Trust and IPR problems | <ul style="list-style-type: none"> - Mechanisms to establish trust / forecast trustworthiness - Enhance trust in VBE establishment itself - transparent rules/regulations - Definition of incentives & sanctions - Enforcement of the defined rules to be a “good citizen” in VBE |
| <ul style="list-style-type: none"> • Fear of partner selection by a virtual system | <ul style="list-style-type: none"> - Neutral transparent definition of selection process |
| <ul style="list-style-type: none"> • Required high commitment level | <ul style="list-style-type: none"> - Different levels of membership |

These are only some empiric examples collected from the interaction with several existing networks [5]. As the number and variety of networks increases, it is important to further and more systematically elaborate on

these elements.

Another relevant issue is the creation of a **system of incentives** to motivate participants to pro-actively engage in collaborative value creation. Complementarily, **fairness** and the crucial issue of properly determining the individual organization's share are important; namely to identify both an organization's contributions towards, as well as benefits from, collaboration in the network. These are the other major issues for which transparent governance principles, whenever possible supported by objective indicators, are needed.

In fact it is frequently mentioned that the lack of objective measurements, clearly showing the benefits of collaboration, is an obstacle for a wider acceptance of these new organizational forms. Generally, it is difficult to prove the advantages of (dynamic) collaborative networks in contrast to more traditional organizational forms in terms of improved performance. Being able to measure the global performance of a collaborative network, as well as the individual performance of each of its members, could represent an important boosting element for the wide acceptance of the paradigm. However **performance indicators** tailored to CN are not yet available [2], [10].

A performance measurement depends on the premises of the measurement system used. Collaborative networks challenge the premises of the methods developed in the past [8], therefore the applicability of existing measurement systems in this area is questionable. First it is necessary to take into account that performance, and related generated values, can be seen from different points of view, e.g. from the individual participant perspective, from the network coordination perspective, and from the surrounding environment / society perspective.

Understanding and making the nature of collaboration benefits explicit, is also an important way to ensure that every member of the network understands the measurements in the same way (same "perception of value"). This is also a requirement for goals alignment in order to facilitate the coherence of members' goals with the measurements.

The actual meaning of a benefit depends on the underlying **value system** that is used in each context. It is commonly accepted that the behavior of an individual, society, or ecosystem is determined by its value system. It is also intuitively understood that the values considered in a business-oriented collaborative network are different from those in a non-profit context (e.g. disaster rescue network). In fact the business / economy oriented school tends to look at a value system in terms of the activity links between a company and its suppliers and customers, putting the emphasis on how much (monetary value), a product or service is worth to someone. On the other hand, the socio-psychological school considers a value system as the

ordering and prioritization of a set of values that an actor or a society of actors holds. The two perspectives are not necessarily incompatible, but more research is needed in order to develop a general (abstract) theory of value systems that can then be instantiated to different application contexts.

In general, the structure of a value system, and therefore the drivers of the CNO behavior, might include multiple variables / aspects. Simultaneously other elements that may determine the behavior of the network and its members, include scheme of incentives, the existing level of trust, code of ethics, culture of collaboration, and collaboration agreements.

As a very preliminary step towards a theory of value systems and characterization of collaboration benefits, a number of indicators have been suggested in [4]. In this work the benefits received by a participant include both the benefits resulted directly from the activities performed by this participant and the benefits to this participant resulted by the activities performed by the other participants (external benefits). By combining base concepts from the transactions cost theory, social networks analysis, and game theory, a number of indicators is proposed (see summary in Table 4).

When combined with for instance a graphical representation, these indicators can provide the collaborative network participants a more objective view of their global and individual performance.

Although some experiments were carried out with real data from both a business-oriented network and a social-oriented network [4], much more research is needed in this area. Furthermore, in practice, collecting the base data from an operational network is rather a difficult task, which requires the development of new approaches and supporting infrastructures.

Table 4 Examples of indicators of benefits in collaborative networks

| |
|---|
| Social Contribution Benefits - sum of benefits contributed by an actor a_i to its partners as a result of its performance in the collaboration process. |
| External Benefits - sum of benefits received by an actor a_i as a result of the activity of the other actors involved in the collaboration process. |
| Total Individual Benefits - sum of external benefits plus self-benefits of an actor a_i |
| Individual Generated Benefits - sum of social contributed benefits plus self-benefits of actor a_i |
| Total Received Benefits - sum of external benefits achieved by a set of actors |
| Total Contributed Benefits - sum of social contributed benefits generated by a set of actors |
| Total Network Benefits - sum of benefits achieved by a set of actors in a specific collaboration process or over a period of time. |
| Progress Ratio - a macro indicator that represents the variation of the global benefits over a period of time. |
| Social Capital - density of the network benefits relation |
| Cooperative Development Ratio - measures the progress of cooperation benefits for a set of actors over a period of time. |
| Individual contribution index - Normalized contribution of an actor to the collaborative network |
| Apparent individual contribution index - based on the number of contribution links (i.e. the <i>out degree</i> of the actor in the graph representing the cooperation benefits), this index gives an apparent and simple to compute measure of the involvement of an actor in the collaboration process. |
| Individual external benefits index (IBI) - Normalized external benefits received by an actor, expressing the <i>popularity</i> or <i>prestige</i> of the actor. |

| |
|---|
| <p>Apparent individual benefits index - indicator based on the number of received contribution links (i.e. the <i>in degree</i> of the actor in the graph). Like IBI, this index also expresses the <i>popularity</i> or <i>prestige</i> of the actor.</p> |
| <p>Reciprocity index (RI) - balance between credit (sum of benefits contributed by an actor a_i to all its partners (or one specific partner)) and debit (sum of benefits received by an actor a_i as a result of the performance of all actors (or one specific partner) involved in the cooperation process). $RI < 0$ - selfish behavior, $RI = 0$ - null balance, $RI > 0$ - altruist behavior.</p> |

5. PURSUING A HOLISTIC APPROACH

A large number of research projects are carried out worldwide and a growing number of practical cases on different forms of collaborative networks are being reported. This trend has so far led to an extensive amount of empirical base knowledge that now needs to be leveraged. In addition to the identification of many required components, tools, and the base infrastructure functionalities, awareness is being built and partially studied regarding the fundamental configuration and operational rules, as well as the behavioral patterns that emerge. It is urgent to consolidate and synthesize the existing knowledge, setting a sound foundation for the future research and development in this area. In this context, the ECOLEAD integrated project was launched in 2004 as a 4-year initiative, involving 20 industrial and academic organizations from Europe and Latin America. This project's vision is that in ten years, in response to fast changing market conditions, most enterprises and specially the SMEs will be part of some sustainable collaborative networks that will act as breeding environments for the formation of dynamic virtual organizations.

The fundamental assumption in this project is that a substantial increase in materializing networked collaborative business ecosystems requires a comprehensive holistic approach. Given the complexity of the area and the multiple inter-dependencies among the involved business entities, social actors, and technologic approaches, the substantial breakthrough cannot be achieved with only incremental innovation in isolated areas. Therefore, the project addresses three most fundamental and inter-related focus areas - constituting pillars - as the basis for dynamic and sustainable networked organizations including: VO Breeding Environments (VBE), Dynamic Virtual Organizations, and Professional Virtual Communities (PVC) and Virtual Teams.

As the main focus of work, the VBE pillar addresses the characterization of these networks, namely in terms of structure, life cycle, competencies, working and sharing principles, value systems and metrics, the governance principles and trust building processes, the VBE management, and VO creation. The dynamic VO area is mainly focused on the VO management and governance approaches, performance measurement, and VO inheritance.

PVC addresses the characterization of these communities in terms of the socio-economic context, governance principles, social and legal implications, value systems, metrics and business models, as well as the support platform for collaboration. Interactions and synergies among these three entities, namely in terms of business models, value creation and corresponding metrics, are a major issue of integration.

Implantation of any form of collaborative network depends on the existence of an ICT infrastructure. Therefore, in addition to specific services to support the three pillars mentioned above, a generic horizontal infrastructure for collaboration is also being developed. Sustainable development of collaborative networked organizations needs to be supported by stronger fundamental research leading to the establishment of Collaborative Networks as **a new scientific discipline**. Ad-hoc approaches and poor understanding of the behavior of the collaborative structures and processes mainly characterize the past developments in the area of collaborative networked organizations. The project includes the establishment of a sound theoretical foundation, and a reference architecture, as a pre-condition for the next generation of CNOs.

6. CONCLUSIONS

Collaborative networks are commonly recognized in society as a very important instrument for survival of organizations in a period of turbulent socio-economic changes. A growing number of varied CN forms are emerging as a result of the advances in ICT, the market and societal needs, and the progress achieved in a large number of international projects. Nevertheless most of the past initiatives have addressed only partial aspects, failing to properly understand and support the various business entities and their inter-relationships in complex and fast evolving business ecosystems. The ECOLEAD project is pursuing a more holistic approach considering both long-term and temporary organizations as well as networks of organizations and networks of people.

A major current research challenge is the elaboration of a sounder theoretical foundation towards a better understanding of value systems, benefits, and success factors for collaboration.

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8. REFERENCES

1. Afsarmanesh, H.; Camarinha-Matos, L.M. – A Framework for Management of Virtual Organization Breeding Environments, in Proceedings of PRO-VE'05 – Collaborative Networks and their Breeding Environments, Springer, Valencia, Spain, 26-28 Sept 2005.
2. Alfaro Saiz, J.; Rodriguez, R.; Ortiz, A. – A performance measurement system for virtual and extended enterprises, in Proceedings of PRO-VE'05 – Collaborative Networks and their Breeding Environments, Springer, Valencia, Spain, 26-28 Sept 2005.
3. Camarinha-Matos, L. M.; Afsarmanesh, H. - Collaborative networks: A new scientific discipline, *J. Intelligent Manufacturing*, vol. 16, N° 4-5, pp439-452, 2005.
4. Camarinha-Matos, L.M.; Abreu, A. - Performance indicators based on collaboration benefits, in Proceedings of PRO-VE'05, Collaborative Networks and their Breeding Environments, Springer, pp. 273-282, Valencia, Spain, 26-28 Sept 2005.
5. Camarinha-Matos, L.M.; Afsarmanesh, H.; Ollus, M. (Editors) – *Virtual Organizations – Systems and Practices*, Springer, 2005.
6. Denise, L. – Collaboration vs. C-Three (Cooperation, Coordination, and Communication), *INNOVATING*, vol. 7, N° 3, Spring 1999.
7. Evans, S.; Roth, N.; Sturm, F. (2004). Performance measurement and added value of networks, in *Collaborative Networked Organizations – A research agenda for emerging business models*, Kluwer Academic Publishers, ISBN 1-4020-7823-4.
8. Folan, P.; Browne, J. (2005) – A review of performance measurement: Towards performance management. *Computers in Industry*, vol. 56, pp 663-680.
9. Himmelman, A. T. - On Coalitions and the Transformation of Power Relations: Collaborative Betterment and Collaborative Empowerment, *American Journal of Community Psychology*, Vol. 29, No. 2, 2001.
10. Kolakovic, M. (2003). *VAVE – A model for measuring the business performance of virtual enterprise – Business Excellence I, performance measures, benchmarking and best practices in new economy*, University of Minho, ISBN 972-8692-08-0.