Collaborative business networks

Evaluation of technological tools for decision support making

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Abstract: Nowadays, companies are living great difficulties on managing their business due to constant and unpredictable economic market fluctuations. Recent changes in market trends (such as the constant demand for new products and services, mass customization and the drastic reduction of delivery time) lead companies to adopt strategies of creating partnerships with other companies as a way to respond effectively to such difficult economical times. Collaborative Networks' concept born by the consequence of companies could no longer consider their internal business processes' management as sufficient and tend to seek for a collaborative approach with other partners for their critical processes. Information technologies (ICT) assumed a major role acting as "enablers" of these kinds of networks, enhancing information sharing and business process integration. Several new trends concerning ICT architectures have been created to support collaborative networks requirements, but still doesn't exist a common platform to reduce the needed integration effort on virtual organizations.

This study aims to investigate the current technological solutions available in the market which enhances the management of companies' business processes (specially, Collaborative Planning). Finally, the research work ends with the presentation of a conceptual model to answer to the constraints evaluated.

Keywords: Collaborative, Planning, Business, Network

1. Introduction

The current market has been characterized by periods of great turbulence, subjecting companies to constant changes in its management strategy, restricting long-term forecast predictions and decisions. Allied to this trend, markets require the development of complex products and services as a response to a new social and technological dynamic world. However, these new products and services require an extreme adaptation and customization to customer requirements and, also combined with a delivery time greatly reduced, have forced companies to deal with new difficult business environments. Many companies have failed to survive over these extreme challenges, especially small and medium enterprises (SMEs), where is noticed a lack of sufficient financial resources for Research and Development activities (to respond, effectively, on the developing new products, for example) or the enough technical/productive capabilities to respond to the operational challenges required.

To remain competitive, companies need to improve competencies in terms of dealing with new business models, strategies, organizational and governance principles, processes and technological capabilities (Luis M. Camarinha-Matos, 2009). The last decades were characterized by the appearance of a large amount of virtual organizations concepts as the solution to this problem (advantages of this approach will be detailed on next chapters). The key influences for this new trend are market globalization, the consequent need to change company's organizational models and the complexity of connecting all partners. Instead of following a hierarchical "individual entity" paradigm, companies are forming groups of alliances. The current business model is one where a company concentrates on what it does best, and partners with other companies who do what they do best, to deliver collaborative solutions or partner-enabled offerings to customers (IBM, 2009).

Information technologies have been responsible for the growth and "official" practice of these new network concepts over the business markets. However, they are often regarded as "organizers" of unstructured data referring the concepts of collaboration, but that does not promote the desired interconnection of business processes between companies. In this research work, it has been carried out an assessment of software applications currently available on the market, with a view to the knowledge of their main advantages and limitations.

Finally, we propose a new conceptual model, which aims to solve all the restrictions founded in the evaluation performed of the current information systems. The proposed model

will allow companies to manage their local resources, providing the desirable flexibility and integration on virtual organizations.

2. Methodology

This research work has been organized in four major phases, presented graphically on Image 1.

Image 1 - Methodology applied for the research work

The first phase included a literature review about business networks and the need for its establishment as a competitive fator for living in today's markets. The second phase sought to summarize and classify companies' processes, with a special concern about Collaborative Planning. The third phase concerned the evaluation of current information systems available on the market, to study the current ICT offer. Finally, the final phase presents an innovative model that addresses a more comprehensive approach and practice which all planning systems should include, as a way to support manager's decision making.

3. Business networks

3.1. Inter-organizational networks

In order to react to market turbulences, the first movement performed by companies was to re-engineer their internal business processes and information systems to eliminate waste and organize them in the creation of value. The main goal of this intra-organizational approach was to integrate all functional departments of a company. Some approaches like Lean Manufacturing, Six Sigma and Continuous Improvement started to become fluent on industrial companies as a solution to internal production management.

Furthermore, companies have been changing their way of managing their business, increasingly partnering with other companies in complex value chains and business ecosystems that extend globally (Myers, 2006). This main goal of this inter-organizational approach was to guarantee the cooperation of several companies, where each company

creates value and "transfer" to the value chain. According to (Pedro José Ramos Moreira de Campos, 2007), the concept of inter-organizational network is applied to a wide variety of relationships among organizations. It can be applied to joint ventures, strategic alliances, industrial districts, consortia, social networks and others. In summary, it can be used to define any set of recurring ties (resource, friendship and informational ties) among a set of nodes (individual, groups, organizations, information systems, etc.).

(Mehmet Kurumluoglu, Rita Nostdal, & Iris Karvonen, 2005) resumed two types of inter-enterprise organization: Network (or Breeding Environment) and Virtual Organization (or Virtual Enterprise). The first concept is related with a more stable group of organizational entities able to cooperate in case of a customer demand. The second approach is a temporary consortium of partners from different organizations established to fulfill a value adding task; it is created from the Breeding Environment for a definite task and dissolved after the task has been completed. Image 2 presents a graphical example of these two types of inter-enterprise organizations.
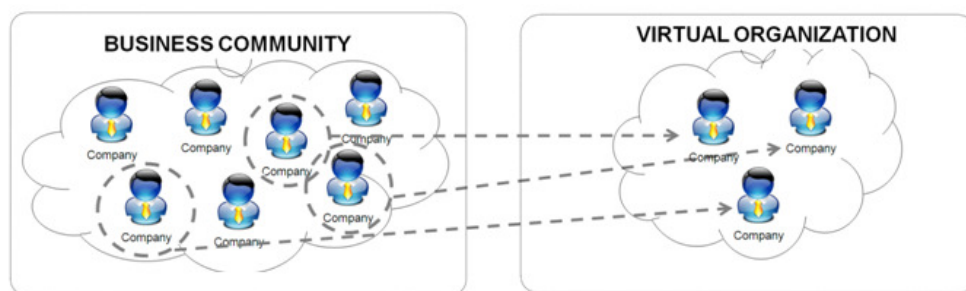

Image 2 - Breeding Environment and Virtual Organization.

An important issue that rises from these definitions is the "governance" of the network, i.e. who manages the relations between partners, who communicate with the customer, etc. That subject lead to the definition of hierarchical and non-hierarchical networks. In most cases, are difficult to identify and apply on several businesses. According to (Gary P. Pisano & Roberto Verganti, 2009), hierarchical networks are characterized by a specific organization which has the authority and provides it with the advantage of being able to control the direction of the innovation efforts and capture more of the innovation's value. At non-hierarchical networks, these decisions are either decentralized or made jointly by some or all collaborators; the advantage is the ability to share with others the costs, risks, and technical challenges of innovating. Indeed, the hierarchical networks still have a strong predominance in the world market, not promoting the development of partnerships for joint gain. Applying the concept of non-hierarchical networks has been growing but not reached

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yet a mature position. A proof of this theory is the difficulty in finding case studies of such kind of organizations all over the world.

3.2. The advantages of collaboration

(Luis M. Camarinha-Matos & António Abreu, 2005), it can be identified a considerable number of variables related to collaboration benefits, resumed next.

- Cost sharing
  - o Access to new markets and businesses without the need to make high investments;
  - o Share Research and Development costs;
  - o Ability for SMEs to compete with large competitors;
- Risk sharing
  - o Knowledge sharing to reduce decision-making uncertainty;
  - o Share responsibility on projects;
  - o Allow SMEs to compete with large companies;
- Decrease dependence level in relation to third party
  - o Creation of privileged links to other companies, reducing transaction costs;
  - o Also enables SMEs to compete with large companies;
- Increase innovation capacity
  - o Increase the capacity of generating new ideas through the combination of existent resources and diversity of cultures and experiences;
  - o Reduction of life-cycle of products and technologies;
  - o Increase of quality (due to the development of more robust products);
- Defend a position in the market
  - o Achievement of economies of scale, by sharing resources;
  - o Establishment of "closed" coalitions to new players or dominant companies;
  - o Increase of negotiation power over "outside" players (from the network);
- Increase flexibility
  - o Resource sharing between partners;
  - o Use of core competences from other partners;
  - o Increase adaptation capacity over different business environments;
  - o Offer a broader range of products and services;
- Increase specialization
 - o Focus on their critical activities;

- Establish proper regulations
    - Increase common culture of trust;
- Share social responsibility
    - Obtain recognition from other;
    - Integration of ICT tools;
    - Reinforce values that are common.

3.3. Future trends

According to SCDigest Editorial (2008), systems related to:

- Supply Chain Intelligence;
- Demand Forecasting and Planning;
- Product Life-Cycle Management;

Are considered as being at growing stages and achieved the equilibrium stage in the next 1 or 2 years. Advanced Planning Scheduling systems (which consider only internal production management) were classified as being in equilibrium phase, although believing it will reach de Decline stage in 1 year. As expected, MRP systems were classified on the Decline stage.
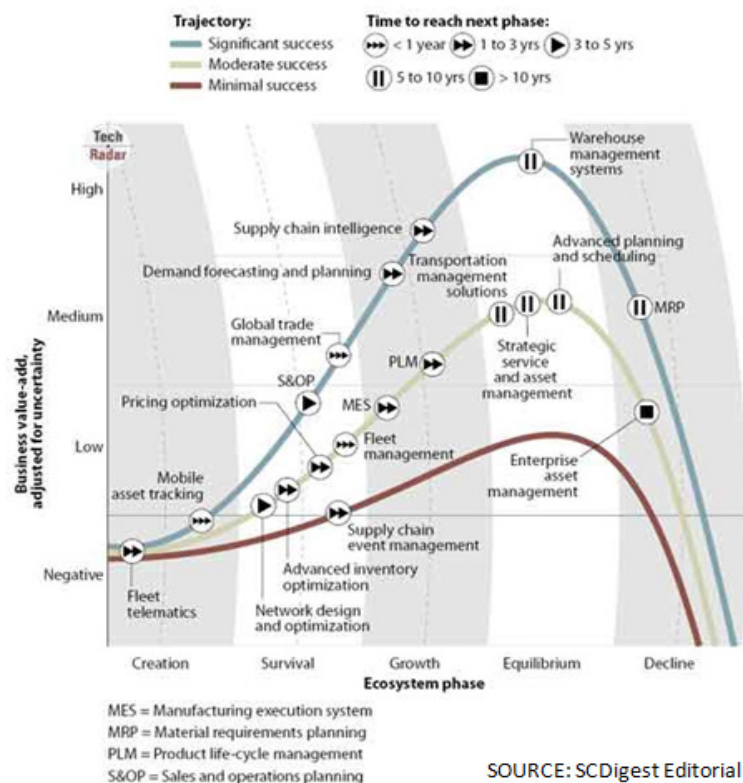
Image 3 - Market evolution.

This study provided by SCDigest Editorial (2008) re-enforced the idea of the virtual organization concept's evolution on market and the needed information systems to support, as being positioned on growing stages and expecting on achieving an equilibrium stage in less than 3 years.

4. Collaborative business processes and ICT tools evaluation

To fulfill our goal of studying companies' business processes we decided to, as a first challenge, to evaluate the meaning of *business process*, since our experience lead us to believe that has several definitions according to the organizations' type. (Ann Lindsay, Denise Downs, & Ken Lunn, 2003) developed a complete study about business processes' definition and appliance (from production to office processes). According to these authors, their deep bibliography analysis gathered a set of concepts to sustain business process definition, like (for example): processes always have a start, an end and a measurable goal; other approaches claim that, on production environments, processes start with raw materials and end with finish products. A more radical approach is that processes are never ending tasks, without clear milestones, which the goal is to reach a final status. Besides these concepts, it helped us to realize the coverage the term *business process* and the practical appliance to companies, which derived on a business processes' classification to fulfill our research:

- *Business management processes* (Processes dedicated to manage companies' tasks related to the business itself and to support the major activities, which concerns a high level of data integration and dependence between them. These processes are considered as crucial for companies' daily management);
- *Business office processes* (Processes which support the business management processes with the needed data, acting like repositories of non-structured information)
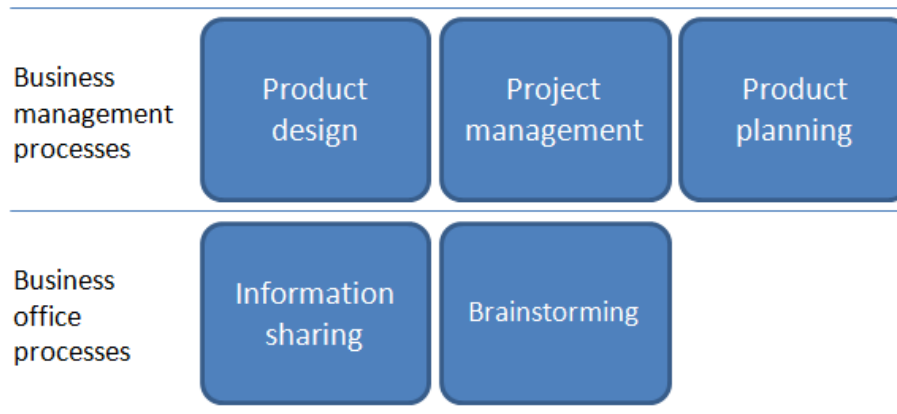
Image 4 - Collaborative business processes classification (BP matrix).

The following step included, and based on the professional experience of both authors, included the analysis of the relevant activities on company's daily management sensible to collaborative approaches, and their classification on the developed BP matrix (presented, graphically, on Image 3). This classification became crucial to an accurate research of current information systems available on the market, which will be presented on the next sub-chapters.

4.1. Business management processes

4.1.1. Product design

According to (G. Chryssolouris, M. Pappas, V. Karabatsou, D. Mavrikios, & K. Alexopoulos, 2007), manufacturing companies need to innovate, both by design new products and enhancing the quality of the existing ones. A common practice is, during the product design phase, all involved entities share a great number of drawing files. Often, different components or sub-assemblies of the product are designed by different groups of designers at geographically different locations. Many times, some manufacture of components are out-sourced from suppliers and a "shared" product design process is supported by constant e-mails exchange and phone calls, which are characterized as an unstructured method, very difficult to manage by several persons all over several companies.

The last two decades revealed new methods for managing the Product Design phase, supported by a new set of ICT tools which helped their management and integration with the traditional operational systems. Some of the most recent product development software systems, such as Computer Aided Design (CAD), Computer-Aided Manufacturing (CAM), database management and intelligent knowledge-based, have been also integrated through

web technologies into web based collaboration systems. The major concern is to allow companies to increase their participation on such important phases like Product Design, reducing future errors and optimizing the overall production process (since the optimization is performed on the beginning of the business lifecycle). Some of these applications' interfaces are presented on Image 5.

**CoCreate Product View**   **HP Sky Room**   **Catia**

Image 5 - Product Design software applications.

The CoCreate's product family includes a complete design environment, offering 3D CAD and 2D CAD, CAE and integrated product data management (PDM). Several add-ons can be added bringing new product development capabilities. CoCreate provides flexibility for facing short design cycles, one-off product designs, or companies demanding a lightweight design, reducing product design cycles. A complement product (ProductView MCAD Professional) provides an intuitive and tasked-based interface to, easily, visualize products and gain valuable engineering design insight.

We believe the ICT market already have several applications to answer these demands (like presented on Image 4), therefore, we don't consider as the major focus of our research work.

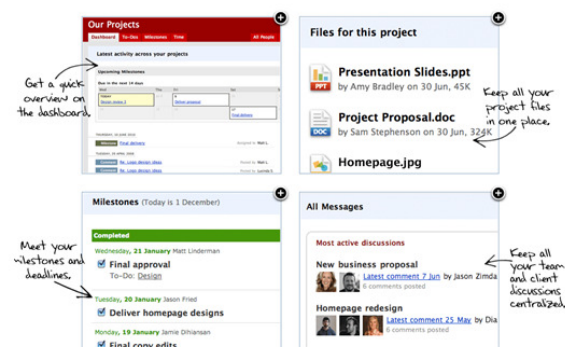### 4.1.2. Project management

Project management is the discipline of planning, organizing, and managing resources to bring about the successful completion of specific project goals and objectives. Collaborative project management tools cover all detailed aspects of collaboration activities and management of the overall project and its related knowledge areas. It also considers business or corporate related goals with some kind of social boundaries most commonly used for project management.
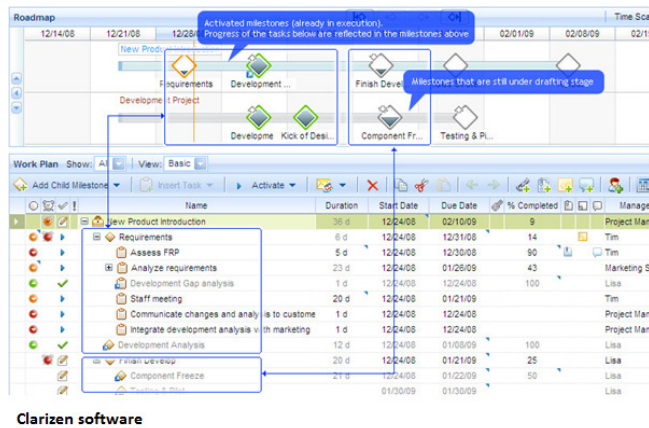
Image 6 - Project management software tools

Clarizen's collaborative planning allows project managers to invite others collaborators to co-plan the project and work together by delegating work items and utilizing the project life cycle drafting modes. According to Clarizon's commercial information available, it is possible to create a master plan; create joint-milestones and intersections between individually planned sections and the master plan; increase accuracy of the planning tasks, timelines and details by delegating the planning of the various sections to the people on your team; enable each of the collaborating team members to upload and share information; manage projects across distributed teams or multiple organizations.

Project Manager.COM allows the creation of a detailed task list, schedules the start and end dates of tasks and adds links between them, and helps to baseline the project. It also gives you a heads-up, by providing email alerts for tasks that are late. It's possible to lock tasks and add notes to tasks that everyone can see. Project Manager.COM allows the management of Virtual Projects, involving people from other departments or companies. Although these resources don't work directly, they are allocated to the project for some of their time. Using Web Project Software, every team member can login and enter their progress, whenever they get time to work on the collaborative project.

Basecamp provides a project collaboration suite which is hosted on the web. As standard functionalities, it allows companies to share project information with other project partners, share files and joint project calendars. Project status is available to all members and message exchange is also possible.

ProjectPier provides on online environment for collaborating in a project. Besides exchanging messages and files, ProjectPier promotes the definition of milestones and tasks and the assignation to partners. It is an OpenSource environment allowing companies to download and host the system on their own servers.

4.1.3. Production planning

According to (Hartmut Stadler, 2007), Supply chain management (SCM) is concerned with the coordination of material, information and financial flows within and across legally separated organizational units. One important way to achieve coordination in an inter-organizational SC is the alignment of future activities of SC members, hence the coordination of plans. When referring coordination, it's considered aligning of two or more decision makings; when considering collaboration, it's considered the willing to find a join decision making, which is suitable for all partners (trying to achieve the best solution for the overall supply chain network).

Misunderstandings are common when the considering definitions of SCM and logistics management. (Gregor Dudek, 2009) confirmed that the methods proposed within the context of SCM by academia as well as practitioners often include elements that go beyond what is usually regarded as logistics management (for example, joint product development between partners or aligned promotion activities). This author differentiates integrated logistics and SCM, considering SCM as a broader management concept, concerned with the integration of all business processes and not just logistic activities. Additionally, this author identifies seven typical business processes along the supply chain: customer relationship management, customer service management, demand management, order fulfillment, manufacturing flow management, procurement, product development and commercialization.

The function of a traditional production planning tool is to be responsible for the efficient planning, scheduling, and coordination of all production activities. The planning phase involves forecasting demand and translating the demand forecast into a production plan that optimizes the company's objective, which is usually to maximize profit while in some way optimizing customer satisfaction. Many software applications were developed over the

last three decades to answer to such requirements (from internal production capacity management constraints to systems which provide overall business process integration). Most of the times, these two software types are totally separated due the required level of specialization; for instance, most ERP systems still don't provide a Production Planning module with finite capacity and optimization algorithms.

The last decade has brought a new trend for ERP systems which concerned the supplier integration in the company's production planning. SAP offers one of the most complete software solutions about this thematic, with three modules available:

- SAP Supply Chain Management
    - o Includes features and functions to support collaborative supply chain planning processes, including strategic, tactical, and operational planning as well as service parts planning;
- SAP Supplier Relationship Management
    - o Built on the SAP NetWeaver technology platform, enabling multiple levels of suppliers, partners, and manufacturers to work together on a fully integrated source-to-pay process;
- SAP Supplier Network
    - o Global document exchange platform that allows enterprises to transact business electronically with thousands of suppliers using a single, standards-based network connection;

Another solution founded was the applications developed by ProjectPlanning.COM company. This company commercializes:

- ProjectManager.COM Supply Chain Management
    - o It administers the flow of supplies, logistics, services and information through the supply-chain, from suppliers, manufacturers, sub-contractors, stores and distributors to customers and end-users. It involves business strategy, information flow and systems compatibility.
- ProjectManager.COM Supply Chain Planning

4.2. Business office processes

4.2.1. Information sharing

One key for successful online collaboration is to provide an open and web based environment to easily share between all members. Nowadays, it may be founded several internet offers to achieve this goal.
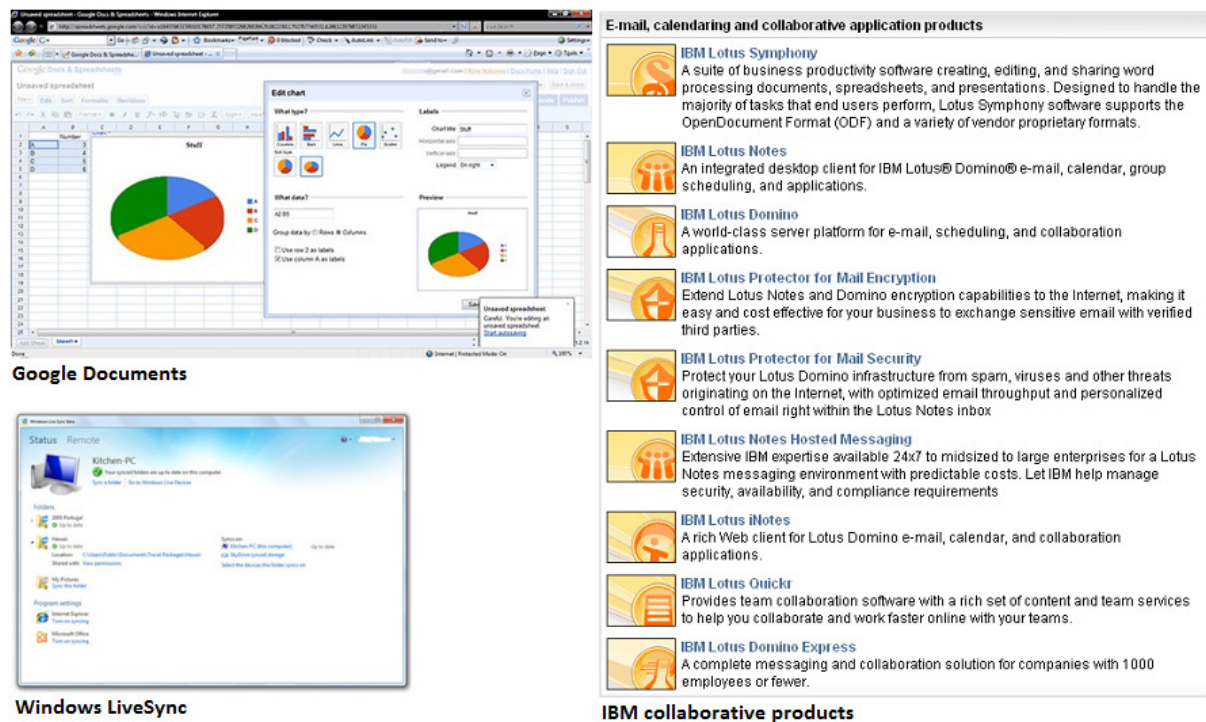

Image 7 - Information sharing software tools

Google Docs provides an easy way for to share documents, such as spreadsheets, text information, presentations, in a collaborative environment. Documents can be changed and team members evaluate them in real time. The concept of Google Repository has been created to allow companies to store the developed documents.

Windows Live Sync is a free-to-use internet-based file synchronization application by Microsoft that is designed to allow files and folders between two or more computers be in synchronization with each other on Windows (Vista and later) and Mac OS X based computers, based on Live Mesh's data synchronization technologies.

IBM Lotus provides several applications to enhance collaboration and flexibility between companies. IBM provides a variety of security-rich, multi-platform messaging products that can work together to build cost-effective solutions to meet your varying requirements.

4.2.2. Brainstorming

Brainstorming is a technique to enhance creativity and generate a large number of ideas. Usually, is performed face to face! But, following the globalization trend, teams are distributed over different physical locations in the world. In those environments collaborative brainstorming tools are particularly helpful as they allow companies to work together on different tasks without having to rely on physical meetings.
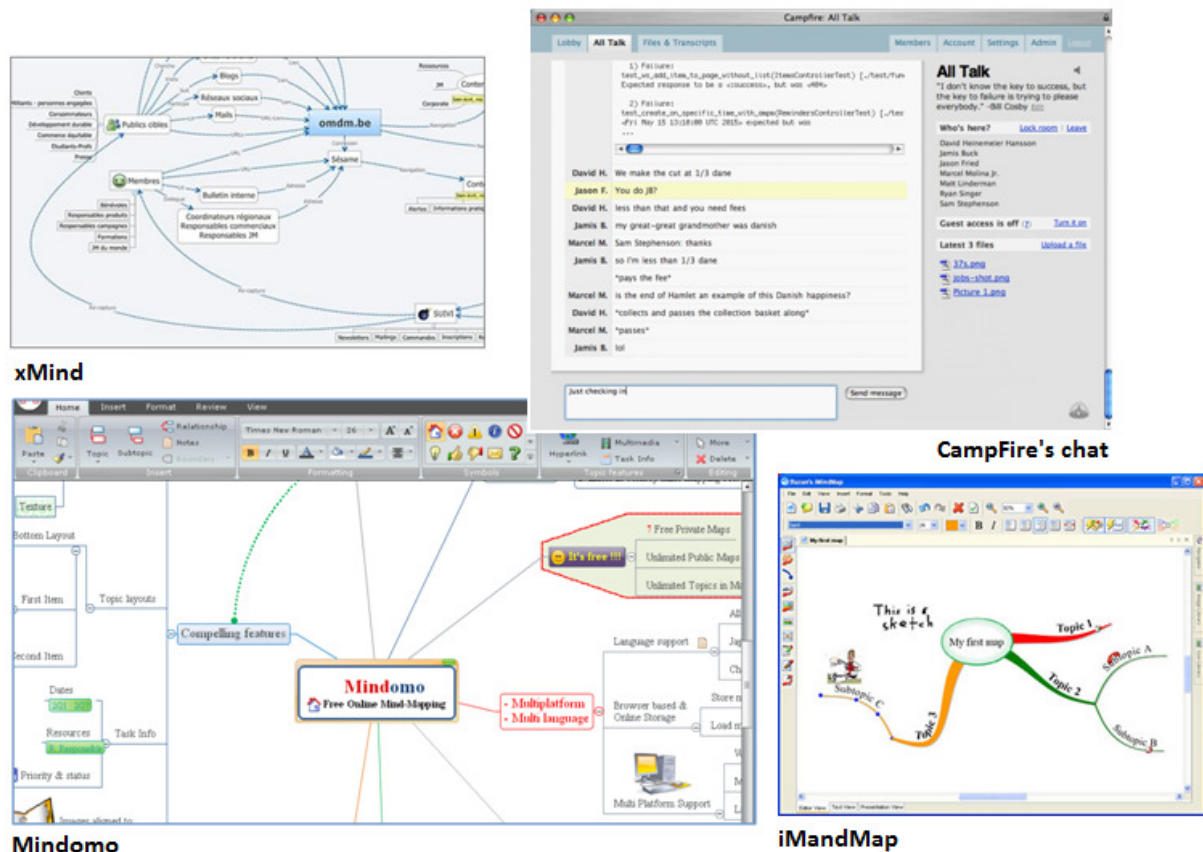

Image 8 - Brainstorm software tools

xMind is a open-source social brainstorming and mind mapping tool. It allows companies to share and present their ideas on complex projects with team members. The xMind application allows companies to create mind maps and to share them in a team. xMind provides integrated features to share and publish brainstorming results and to embed them into web platforms, such as blogs and websites.

iMandMap is a mind mapping tool software package. It allows the creation, visualization and managing vital information more productively than you ever thought possible.

It includes a fully integrated Project Management System and it's fully integrated with Microsoft Office, OpenOffice and iWork for advanced import/export.

Mindomo is an online mind mapping tool allowing companies to easily create brainstorms and share them with other users. It's an advanced tool for problem solving, with an enhanced interface and functionalities for project management.

Campfire provides an easy to use, web based application for online team collaboration and planning. Campfire allows members of different companies to share messages in real time with each other. It promotes a web-based group chat tool (set up password-protected) chat rooms in just seconds, allowing inviting a client, colleague, or vendor to chat, collaborate, and make decisions.

4.3. ICT overall classification

This chapter aims to resume the presented applications at the previous chapter, classifying them by type of business appliance and organizational processes, represented graphically on Image 8.
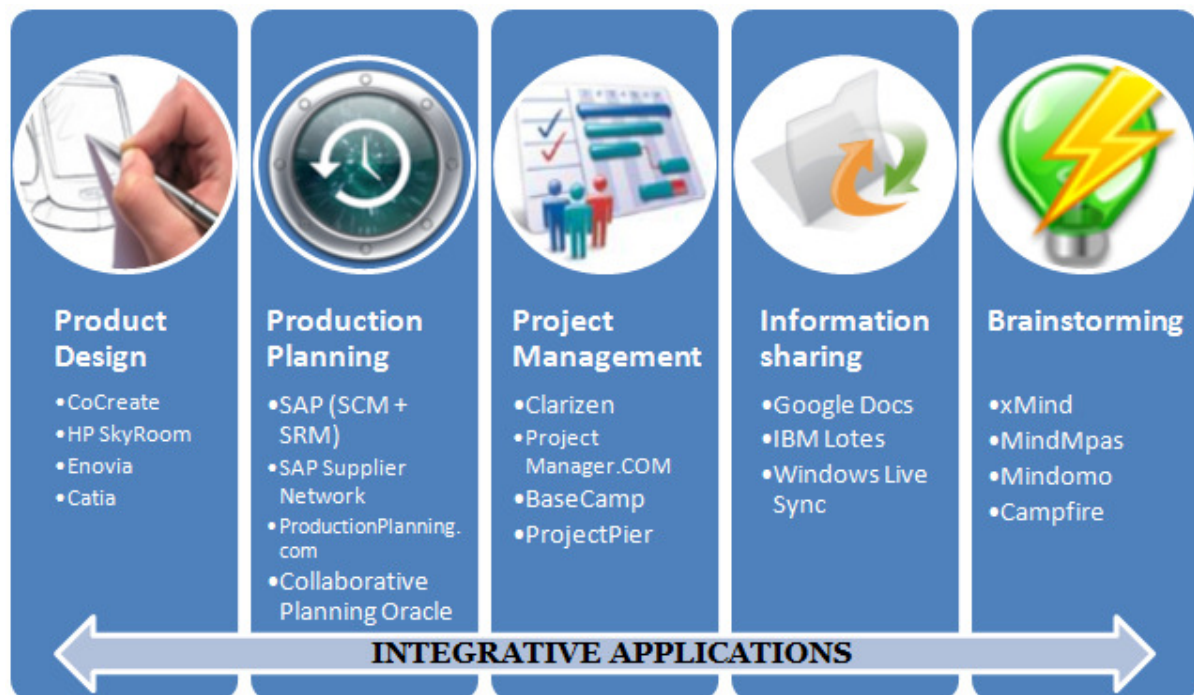

Image 9 - Overall classification of software tools

An "independent" type of applications (named, in this paper, as "Integrative") has been identified in this research work. It aims to represent those kinds of applications built to promote the integration between different software packages. Some of the most common applications are Microsoft BizTalkServer and Microsoft InfoPath. Although Microsoft Business Solutions (responsible company for Dynamics Navisions development and distribution) "claims", on their commercial documentatio, for collaborative planning tools ; the truth is Microsoft re-directs this responsibility to these integrative platforms.

As integrative solutions, one of the most complete applications founded was Microsoft Sharepoint Foundation. It enables companies to "mix" 3 main areas: intranet, extranet and web platforms; allowing companies to manage all the process (either involving internal or external activities). According to Microsoft, is the ideal application to manage business connectivity services. Additionally, Microsoft also developed Forefront to ensure the security management of all information.

A even (more) sophisticated and integrated approach to enhance interoperability has been defined with the solution Microsoft Duet Enterprise, which blends SAP with Microsoft SharePoint and Office, combining collaboration and productivity with business data and processes. Business users can benefit from a unified and simplified access to the data and actions they need that increase their personal and team productivity.

The major functionalities of this platform are:

- Administration/supportability (same user validates on both platforms, for instance);
- Security;
- System management;
- Templates & building block to SAP access objects (for instance, shared error messages);
- Office support;
- Industry standards.

Although this platform seems to be enough for companies' demands, the truth is some of the major functionalities are still unconvered.

5. Proposed solution

5.1. Research motivations

For this research work, the most important classifications considered are Production Planning and Project Management, due to the "closest" connection to the daily management

on companies. One of the major difficulties on searching software applications of these types was the misunderstood concepts provided by the software houses. Some of them "claim" for planning and collaborative functionalities, but the truth is are very limited, not achieving the desired decision support main objectives.

Since the market business paradigm has changed, these software applications become misfit to companies' strategic demands. The major challenge arises of how to link and coordinate planning between isolated parts of the supply chain. The need for a process of negotiation (coordination scheme between two or more parties) was detected by several authors, to ensure the synchronization between production plans from distinct organizations. Following the negotiation concept, (Hartmut Stadler, 2007) defines a Coordination Scheme, through which plans of two or more decision-making units are aligned. This scheme requires all members to adapt their individual plans in order to be developed an overall planning that is acceptable by all supply chain members, and refusing to follow any centralized planning approach that do not consider an active contribution of all partners. In summary, (Hartmut Stadler, 2007) define Collaborative Planning (CP) as a joint decision making process of individual ("local") production plans (supply chain partners), with the aim of achieving coordination to create an overall optimized solution for a business opportunity.

The main objective of a collaborative production planning tool is to "integrate" all partners of a virtual organization in this decision support scenario. The optimizing solution is not for only one company, but for the overall virtual organizational network. Several challenges are faced for this environment, such as trust and permissions and roles management.

The most interesting solution for our study has been Microsoft Duet, due to the relevant integration given to business processes. But, even so, we believe it didn't achieve the desired results. By the documentation and videos provided, this application enables SAP's business processes to be available (on Microsoft Sharepoint) to promote workflow updates, but doesn't promote our biggest concern: enhance collaborative planning and management resources.

Another issue to consider is the fact that most of the solutions presented for collaborative supply chain planning oblige companies to work with a centralized architecture, i.e., to use a central server application where the partners must be connected in order to be "technologically" integrated with the virtual organization. This concept doesn't promote the quick integration and the desired flexibility on virtual organizations (specially, the non-hierarchical networks); therefore, we believe it should be a decentralized solution.

5.2. Conceptual approach

The research work developed already highlighted some of the major concerns to deal with collaborative planning over the supply chain networks. Image 9 presents a first draft of a possible conceptual framework.

A first approach to the conceptual framework is a software agent on each partner, which would retrieve aggregate data from partner's ERP system. This software agent would be responsible for:

- Gather information about the local planning (available capacity), in real-time, to respond to a partner request;
- Provide alternative scenarios based on criteria previously defined (parameterized indicators for each business opportunity);
- Evaluate, accurately, delivery dates and costs of each solution;
- Ensure the security of data, providing only information about available capacity (and not accessing internal and confidential data).
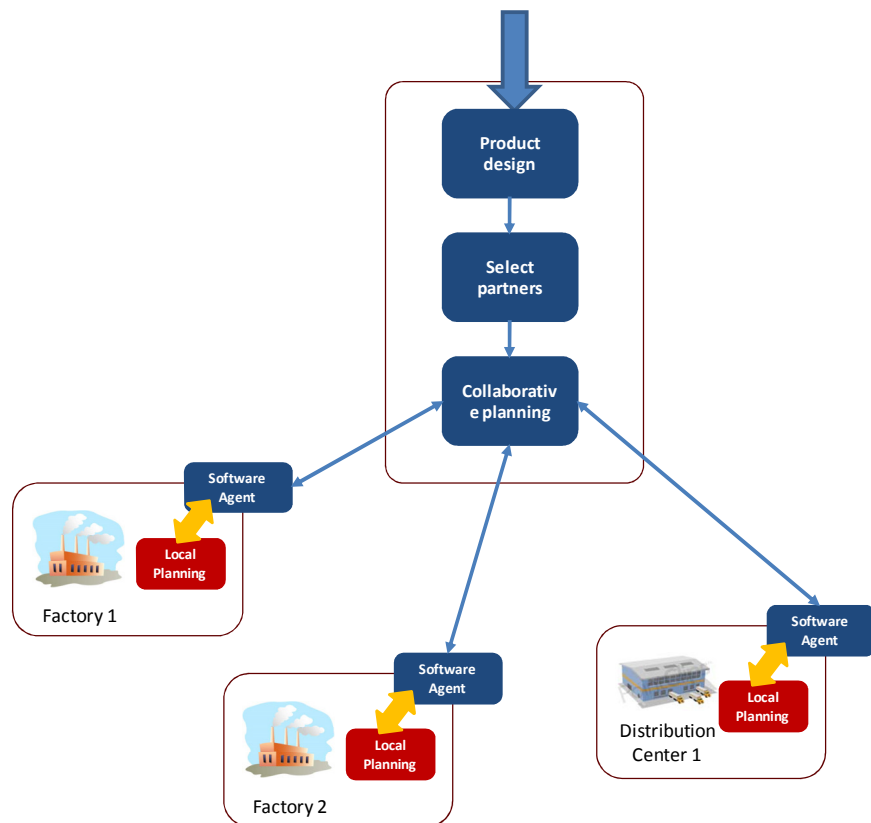

Image 10 – First conceptual approach

At the moment, it's not (yet!) defined the system architecture to support such model. The objective of this research work is the study of the best conceptual methodology to

handle such type of virtual organizations, not requiring (at the moment) any concern with technological architectures.

5.3. Major benefits

As major benefits, companies would reduce the need of "manual" communication (phone calls, e-mails, etc) with other partners. Besides the reduction on non-structured data, is also relevant the concentration of important information a common place, available to all partners.

One relevant aspect is the promotion of local flexibility (internal planning) for each partner, allowing companies to optimize their resources according to their internal rules and needs but, at the same time, always aware of the network objectives and "matching" between two objectives.

A major objective that could be achieved would be the reduction on uncertainty in the decision process. Managers would rely more on their planning (due to the real-time approach) associated to delivery dates and costs, enhancing a truthful collaborative environment.

6. Conclusions

Companies are living difficult times concerning product complexity, innovation and drastic reduction of lead-times, which require a new approach when managing their business. At this research work it has been studied one possible strategy to answer to these new challenges: the creation of virtual organizations. Benefits were evaluated in order to understand the future trends and their appliance over companies' traditional business processes.

An important contribute was the classification of business processes (which require collaboration) and the research of current software applications to answer the major needs.

During this research work, Collaborative Planning assumed the role of other differentiating business processes due to its importance in terms of strategic importance to the organization and management of business opportunities with partners. It has been considered several areas of activities which require a "tight" and efficient integration of business processes across all the organizations, to ensure the desired results. In addition, some restrictions arisen of the physical relocation of the organizations and the use of different applications with partners.

Finally, the research work presented a new conceptual framework which, according to the authors, would solve many of the current restrictions revealed, like the promotion of partner's local flexibility (internal production planning), reduction on communications and uncertainty in the decision process.

As a final comment, for future studies, it is expected to disseminate the proposed conceptual model in a detailed system architecture model and execute a deep study of the current trends related with technological service-oriented approaches; to evaluate the best solutions to implement the proposed model.

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