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The Emergence of Global Distributed Teams for Innovation

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ABSTRACT

In the competitive market, global distributed teams represent a growing and useful tool for organizations seeking to fasten time-to-market, permitting them to choose from a pool of skilled individuals and eliminating time and space barriers.

In the modern enterprise all teams are distributed to some extent.

However, most of the literature to date has focused on their problems and on a defensive, reactive approach to them, and not on how they can add value to an organization.

This dissertation aims instead to analyze that literature which focuses on their added value, and in particular addresses how distributed teams can be used to deliver innovation.

In addition, given the fact that most of the empiric literature has addressed individual issues, this dissertation aims not only to compare their findings, but also to give an ample vision addressing many different issues, hoping to be of use especially to those seeking to deliver innovation when dealing with this working approach for the first time.

In order to do so, an integrative model will be presented, collapsing a number of enhancers of innovativeness and effectiveness.

The dissertation will then continue to analyze in more detail various aspects of this model: the members' interactions, their working environment and, specifically in the design field, the use of appropriate tools and technology.

Lastly, since many organizations use distributed teams composed by many different stakeholders to reduce the new product development cycle, some information on the Red Dot design award winning Onyx Concept Phone project will give an insight of how these teams work in practice.

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1. INTRODUCTION

The practice of global distributed teamwork has moved beyond early experimentation towards maturity (MacGregor and Torres-Coronas, 2007).

However, most of the academic literature on the subject is still conceptual, not empirical.

"*If there is empiric literature, most studies are based on descriptive case-studies or quasi-experimental settings with (MBA) students as respondents. In addition, the empirical articles mostly report on specific issues; therefore the literature may be characterized as fragmented*" (de Leede et al., 2008, p.24).

This document focuses on frameworks and technologies to use in distributed teams in order to deliver innovation, aiming to discover common drivers of innovativeness by making confrontations between researchers' theories and their supporting experiments and studies.

Chapter 2 gives a definition and synonyms of distributed teams, while chapter 3 explores their origins and, in particular, the motivations behind their recent emergence.

Since these motivations are mostly related to distributed teams' benefits, chapter 4 gives an insight on them along with which challenges are generally encountered.

Chapter 5 serves as a transition between talking about distributed teams in general and their practice in delivering innovation, explaining why "distributed teams for innovation" is indeed an oxymoron and the fact that they should not be considered suboptimal methods of working but instead add value to organizations.

Therefore, chapter 6 will provide several models born from (or used for) the research of various authors, detailing how distributed teams can indeed add value, specifically through enhancing their effectiveness and innovativeness. In the last paragraph of chapter 6 the data derived from these models will be used to form an integrative model, which in turn will be compared to other researchers' findings.

Chapter 7 will focus on the members that form a distributed team, exploring the impacts of their personalities, interactions and working environment on innovation.

Chapter 8 will instead focus on tools and technologies used by distributed team members to collaborate and communicate and by management to support them in delivering innovation, specifically in the design field, which is considered an “extreme” virtual context.

Lastly, chapter 9 will address how distributed teams work in practice, but it will do so using, as an example, a design team that brought other stakeholders into the project as members.

2. WHAT IS A DISTRIBUTED TEAM?

Global distributed teams, also known as geographically dispersed teams and virtual teams, have been defined in many different ways.

One of the most widely accepted definitions is: “*we define virtual teams as groups of geographically, organizationally and/or time dispersed workers brought together by information technologies to accomplish one or more organizational tasks*” (Powell et al., 2004, p.7).

Taking into consideration both these characteristics and other ones highlighted by Bal and Teo (2001), a summary of the definitions may be taken as: “small temporary groups of geographically, organizationally and/or time dispersed knowledge workers who coordinate their work predominantly with electronic information and communication technologies in order to accomplish one or more organizational tasks” (Ale Ebrahim et al., 2009, p.2654).

While the term “virtual”, meaning “being such in essence or effect though not formally recognized or admitted” (Merriam-Webster, 2014), doesn't complement teams' performance orientation and should be considered poor terminology in this context (Smith, 2007), I will be using it as a synonym of “distributed” for the sake of consistency with the citations of the many authors that make use of it.

2.1. Other types of distributed work

Distributed work can be differentiated into various forms depending on the number of individuals involved and the degree of interaction between them (Ale Ebrahim et al., 2009):

- “teleworkers” (telecommuters) are individuals who work partially or completely outside of the main company workplace using information and telecommunication services,
- “virtual groups” are the combination of several teleworkers who report to the same manager,
- “virtual teams” exist when the members of a virtual group interact with each other in order to accomplish common goals,
- “virtual communities” are larger entities of distributed work that are not implemented within an organizational structure, but are usually initiated by some of their members via the Internet, and have commonly accepted roles and norms. Examples of virtual communities are Open Source software projects.

3. WHAT ARE THE CAUSES OF DISTRIBUTED TEAMS' EMERGENCE?

Work teams have been used since the 1960s in the United States, and their widespread use began with the Total Quality Management movement of the 1980s. By the mid 1990s, an increasing number of companies such as Goodyear, Motorola, Texas Instruments and General Electric had begun forming virtual teams with their foreign affiliates in Asia, Europe and Latin America to integrate global human resource practices (Kirkman et al., 2001).

In the last several years, due to globalization and improvements in communication technologies, virtual teams have increased rapidly worldwide (Kirkman et al., 2002) and, with rare exceptions, all organizational teams have become virtual to some extent (Martins et al., 2004).

The degree of virtuality is now one of the constituent characteristics of teams,

like the degree of autonomy, diversity or cohesion (de Leede et al., 2008).
The need for distributed teams is related to business pressures like mergers, acquisitions, downsizing, outsourcing, offshoring, technical specialization and relocation expenses. It is also related to social factors, like employees' reluctancy to relocate in contrast with skilled workers' presence everywhere, or distributed teams' greenness in accord with environmental laws.
The nature of work itself has changed from mostly physical labour to mostly knowledge work, and the technology that allows to do these knowledge work jobs from anywhere is now cheap, effective and plentiful (K.Fisher and M.Fisher, 2011). The ubiquity of the Internet, in particular, allows people to collaborate regardless of location, helping companies to be “both global and local at the same time” (Yip and Dempster, 2005).

4. BENEFITS AND CHALLENGES OF DISTRIBUTED TEAMS

Distributed teams, being an important mechanism to leverage scarce resources across geographic and other boundaries (Munkvold and Zigurs, 2007), represent an organizational form that can provide to organizations unprecedented levels of flexibility and responsiveness (Powell et al., 2004).
Flexibility is the main asset that comes with forming a distributed team and permits to satisfy the various business pressures discussed in chapter 3.
Responsiveness in terms of time to market has been generally admitted to be one of the most important keys for success in manufacturing companies (Sorli et al., 2006), and will be further addressed in chapter 9.
“*Especially the multinationals that are operating globally are using this type of work organization*” (de Leede et al., 2008, p.23).
But, of course, with distributed teams have also emerged many challenges and drawbacks.
The concept of extended enterprise, the Open Source movement and the recent emergence of “open innovation” (Chesbrough, 2003), have clearly shown that work can be highly collaborative, potentially large-scale, and without

boundaries (MacGregor and Torres-Coronas, 2007).

But even the author of the “open innovation” term has criticized the distributed team model, in that it cannot be implemented for each and every business case (Chesbrough and Teece, 1996). The same has been argued by Nemiro (2007): while there are situations in which distributed teams may be appropriate (for example, when work can be easily broken down and parceled out to team members), they may not be appropriate in other ones (like physical construction, geographically specific tasks and customer service).

Kimball Fisher and Mareen Fisher (2011) view space, time and culture as the most important variables affecting distributed teams and view their management as critical, because collocated teams (shared space) who work the same schedule (shared time) and know how to collaborate (shared culture) have a significant advantage over distributed teams in terms of communication.

In fact, while communication could be seen as a traditional team issue, the problem is magnified by distance, different time zones, cultural diversity and language or accent difficulties (Ale Ebrahim et al., 2009).

Distributed teams are also vulnerable to mistrust, conflicts and power struggles (Rosen et al., 2007). This could be due to the lack of physical “face-to-face” interaction, and the subsequent tendency to exchange less socio-emotional information of the members (Schmidt et al., 2001), but also to the probable lack of prior experience between distributed team members (de Leede et al., 2008).

Therefore, despite being suited to projects requiring cross-functional or cross-boundary skill inputs (Ale Ebrahim et al., 2009), distributed teams require a defined strategy to overcome these issues.

Especially for migration or similar large-scale projects, fundamentals of a successful distributed team are personal project management competencies, appropriate use of technology, networking ability, willingness for self-management and cultural and interpersonal awareness (Lee-Kelley and Sankey, 2008).

Open disclosure of information helps to overcome mistrust and potential conflicts (de Leede et al., 2008).

A technology facilitator role can also be critically important to virtual team success (Thomas and Bostrom, 2005), since virtual teaming often requires complex technological applications (Bergiel et al., 2008).

5. IS “DISTRIBUTED TEAMS FOR INNOVATION” AN OXYMORON?

An oxymoron is a figure of speech which, by combining two apparently contradictory terms, provides a novel expression of some concept, such as “cruel to be kind”.

“*For innovation in an increasing demanding environment, creativity is a critical element. Of course it is not the whole story for innovation but if innovation is the destination, creativity can be viewed as the journey, or at least the first critical steps on that journey*” (MacGregor and Torres-Coronas, 2007, p.xii).

Those that view “distributed teams” and “creativity” (and therefore innovation) as contradictory are concerned for attention cycles (time and resources) going to “coordination” and distributed team scenarios rather than personal creative thought, and cannot view “virtual creativity” as a new and emergent concept.

Researchers in this area instead strive to make this new concept “real”, treating it as an oxymoron rather than a simple contradiction (Larry Leifer, 2007).

“No longer should virtual teams be considered new or suboptimal methods of working. They now constitute common practice and the value which they add should be greatly increased” (Macgregor and Torres-Coronas, 2007).

6. FOSTERING EFFECTIVENESS AND INNOVATIVENESS IN DISTRIBUTED TEAMS

In this chapter several models from different authors will be discussed, which are intended explicitly for distributed teams: four models for fostering effectiveness in terms of task performance and two models for fostering innovativeness in terms of innovation behaviour and creativity of the team members.

The latter two will be described in more detail (as the research they were used for or based upon is relevant to the subject matter too) and the key factors considered by them will be compared with those considered by the first four models (using an integrative model) and with other researchers' findings and opinions, in order to examine the commonalities and differences between them.

6.1. Models for effectiveness in distributed teams

One of the first models for distributed team effectiveness was outlined by Lipnack and Stamps (2000) and is defined by them as “periodic table of organizational elements”.
In their model the key elements are purpose (the element sustaining the work process), people (team members and organizational levels), links (between team members) and time (physical time, process time and teams' life cycle).
As in Table 6.1., these four elements are then put into an input-process-output perspective to form the complete model, which has a strong emphasis on trust and interdependency.

	Inputs	Processes	Outputs
Purpose	Cooperative goals	Interdependent tasks	Concrete results
People	Independent members	Shared leadership	Integrated levels
Links	Multiple media	Boundary-crossing interactions	Trusting relationships
Time	Coordinate calendars	Track projects	Follow life cycles

Table 6.1. Periodic table of organizational elements (Source: Lipnack and Stamps, 2000, p.240)

Gibson and Cohen (2003) identified instead three “enabling conditions for virtual team effectiveness”: shared understanding (commonalities in beliefs and expectations), integration (process of establishing ways to work together) and mutual trust (shared acceptance of vulnerability).

In their model these conditions are established through five “design factors”: organizational context (selection, education, training, performance evaluation and reward systems), team's structure (leadership, goals, task design and social structure), use of technology (in particular its accessibility), people (unique and lateral skills of team members) and process (communication, decision making and resolution of conflict).

Two “moderators”, the degree of virtuality and the degree of diversity, have a negative impact on the way the design factors can help establish the enabling conditions.

Duarte and Snyder (1999) offer another model, proposing seven “factors” to affect the probability of a virtual team's success:

- human resource policies (career development system as in traditional teams, rewarding of cross-boundary work and results),
- training (formal and on-line), education (on the tools' usage) and development (of knowledge sharing systems),
- organizational and team processes (standardized to eliminate reinvention of operating practices),
- use of electronic collaboration and communication technology (providing adequate access to both them and their technical support),
- organizational culture (openness, constructive criticism, respect of culture, adaptiveness, autonomy, orientation to technological advancements),
- leadership support (communicating, establishing expectations, allocating resources, modeling desired behaviours),
- team-leader competencies (coaching, selecting collaboration tools, managing untraditional feedback, building trust, adapting organizational processes to meet the demands of the team, etc.),
- team-member competencies (using collaboration tools effectively, using interpersonal awareness, working across cultural and functional boundaries, managing time).

Finally, Bal and Gundry (1999), identified twelve elements for virtual team effectiveness, grouped in three points of view. This model was then used by Ale Ebrahim, Ahmed and Taha (2009) as a framework to put in evidence further discussion on those elements.

From the “technology” point of view, the elements are: selection (information richness, implementation, purpose of the meeting), location (relationship between tool, time and space), training (in using the tools) and security (of sensitive information and data).

From the “people” point of view: team selection (necessary skills, geographical and organizational separation), reward structure (fair and motivating), meeting training (different from that of more traditional teams) and specify objectives (leadership less oriented to control and more oriented to coaching and moderating functions).

From the “process” point of view: alignment (with the capabilities and willingness of virtual team members as opposed to face-to-face teams), meeting structure (formal practices and routines), performance measurement and team facilitation (to enhance accountability for results).

6.2. Conditions for innovation behaviour of distributed team members

The model proposed by de Leede, Kraan, den Hengst and van Hoof (2008) follows an input-output framework and is based on a set of relevant virtual team characteristics (input), plus two broad sets of conditions that moderate the relationship with innovation behaviour (output): organizational and technological conditions.

This model was used by them as preliminary to a multilevel analysis of a survey among 83 virtual team members from 16 organizations. Since the sample consisted of not just one respondent per company, the multilevel analysis, taking into account that the data at the lowest level are nested within a higher order level (Hox, 2002), resolved the statistical dependencies and the possible subsequent bias. The core business of the virtual teams taken into consideration was characterized as “software development, maintenance and support” by 28% of the respondents, as “creative/content-generating work (research and development, design, editorial work)” by 24%, as “data processing, typing and other forms of data input” by 18%; the rest of the respondents worked in teams with another core activity.

The virtual team characteristics are: the degree of virtuality (negatively related to the amount of face-to-face contacts), time intensity (the amount of time that team members spend on virtual settings and activities) and the degree of complexity (the quantity of diverse time zones, locations and companies involved).

In the multilevel analysis, while time intensity was found to be counterproductive for innovation, both the degree of virtuality and the degree of complexity were not significantly associated with workers' innovation behaviour.

Regarding technology conditions, three types of interdependence from Thompson (1967) were used to classify the IT (information technology) tools of the virtual teams: “pooled” IT tools may be used rather independent from each other (e.g. shared project planning tools), but their outcomes are important for the whole team since they are generally used for planning activities; “sequential” IT tools prescribe the sequence of activities (e.g. workflow software); “reciprocal” IT tools are more advanced types of online, synchronous tools that support the content of activities (e.g. document sharing tools).

From the multilevel analysis emerged that while the use of reciprocal IT tools was positive for innovation behaviour, the use of pooled and sequential IT tools was not significantly associated with it. This was due to the fact that “*making more frequent use of reciprocal IT means more interaction and consequently more close and cohesive relationships within the group*” (de Leede et al., 2008, p.36).

However, another finding precised that while in virtual settings with a low degree of complexity the use of reciprocal IT tools was better than that of pooled IT tools for innovation behaviour, in virtual settings with a high degree of complexity their usage was equivalently positive. This was due to the fact that teams that are more homogeneus “do not need advanced IT for project planning, agreement on activities etc.” (de Leede et al., 2008), while highly complex ones need such pooled IT tools for planning.

Regarding organizational conditions: job demands, task interdependency, support of co-workers and coordination of workers were proposed as critical.

High job demands, indicating a heavy work load in quantitative terms, were found to be associated with high innovation behaviour, regardless of the degree of virtuality or the degree of complexity. Low job demands instead were associated with high innovation behaviour only when the degree of virtuality and the degree of complexity were low. Hence, "*if virtual teams operate in a rather complex context (little face-to-face contacts; more locations, time zones and companies involved), they show more innovation behaviour if they have high job demands*" (de Leede et al., 2008, p.40). This must be up to a point, since time should also be taken into consideration. The relationship between multitasking and innovation in distributed teams has also been analyzed by Lojesky, Reilly and Dominick (2007) and will be further discussed in the last paragraph of this chapter.

High task interdependency, indicating that team members need each other in order to carry out the individual tasks, was found to be associated with low innovation behaviour when the degree of virtuality was high, which is counter-intuitive. A possible explanation was given using the cognitive network model (Santanen et al., 2003): people cannot cope with too many interactions, which are subsequent to high task interdependency and require a lot of cognitive resources, cognitive resources that are needed for other matters in these highly virtual settings (de Leede et al., 2008).

Co-worker support was found to be necessary for innovation behaviour when the degree of virtuality was high. Low-virtual work (and thus more face-to-face work) was instead found to be innovative even without much co-worker support available.

Coordination's main effect on innovation behaviour was different if it was based on output/targets to reach or if it was based on trust: while coordination by output had a negative association, coordination by trust had a positive association.

In addition, as an interaction effect, coordination by output had a stronger negative association when the degree of complexity was high; in settings of similarly high complexity, coordination by trust had a stronger positive association.

These last results were due to the fact that coordination by output normally implies a stronger intolerance for making mistakes, which does not stimulate the “risky behaviour” needed for innovation. A climate that encourages trusting relations has instead been defined by Edmonson (1999) as “psychological safety”, in which people can speak up without being punished or feeling embarrassed and that will be further discussed in the last paragraph of this chapter.

As remarked by Jan de Leede et al. (2008), a limitation in their model was the absence of the feedback loop. Hence, despite being important in input-process-output models, the fact that the “current conditions” (both inputs and outputs at the time) might have been the result of past innovation behaviours was not included in their measurements. Therefore, “*longitudinal research may open up the rather black box of the influence of time and experience on the different variables...*” (de Leede et al., 2008, p.43).

6.3. Five building blocks for creativity in distributed teams

The model proposed by Nemiro (2007) is based on an “in-depth investigation of what is necessary for virtual teams to be creative” (Nemiro, 2004).

For this investigation, the maximum variation sampling (of the teams) was used, continuing until no new or relevant data emerged regarding a category, and relationships between categories were well established (Strauss and Corbin, 1991); in other words: until “theoretical saturation” was reached. The teams were chosen to vary in size, years of existence, and “virtualness” (defined by both the degree of virtuality already discussed and the ratio of members within the team that were geographically dispersed).

They also varied with respect to the core business of the originating organization, and in the nature of the team's work.

Only virtual teams whose existence was ongoing, that used electronic means rather than face-to-face interaction for the majority of their communication, and that had at least one geographically separated member, were selected.
In the end, 36 selected members from nine different virtual teams were interviewed individually about their virtual teams' functioning, communication behaviour, and high and low creative experiences within the team.
Three teams were organizational consulting firms, two teams were in the field of education, three teams were on-line service providers and the final team was made up of product design engineers.
The resulting model included five “building blocks” that, when all in place, let the virtual team reach the highest creativity: design (appropriate work design approach and leadership structure), climate (supportive), resources (sufficient), norms and protocols (agreed on and adhered to), and continual assessment and learning (as a result of the assessments).
Regarding design, as the virtual teams moved through several creative process stages, “*from initial idea generation, through development, to finalization and closure of a creative effort, they utilized two work design approaches*” (Nemiro, 2007, p.108).
The “modular approach”, through which the work is “parceled out or distributed among team members, usually based on individual team member's expertise or interest” (Nemiro, 2007), was found to be the most commonly used of the two. The “iterative approach” instead was mainly used in conjunction with it, and consisted in members working a little, then presenting results to the team, then using feedback to work a little more, and so on until the finalization of the project.
In fact, creative teams were found to adapt a “flexible design” to be the most appropriate for the situation at hand, using a modular approach for those situations in which work could be easily divided into sections, and switching to an iterative approach when it could not.
Despite the fact that all the team members selected indicated high levels of creativity, there was a variety of leadership structures followed. Hence the model also suggests different categories of them, each one appropriate for

different situations. Permanent leadership structures are suggested in situations of centralized decision making, and when work can be parceled out to team members according to different roles and areas of expertise. Rotating leadership structures are suggested when there is a high level of trust between members, when team members' roles are less differentiated, when all members have the necessary competencies to effectively lead the team, when operating practices are standardized, and when support staff do not rotate (to assist in maintaining stability). Finally, leaderless structures (self-managed teams) are suggested when there is a high level of trust between members, when there is a high level of accountability for the work of each member, when team members have equal status or rank within the functions they belong to, and when team members are “equally invested in and will benefit from the team's outcome” (Nemiro, 2007).

Regarding climate (the second building block), “connection” (defined by both task connection and interpersonal connection) emerged as one of its key elements. Task connection was found to be related to a strong sense of dedication and commitment of the members, and to shared goals “clearly defined and developed through constant clarification and feedback” (Nemiro, 2007). Interpersonal connection was found to be related to timely information sharing, personal bonding and mutual trust.

To form the climate for creativity within distributed teams, seven team member and management “conditions” also emerged: acceptance of ideas (with honesty rather than unnecessary criticism, leading individuals to feel comfortable), constructive tension (some teams actively sought to create it in order to not be subject to groupthink), a sense of challenge (stemming from an intriguing problem, urgent needs or the desire to push beyond a status quo), a high level of freedom (e.g. schedules were flexible and adaptable to the individual member's lifestyle), management encouragement (of new ideas and new ways of doing things), and sufficient resources (information, human and technological) and time.

However, Nemiro (2007) also remarked that these conditions should not be established through the “simple-minded” approach of eliminating aspects that hinder them and putting in place those that foster them, but rather taking a more realistic approach of striving for a balance of them. For example, the acceptance of ideas is important, but not all ideas can be totally accepted. Oertig and Buergi (2007, p.135) also suggest that "*encouraging some team members to think beyond the boundary while restraining the wide-eyed visionaries requires a balancing act*".

As in Table 6.2., in order to achieve these conditions "*members, leaders and managers need to develop and practice a special set of interpersonal competencies*" (Nemiro, 2007, p.112).

Conditions:	**Related Competencies:**
Acceptance of ideas	- Supportive communication
Constructive tension	- Conflict resolution - Cross-cultural communication - Decision making - Supportive communication
Challenge	- Developing and motivating others - Stress management - Time management
Collaboration	- Conflict resolution - Cross-cultural communication - Decision making - Knowledge management and information access skills - Supportive communication
Freedom	- Stress management - Time management
Management encouragement	- Cross cultural communication - Developing and motivating others - Supportive communication
Sufficient resources and time	- Conflict resolution - Knowledge management and information access skills - Time management

Table 6.2. Conditions and related competencies (Source: Nemiro, 2004, p.112)

However, Nemiro (2007) remarked that not all competencies may be of equal importance to every virtual team. Hence he suggested for each team to assess the individual members' opinion on them, in order to then focus on “the most pronounced gaps” (competencies lacking in the team but valued as important) and “areas of strength” (competencies both possessed and valued as important by the team).

Regarding resources (the third building block), what was found critical was selecting the communication tools that might work best for each stage of the creative process.

However, as suggested by Armstrong and Cole (1996), a “shared agreement across distance” on how to use this technology is just as important. Hence, two categories of norms and protocols (the fourth building block) need to be put in place: communication behaviour norms and project and task management norms.

Communication behaviour norms included in the model (Nemiro, 2007) were:

– availability and acknowledgement norms (on acceptable time frames and frequency for when members will check in the communication tools, and hence when members can expect others to do it as well),
– appropriateness of specific communication tools (as selected for the third building block),
– protocols for usage of specific communication tools (specific forms of etiquette or guidelines),
– rules governing subgroup and information exchange (the need for them increases as the team does in size),
– balance of structured and unstructured communication (which types of communication exchange are formally scheduled and the level of acceptability for the random ones, as well as for what purpose is best to use structured and unstructured types).

The project and task management norms included were:

– a creative process life-cycle map (some of the teams selected used it to develop a shared working picture and to determine the boundaries and scope of the work),

- distinguishing between routine and creative tasks (so that efficiency is an outcome as well as creativity),
- assigning roles and responsibilities (to avoid confusion and redundancy),
- timeframes and accountability measures (to avoid an “out of sight, out of mind” mentality with dispersed virtual team members, there is a need to establish when certain actions need to be completed by, what actions will be taken to ensure on-time delivery of task-related output and what will happen if members do not meet their responsibilities),
- protocols for shared workspaces and files (to ensure that all the members have current project-related information),
- project review, revision and final approval norms (when and how they should take place, and which individuals can offer and must receive input for them).

Finally, regarding continual assessment and learning (the fifth building block), most of the teams interviewed “set aside time, sometimes formally, sometimes informally, to review what worked and what could be improved upon” (Nemiro, 2007). In fact, the last step of the creative process is not finalization/closure, but rather evaluation.

As remarked by Nemiro (2007) himself, the limitation in his research was its being based on interview data: memory biases and the absence of external validation could have therefore affected the accuracy of reporting and the assessment of the high and low creative experiences.

6.4. Comparing models for innovativeness with models for effectiveness and with other research

All of the models described in this chapter had three key words in common: technology, processes and people. Using these key words, the critical predictors of effectiveness and innovativeness of each model can be collapsed into an integrative model (Table 6.3.).

	Technology	Organizational and team processes	People
Lipnack and Stamps (2000)	Multiple Media (links)	Cooperative goals (purpose) Interdependent tasks (purpose) Concrete results (purpose) Coordinate calendars (time) Track projects (time) Follow life-cycles (time) Boundary-crossing interactions (links)	Indipendent members (people) Shared leadership (people) Integrated organizational levels (people) Trusting relationships (links) Boundary-crossing interactions (links)
Gibson and Cohen (2003)	- Accessibility and use of technology (design factor)	Processes (design factor) Integration (enabling condition) Team structure (design factor) Organizational context (design factor)	Unique and lateral skills (design factor) Shared understanding (enabling condition) Mutual trust (enabling condition) Team structure (design factor) Organizational context (enabling condition)
Duarte and Snyder (1999)	- Electronic collaboration and communication technology - Organizational culture	- Standardized organizational and team processes - Organizational culture	Human resource policies Training, education and development Leadership support Team leader competencies Team member competencies Organizational culture
Bal and Gundry (1999)	Selection Location Training Security	Alignment Meeting structure Performance measurement Team facilitation	Team selection Reward structure Meeting training Specify objective (leadership orientation)
Jan de Leede et al. (2009)	- Use of pooled, sequential and reciprocal IT tools	Job demands (organizational factor) Task Interdependency (organizational factor)	Co-worker support (organizational factor) Coordination (organizational factor)
Nemiro (2007)	- Selection of appropriate communication tools (resources)	Design approaches (design) Task connection (climate) Norms and protocols Continual assessment	Leadership structure (design) Interpersonal connection (climate) Conditions and competencies (climate) Continual learning

Table 6.3. Integrative model: predictors of effectiveness and innovativeness in distributed teams.

Table 6.3. indicates that both the “five building blocks” (Nemiro, 2007) and the “conditions” (de Leede et al., 2008) to foster innovativeness in distributed teams can be linked to many indicators of effectiveness.

This was to be expected, since “*the five building blocks...led the virtual teams interviewed...not only to high levels of creativity, but also to better task performance and interpersonal relations...*” (Nemiro, 2007, p.118).

However, regarding “processes”, while task interdependency is clearly indicated as an enhancer of effectiveness, it was not found as an enhancer of creativity by Nemiro (2007) (“task connection” mainly refers to “shared goals” in his model), and was negatively associated with innovation behaviour in the study conducted by Jan de Leede et al. (2008).

In addition, while Duarte and Snyder (1999) suggested having standardized processes in order to reduce the team's start-up and operating practices, Nemiro (2007) found that many creative teams used a flexible design, adapting their approaches to the nature of the work and complementing the more mainstream modular approach with an iterative one. In fact, this is one of the main differences between striving for task performance and delivering innovations, and the teams interviewed by Nemiro (2007) left to the “project and task management norms and protocols” the distinguishing between routine and creative tasks. As remarked by Smith (2007, p.246) in his study of dispersed product development teams: “*dispersed teams are easiest to manage when they can execute their original plans without change, but creativity requires change*”. Therefore, while flexibility is one of the main assets that comes in forming a distributed team and is represented by having “a large pool of new product know-how, which seems to be a promising source for innovation” (Ale Ebrahim et al., 2009), the “*flexibility to be able to explore options and make changes, even late in the development cycle... is difficult to achieve, especially for dispersed teams*” (Smith, 2007, p.247).

Smith (2007, p.253) also added that, in order to enhance this other type of flexibility, “*when change is commonplace, planning requires a shorter horizon, and management and control take on more of a cut-and-try style... which could encompass formal or quick experiments, simulations or analysis, prototypes or* *mock-ups, models, tests, and tryouts*”. The iterative approach followed by the teams interviewed by Nemiro (2007) is expectedly very similar to this “cut-and-try” style.

As anticipated in paragraph 6.2., the study conducted by Lojeski et al. (2007) on the relationship between multitasking and innovative behaviour of distributed team members is similar to the analysis done by Jan de Leede et al. (2007) on the impact of high job demands (an organizational condition in their model). However, while the results of the second study (de Leede et al, 2007) associated high job demands with high innovative behaviour regardless of the degree of virtuality and the degree of complexity, the results of the first study (Lojeski et al., 2007) were different: under conditions of high virtual distance (a multi-dimensional construct similar to a combination of the degree of virtuality and the degree of complexity), low levels of multitasking were positively related to innovative behaviour, but as multitasking increased its “benefits quickly diminished”. As an explaination to this last result: “*when virtual distance is high, it is more likely that outsourcers and/or contractors are part of the resource mix. So with more tasks to accomplish, more projects to keep track of, and more virtually distant resources working on projects without the benefit of past work experiences, absorptive capacity and knowledge sharing suffer...therefore innovative behaviors are likely to do the same especially when complex interactions are needed to accomplish goals*” (Lojeski et al., 2007).

Regarding “technology” in the integrative model, its suggested characteristics that almost all models have in common are accessibility and appropriateness. In addition, both the model of Lipnack and Stamps (1997) and the study done by Jan de Leede et al. (2009) are in line with other research indicating that distributed team platforms need to incorporate all kinds of collaboration tools (Precup et al., 2006; Leenders et al., 2007). After conducting an empirical study of the media ensembles used by distributed teams, Leenders et al. (2007), found that higher levels of innovativeness were not explained by the “frequency of use of one particular medium”, but were instead related to the ways in which “various communication media are used in a consistent media ensemble”.

The integrative model takes into account many factors that could also be considered when trying to foster effectiveness and innovativeness in a traditional colocated team or, more precisely, in a team where the “virtual team characteristics” (degree of virtuality, degree of complexity, time intensity) described by Jan de Leede et al. (2008) are less accentuated.

The impact of these characteristics is therefore more critical and beneficial in order to understand the real difference in managing more distributed or less distributed teams.

The degree of virtuality and the degree of complexity had two different results in the model of Gibson and Cohen (2003) and the study done by Jan de Leede et al. (2008): in the first one, both of these characteristics made it more difficult to establish the “enabling conditions” for effectiveness; in the second one instead they were not significantly associated with innovation behaviour by themselves, and although their interaction effects when associated with other conditions were significant, only the degree of virtuality had mainly negative interaction effects.

Regarding the degree of virtuality in fact, many authors view partial colocation as critical to foster innovativeness and effectiveness: both Kimball Fisher and Mareen Fisher (2011) and Smith (2007) suggest having at least a face-to-face meeting at the beginning of the project. Smith (2007) explains that this is related to the importance of appreciating “what it is that makes colocation valuable”, as it is in fact considered to have the most value at the beginning by these authors.

However, a consistent finding across three other experiments (Ocker et al.1996; Ocker and Fjermestad, 1998; Ocker, 2001) was that completely asynchronous distributed teams (without any face-to-face or synchronous electronic communication) were significantly more innovative than teams that were instead colocated, partially colocated or used synchronous tools. Even though the researchers didn't find an explaination to this finding, the investigation done by Rosalie J. Ocker (2007) will be further discussed in the next chapter, and a possible explaination will be considered.

Regarding the diversity between team members, which is subsequent to a high degree of complexity, Jan de Leede et al. (2009) consider it as “an extremely difficult subject in promoting innovation” : the “information decision” approach views it as an enhancer of creativity, if managed well (Iles and Hayers, 1997); the "social identity" approach points on the risks of reduced cohesiveness, communication problems and other negative effects (Ely and Thomas, 2001); Fleming (2004) argues that diverse innovation teams are both better and worse, in that they produce more breakthroughs, but also more failures than homogeneous innovation teams.

The communication problems of heterogenous teams are mainly related to differences in language and culture (on both organizational and national levels, or sub-related to differences in domain specific knowledge, like the ones between technical disciplines). Paul R. Carlile (2004) identified two main "knowledge boundaries" that must be bridged through "knowledge processes" in order to achieve the effective communication needed to deliver innovation:

– the syntactic boundary is related to language differences, and bridging it requires knowledge transfer processes through the development of a common lexicon,

– the semantic boundary is related to meanings not uniquely held by the members, and bridging it requires knowledge translation processes through the development of common meanings.

Bridging these boundaries becomes more difficult in distributed teams, because the lack of physical interaction hinders the two knowledge processes mentioned. In particular, dealing with *"serious culture differences of any type may require special training in cross-cultural sensitivity. In some cases professional consultation or mediation may be required"* (Kimball Fisher and Mareen Fisher, 2011, p.13). While Bell and Kozlowski (2002) remark that the difference in values across cultures may require leaders to tailor their actions to coincide with a particular team member's orientation, Graen and Wakabayashi (1994) suggest that leaders need to implement a leadership structure that builds a unique or "third" culture. Similarly to the latter suggestion, an experienced team leader interviewed by Oertig and Buergi (2007, p.131), describes distributed team leaders as "bridge people": *"if someone is going to be promoted to be a global team representative, they look for people who can bridge the language and cultural gap"*. Such a leader could be assimilitated to the “gatekeeper” figure, boundary spanning individuals, the presence of which has been linkened to higher performance rates in heterogeneous development teams (Tushman and Katz, 2012).

However, more homogeneus teams have instead to deal with “groupthink” as a main drawback, which was described by Janis (1972) as a mode of thinking enganged “when the members' strivings for unanimity override their motivation to realistically appraise alternative courses of action”.

Despite dispersed teams having a naturally higher degree of complexity, groupthink was actively avoided through “constructive tension” by the teams interviewed by Nemiro (2007). Citing an interviewed team member: “*we believe that creativity arises from having differences amongst team members that sets up a creative tension, so that we're not subject to groupthink...so we will go out and attract people who agree on this basic set of beliefs, but have a different perspective, from a different technical speciality, or from a different culture...*” (Nemiro, 2007, p.111). In fact, the main advantage of heterogeneous teams is having those same “different views of the world” that pose so many communication problems.

Regarding “people”, Table 6.3. indicates that the trust issue is critical for the success of distributed teams, which is in line with other research (Lurey and Raisanghani, 2001; Kirkman et al., 2002). Trust leads to high levels of cooperation and less conflict between team members (Williams, 2001).

Daassi et al. (2006) showed that trust levels are associated with collective awareness levels, which may increase over time making distributed teams more effective.

In his reasearch on “psychological safety”, Edmonson (1999) found that surgical and nursing teams whose members were comfortable putting across doubts and disagreements were faster in learning new procedures, and that they had a higher error detection rate leading to a higher effectiveness.

The reason why mutual trust is even more critical in distributed teams can be summed by citing an interviewee of Nemiro (2007, p.110): “... *the reason is, you can lie your way out of anything if it's just typed. If you're dealing face-to-face, it's harder to not be straight. You have eye contact. You have voice. You have* *the integrity of the whole body language that has to be dealt with. So, the trust has to be there*".

In addition, Jan de Leede et al. (2009) have regarded as safe to assume that, within distributed teams, the cognitive aspect of trust (referring to the calculative and rational characteristics demonstrated by trustees) is higher than the affective aspect (referring to the emotional and social skills of trustees), because while the latter is typical of close personal relationships, distributed teams rely heavily on computer mediated communication.

7. PERSONALITY FACETS, TEAM INTERACTION AND WORKING ENVIRONMENT IN DISTRIBUTED TEAMS FOR INNOVATION

As the many predictors of innovativeness related to "people" in the previous chapter confirmed, "*Innovation is very much a people-centered process,... behavioral and cultural features are less easily amenable to managerial control*" (Rothwell and Zegveld 1982, p.229).

In this chapter, some of the findings of three studies conducted by Rosalie J.Ocker (2007) and a study done by Margaret Oertig and Thomas Buergi (2007) will be discussed, regarding the impact of team members' personalities and team interaction on innovativeness in distributed teams, and how the issues related to the first aspect should be adressed by team leaders.

Ocker's study (2007) is based on an experiment (Ocker, 2001) involving nearly 100 teams and 400 graduate students. In this experiment, teams varied in their communication modalities (only electronically via asynchronous computer conferencing, or using a combination of asynchronous communication and face-to-face meetings), and they worked for seventeen days to determine in a report the level requirements and design for a computerized post office.

In the subsequent analyses (Ocker, 2007), the degree of creativity of their work was objectively measured by the number of original ideas presented by each team. Thompson (2003) considered "original" those ideas generated by 5% or less of a given sample.

The study done by Oertig and Buergi (2007) is instead based on a series of interviews with seven experienced global team leaders of a multinational company.

Regarding the impact of personality: Ocker (2007) analyzed, using an adjective check list (Gough and Heilbrun, 1983), the personalities of ten teams (47 individuals in total) which communicated only asynchronously in the experiment, and found that members who were more curious and imaginative than the norm and those who were more intrigued by the task itself (intrinsically rather than extrinsecally motivated by the task) were also the ones who enhanced more their team's creativity.

She also found that teams where multiple members exhibited self-confidence and assertiveness were associated with higher levels of creativity.

From the study of Oertig and Buergi (2007) emerged that introverted members may have a lot to contribute too, but often need to get to know the team at a face-to-face meeting before they can. An interviewed team leader also remarked how it was his task to make sure that the right people were coming forward with their ideas, having to be "very directive" through interpersonal skills and interjecting when these ideas were being obstructed by other members who were simply more confident.

Regarding team interaction, the results of a qualitative analysis conducted by Ocker (2007) on the team communication transcripts (which represented the entirety of team communication and collaboration), using the same data set as her previous study (10 teams), indicated nine "inhibitors of creativity":

– dominance, which is experienced when a team member has "undue influence on the team's processes or work product" (Ocker, 2007), was the most frequently occuring inhibitor (5 teams), and its presence was due to a combination of status traits in the dominant team member (age seniority, work experience seniority, and expertise),
– emphasis on the external reward (experienced by 2 teams), and as such in the report deliverable in the experiment,
– time pressure (2 teams), which made teams resort to a more streamlined approach,

- structured problem solving approach (2 teams),
- downward norm setting (4 teams), which is experienced when team members “reduce their performance level to match that of the least productive team member” (Camacho, 1995),
- technical problems (2 teams),
- duality of concepts (2 teams), which as already discussed in the previous chapter can potentially enhance creativity as different points of view are explored, became an inhibitor when, combined with an inability to reach agreement, “thwarted the teams' efforts to elaborate a single cohesive concept”,
- preponderance of nonstimulating team members (1 team).

However, two teams were “exceptionally creative”, and this was due both to their avoidance of the inhibitors and to the confluence of five “enhancers of creativity”:

- stimulating colleagues (one or more team members contributed creative ideas very early on in the project),
- variety of social influences (team members did not fall into “routines of interaction”, such as habitual agreement or disagreement),
- collaboration on problem definition,
- surfacing and reducing of equivocality (through a process of “coming to terms with different perspectives”).

Since dominance was found to be counterproductive for creativity in virtual settings, it is also safe to assume team members' status balance as another enhancer of creativity, with the difference of being based on team composition rather than team interaction.

However, as anticipated in the previous chapter, one of the most interesting and consistent findings across Ocker's experiment (2001) and two similar experiments (Ocker et al., 1996; Ocker and Fjermestad, 1998) in which teams varied even more their communication modalities (relying only on asynchronous tools, only on synchronous tools, on a combination of asynchronous tools and face-to-face meetings, or only on face-to-face meetings), was that teams without any face-to-face meetings or synchronous communication produced significantly more creative results.

Despite Ocker (2007) not finding an empirical explaination, a possible hypothesis coul be found in a study conducted by Javier Fínez (2007).

By analyzing a series of interviews with team leaders from three leading companies in the implementation of virtual teams in the Mondragón Cooperative Corporation, Fínez (2007) drew a chart regarding the relationship between the teams' working conditions, creativity and virtuality (Table 7.1.).

	Breeding ground for creativity	Encouraged by virtuality	Hindered by virtuality
Repetitive work			X
Changing/lively enviroment	X	X	
Hierarchical work			X
High autonomy	X	X	
Feeling of isolation		X	
Cooperative values	X	X	
Working under pressure	X		X

Table 7.1. Working conditions, creativity and virtuality relationships (Source: Javier Fínez, 2007)

This chart seems to indicate that those working conditions that provide a more suitable environment for innovation are generally augmented when working in virtual settings, while those that do not are generally hindered by virtuality, with only two exceptions: one is the sense of isolation (negatively associated with innovative behaviour but encouraged by virtuality), and the other is working under pressure (positively associated with innovative behaviour but hindered by virtuality). The second exception, as explained by the author, is seemingly due to virtuality “allowing people to exchange ideas locally, calmly and off-line… conditions which involve greater relaxation than being in ordinary groups where pressure and responsibility can more easily be exerted” (Fínez, 2007).

However, these hypotheses are considered by the authour himself as “far from being rigorous” (Fínez, 2007) and are still left open to discussion.

8. APPROPRIATE TOOLS AND TECHNOLOGY TO SUPPORT DISTRIBUTED TEAMS' INNOVATIVENESS IN THE DESIGN FIELD

Despite the fact that, as already discussed, innovation is a people centered process, communication and sharing tools are essential to distributed teams, and they are used by them throughout the entire innovation process.

According to Suchman (1987), “Computer-supported cooperative work” (CSCW) arose in the late 1980s, both supported and driven by the globalization.

As CSCW technologies transform computer networks into teams, they have built social networks on the technology and social factors become critical for their success (Grudin, 1994).

However, as already discussed, the task-oriented focus of these technologies can reduce social presence and social cues (Sproull and Kiesler, 1991).

CSCW technologies vary from synchronous tools (where collaborators are present at the same time), to asynchronous ones (where they are not).

In this chapter the focus will be on which tools and technologies (CSCW technologies in particular) can support distributed teams' innovativeness in the design process.

Design has been described by the Department of Trade and Industry (DTI) of the UK Government as a “structured creative process” (DTI, 2005).

It also has been defined by MacGregor (2007) as an “extreme” virtual context (mainly because of the impossibility of gesturing in many virtual scenarios) which deals with “creativity at its very core”.

Therefore many of the tools and technologies described should be of value to those seeking to improve distributed teams' innovativeness outside of the design field too.

8.1. Team formation

In forming the team itself, team evaluation metrics can help to ensure that the team as a whole has complementary skills, “so that highly creative contributors are counterbalanced by those who ensure communication and cooperation is effective” (Malins et al., 2007).
The Web 2.0 (O'Reilly Media, 2004), which is not a technology but a trend in Web development, revolves around the use of social networking systems to break down the need for a large corporate presence and help individuals find and connect to others with complementary skills (Malins et al., 2007). It can therefore prove to be very useful in forming a team, because it seems to effectively exploit the flexibility in forming distributed teams already discussed.

8.2. Brief preparation

A design brief should identify a design problem whilst avoiding suggesting solutions (Press and Cooper, 2003).
“For managing the basics of a brief, a good word processor, a drawing package, and a spreadsheet are the most important tools required” (Malins et al., 2007), all of which are often found included in an Office suite.
Web-based word processing tools are also useful for collaborative authoring, like Google Docs was in the past (it has been recently absorbed by Google Drive, a cloud storage service which will be further discussed), but “can get complicated without a clear division of responsabilities” (Malins et al., 2007).

8.3. Idea generation

Ideas can be generated by association, by analogy, by exploration, or by transformation (Boden, 1994).
Brainstorming is a range of psychologically-derived techniques in generating

ideas, and revolves mainly around two stages: to firstly generate as many ideas as possible, and then to categorize and evaluate the ideas that have been generated. Despite being a highly successful method, brainstorming requires significant support to be used in virtual settings, but there are few tools that support the whole process (Malins et al., 2007).

Mind mapping, allowing the structuring of both abstract and concrete concepts, can assist brainstorming. There are a number of visual tools that can help mapping out concepts, and when used in combination with web sharing tools they allow distributed team members to collaboratively develop and modify the mind maps (Malins et al., 2007).

Another useful technique is TRIZ (www.mazur.net/triz/), which in contrast to brainstorming (based on “random” idea generation), “aims to create an algorithmic approach to the invention of new systems and the refinement of old systems” (Malins et al., 2007): in practice it provides a “large body of design heuristics”, and therefore offers “set ways to transform problems” (in Boden's terms) which are a good basis for creative idea generation. Goldfire Innovator, for example, uses TRIZ as its basis and assists in creative problem solving.

Image searching tools and encyclopedias (e.g. Wikipedia, an open-source online encyclopedia) can also assist in generating ideas by association (in Boden's terms). Images, in particular, can communicate values that cannot be easily expressed through words (Sharples, 1994), while Wikipedia “has taken concept association to a new level and provides a network of... concepts and entries, which can be freely and easily browsed” (Malins et al., 2007).

8.4. Visualization and modelling

Sketching is often times used in the early stages of conceptual design (when ideas are still unfinished).

Quick sketching tools like Adobe Photoshop (with a graphics tablet), enable designers to quickly explore (in Boden's terms) and share ideas, because they usually support “layers”, which “allow aspects of drawing to be combined and recombined", which in turn is "a useful way of exploring alternatives quickly" (Malins et al., 2007).

For more precise drawing instead, vector graphical applications, like Adobe Illustrator, are easier to amend and polish (higher quality) than raster bit map applications like Photoshop, but are also more complex and therefore require more practice and take longer to use effectively (Malins et al., 2007).

Another advantage of these more precise drawing tools is that their files can be exported to form the basis for geometries which can be used in 3d modelling tools, like Rhinoceros, which in turn take even longer to learn and to use and are used closer to the end of the design process (Malins et al., 2007).

Lastly, 3d printers are good for quickly making relatively cheap models for discussion within the team and with clients, but which are limited in materials and dimensions (Malins et al., 2007).

8.5. Collaboration

Collaborative design environments are helpful at certain parts of the design process, especially after brainstorming, when results need to be integrated. However, they "actively inhibit creativity, as they expose work to a community" (Malins et al., 2007), and as such a climate of openness to ideas (which has already been discussed in chapter 6) is needed to encourage team members' contributing.

These environments are often metaphorically called "virtual rooms" (Leerberg, 2007): topics and projects (objects) can be housed in different rooms (and sublocations of different rooms), providing a framework for using different activities and hence for structuring information.

Collaborative design tools, like Autodesk Buzzsaw, "enable a workflow to be established and tracked", but are often overused and may provide, as already mentioned, "too strong an evaluation framework" (Malins et al., 2007).

A possible solution to this is proposed by Leerberg (2007) and consists in creating "private rooms", where people can work individually until they are

happy for others to see their work.
Wikis and cloud sharing systems (like Google Drive or Dropbox), as a part of the Web 2.0 trend, are useful and very common collaboration tools.
Wikis are basically Web pages that allow anyone to easily create and edit them, while supporting tracking and searching too. Since public wiki communities are subject to vandalism, enterprises should opt for private ones.
Cloud collaboration is a new way of using cloud computing: documents are uploaded to a central cloud storage, where they can be accessed by members. Cloud technologies provide software, data access and storage services without requiring end-user knowledge of the physical location and configuration of the system that delivers the services (en.wikipedia.org/wiki/Cloud_collaboration).
Electronic document management systems (EDMS), like Microsoft Sharepoint, are also tools used for collaboration, as they allow not only storing documents, but also to retrieve and work on them with a proper authorization. While access is usually denied when work is being done on them, advanced forms of EDMS may allow multiple users to view and modify the documents in a synchronous manner (en.wikipedia.org/wiki/Document_management_system).

8.6. Communication

Communication between distributed team members is needed throughout the entire design process.
For team members that are actively creative, there is a tendency for lack of communication (Belbin, 2003).
E-mail is still the most commonly used communication tool on the Internet: despite its asynchronicity and the possibility of multiple contributions getting hard to track, it is an ubiquitous system that permits to share digital information of any type easily (although limited in file dimensions).
On the contrary, Skype and similar “voice over the Internet” tools are synchronous. Hence they are good for conference calling, which can be expensive and difficult through other telephone systems (Malins et al., 2007).

Desktop sharing programs, like Webex, are communication tools which enable members to see what others are doing, as they do it. This is especially good for discussing and sharing design ideas, even though they tend to enforce a workflow which can exclude contributors unless the team dynamic is right (Malins et al., 2007).
Lastly, 3G and 4G (LTE) Mobile communications have also an emerging role as a tool in the design field, especially for their quick video sharing capabilities.

8.7. Knowledge management

Since the majority of design work is variant design (never wholly creative nor wholly routine), often times the knowledge needed to successfully form it already exists within the organization, and even apart from previous solutions, the challenge for finding this past knowledge is one of information retrieval (Malins et al., 2007).
Desktop searching tools (Quicksilver and Windows Search are among the most commonly used) can therefore be of assistance, especially for finding relevant texts (in email or other types of document).
“Supporting a team portfolio requires an advanced file repository system...” (the EDMS already discussed) *“...Detailed meta-information such as the name of the contributor, time and date, versioning as well as appropriate commentary on future changes or possible objections in a project are essential features of such tools”* (Malins et al., 2007, p.239).
Web 2.0, and in particular cloud storage and Wikis, are useful tools for knowledge management as well.

8.8. Project management

Scheduling is of utmost importance to keep a distributed team on track towards the successful completion of a project, especially in already discussed situations involving multitasking. What schedulers basically do is ensure that the team members (designers in this case) can meet critical deadlines or join synchronous collaborative sessions (Malins et al., 2007).

Basic project management tools, like Microsoft Primavera (capable of being integrated with SAP's Enterprise Resource Planning), can help with both the calculation of costs and the management of resources, and allow tracking against a defined work plan (and revision of plans), but have limited effectiveness for “informal” project plans (Malins et al., 2007).

Autodesk Constructware and Autodesk Streamline are instead chat- and whiteboard-based collaborative project tools that allow tracking of design phase issues and comments, with a complementary file management tool (Malins et al., 2007).

Lastly, “open source” technologies, although primarily focusing on software development and maintenance (version tracking, issue tracking, project quality monitoring), allow very large-scale distributed collaboration between thousands of people around the world (Malins et al., 2007).

For example, Apache Subversion is a versioning system that creates an audited log of changes to files, recording previous versions so that people can return to them, and also allowing “branching” so that individuals can make an alternative set of files to explore and experiment, before “merging” their work with collaborators (Malins et al., 2007).

9. CONCEPT MATURITY AND CHALLENGES OF STAKEHOLDERS' ENGAGEMENT CYCLES IN THE ONYX CONCEPT PHONE PROJECT

Since the new product release cycle for many markets is decreasing, many development teams have also less time to perform risk reduction activities to integrate new technologies and radical new features into their products.

In order to perform these risk reduction activities more quickly, many firms are assembling virtual innovation “tiger teams” (that “attack” innovation) aimed at rapidly bringing together critical stakeholders in the innovation process and generating a diverse range of effective alternatives (Feland, 2007).

The Onyx Concept Phone project began in 2006 as an internal effort by Synaptics to demonstrate to potential customers the benefits of Clearpad (a touchscreen technology) over other resistive touch screens, since the product marketing manager knew that in order to do so they needed a functional mobile phone experience prototype. However, since the concept prototyping team at Synaptics lacked in industrial design, graphic design and user interface design skills, it formed a distributed team with PilotFish as a first partner.

Since Synaptics and PilotFish didn't have any face-to-face meetings (not even at the start of the project), much of the early phone conferences were spent not only sharing information but also building trust.

Other resources were brought in as contractors, in an on-boarding and off-boarding process through different times in the development of the prototype.

As each new actor entered the stage, Feland (2007), a human interface architect at Synaptics, found many challenges in bringing them into the project:

- some contractors who entered in later stages of the development attempted to shift their efforts back to previous stages, because they did not share the same vision;
- other contractors held on to assumptions that the prototype would turn into a real product and therefore applied overly rigorous costraints in designing;
- tracking project status was made difficult by the lack of proactive communication from some of the new members;
- even though Synaptics had many collaboration tools such as an internal wiki and Microsoft Sharepoint, these tools were not accessible by those members that were “outside the corporate firewall”; the subsequent over-reliance on email hampered the sharing and version control of large files such as CAD (computer-aided design) databases for the mechanical parts of Onyx;
- the reviewing interim progress on certain tasks was instead hampered by the fact that many members worked using different types of software, and the lack of team familiarity lessened the efficiency of joint review;

– unlike the rapid “step like” on-boarding process, the off-boarding was a “sporadic and sputtering” process, because the transfer of tacit knowledge was often incomplete (without being made explicit by human knowledge brokers in a “just in time” fashion) and, if this knowledge was absent when it was critical, former members were asked to come back in for a short time just to broker it.

As a positive note, when the team members were not contributing effectively, having Synaptics as a central decision authority helped the team “focus on solving the problem rather than bickering over who caused it” (Feland, 2007).

However, this was a “lost in the fog” project (Obeng, 2004).

Citing Feland (2007): “there were clear goals... though we were unclear how the team would achieve them and what would be the final deliverable”.

In these types of projects, converging on a shared viewpoint is critical for their success and requires significant communication of implicit information, which is made more difficult by the distributed nature of virtual teams. Feland (2007) remarks that in order to do so “what is needed is a framework that provides a shared language for discussing progress towards conclusion. The passage of time and expenditure of financial resources are poor surrogates for measuring progress towards a compelling innovation during a design thinking project”.

He therefore suggests using “concept maturity”, which is the “assessment of the uncertainty remaining, rergarding the future success of the path being taken by the team” (Feland, 2007), as a process measure, and applying it through a comprehensive design framework (Feland et al., 2004) that considers:

– technical aspects related to the question “can we build it?”;
– business aspects related to the question “can we profit from it?”;
– and human aspects related to the question “does it delight the user?”.

Most virtual innovation teams in modern enterprises focus almost exclusively on the technical aspects, assuming that human and business aspects are being adressed by others in the organization. Feland (2007) explains that the membership of these teams must be expanded to include the stakeholders responsible for these aspects too.

Concept maturity should improve through all the innovation process stages:

maturing the concept too quickly may reduce the design freedom of the team, while a delay may require a later influx of resources to accelerate project progress (Feland, 2007).

Figure 9.1. illustrates the dynamics of concept maturity in the Onyx project, using the six stages of the innovation process proposed by Marquis (1988).

The technical maturity took a significant leap in the “recognition” stage, due to the initial costraints of the Clearpad technology.

As PilotFish on-boarded towards the end of the “recognition” stage, the “human” aspects of the project started maturing as well, since the graphic user interface was a joint collaboration between the Pilotfish and Synaptics design teams.

The business issues instead received less attention until late in the project, when the Synaptics Marketing Communications Group began to craft a publicity strategy for Onyx.

As a manager, Feland (2007) used these notions of concept maturity to decide where to focus his attention, and therefore resources, during the project.

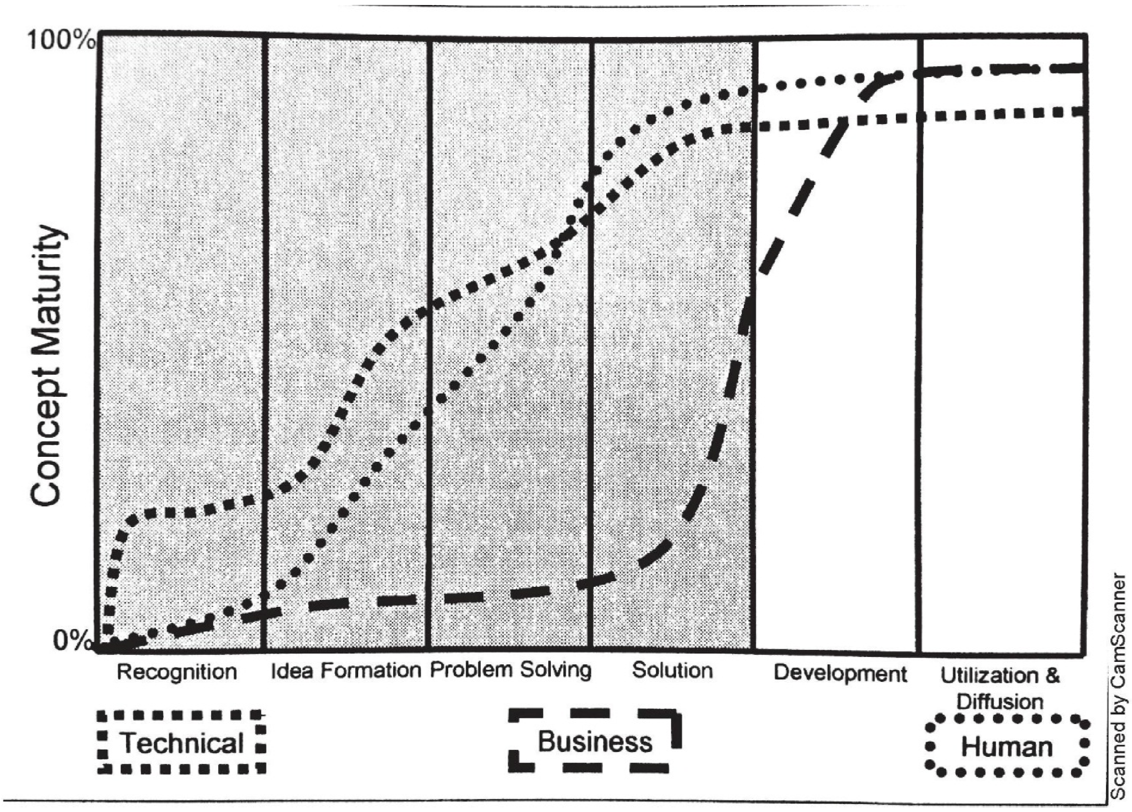

Figure 9.1. Concept maturity qualitative graph for the Onyx project (Source: Feland, 2007)

The distributed team took a great risk in pursuing parallel development of all the critical components, hoping that when these disparate pieces were first integrated the Onyx would work fine the first time, but in the end most of them came together without design flaws and the Onyx project won a 2006 Red Dot design award, generating significant worldwide press attention for both Synaptics and Pilotfish (Feland, 2007).

CONCLUSION

The last two decades have seen a significant increase in the practice of distributed teams, due to business pressures, social pressures and a changing in the nature of work itself, and now all teams have become distributed to some extent.

This dissertation has not focused on defensive approaches to them, but rather on how they can be proactively chosen to deliver innovation and add value, analyzing and confronting various findings regarding the “enhancers of innovativeness”. From this confrontation an integrative model was born, which has linked many of these predictors to those of effectiveness.

However, there were also findings that weren't consistent, like the impact of task interdependency or that of multitasking, and as such further investigation in specifically those areas might prove useful.

Perhaps the most interesting and inconsistent one was that fully asynchronous teams (not even using synchronous tools) can be significantly more innovative than colocated or partially colocated teams, which perhaps (in the experiments discussed) was due to certain conditions in the working environment specifically enabled by virtualness and instead hindered by colocation.

While the appropriateness of tools and technology plays a distinct role in characterizing the innovativeness of distributed teams, the fact that innovation is a people-centered process is to be kept in mind at all times, and as such distributed team leaders should focus on bridging boundaries as “gatekeepers”, and should assume a more “directive” role than in more colocated teams.

This same “directive” role has been found useful when taken by the core enterprise that assembles a distributed team composed by other stakeholders too, where managing their expectations and “directing” them through concept maturity brings to the success of projects aiming to “turbocharge” the innovation process.

Another important aspect that has been found as multifaceted is flexibility, which is gained while forming the team but lost when trying to pursue effectiveness through standardized processes and “sticking to the plan” approaches.

Iterative approaches can be difficult to manage in distributed teams, and must be supported by tools and technologies capable of versioning and tracking, and by creating virtual “private rooms” (which seem to be ideal when dealing with certain members' personality facets).

Although this last solution is useful in practice, in theory it should not even be as much, because the foundation of distributed teams' innovativeness is ultimately a climate of trust and openness to ideas.

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