The influence of spatial distribution and work organization on the effectiveness of teamwork in an innovative multidisciplinary project

Betsabea Bussi,[1*] Francesco Ottoboni,[2] Giuseppe Buccoliero,[2] Ludovica Spazzini[2]

[1]Politecnico di Torino, Castello del Valentino, Viale Pier Andrea Mattioli 39, 10125 Torino
[2]CDI Italia, TAG Fondazione Agnelli, Via Giuseppe Giacosa 38, 10125 Torino
*Corresponding author: betsabea.bussi@polito.it

ABSTRACT

The aim of this paper is to investigate and define the type of teamwork that best fits along various phases of innovation projects based on design thinking process.Within the context of *Innovation 4 Change* program, the typical phases of a design thinking project have been analysed by means of a macro methodology matrix based on two core variables: spatial distribution and internal organization of team members. Every single team member was asked, based on his experience, what is the most effective combination for teamwork.

Keywords: Spatial distribution; team organization; teamwork effectiveness; design thinking process; innovative environment.

INTRODUCTION

This paper is framed into the interdisciplinary project of *Innovation for Change* (I4C). Created and promoted by the partnership among the Polytechnic University of Turin, the Collège des Ingénieurs Italia and the centre for experimental innovation of CERN IdeaSquare, this project groups 50 young researchers and MBA fellows. Divided into teams, they are engaged into 5-months project to identify innovative solutions to eight global challenges of collective interest.

The authors participated in the contest, tackling the challenge of future urban mobility in partnership with the Municipality of Turin. The focus was on road safety and on the promotion of sustainable and ecological mobility. The global objective was to find a solution able to promote safe and ecological means of moving in the city as well as to reduce accidents' rate and pollution.

I4C program encourages innovative approaches, dividing the project according to the five stages of design thinking process: *Empathize, Define, Ideate, Prototype, Test* (according to the codification made by Stanford University of California). Each team is composed of five to seven scientists with different backgrounds and nationalities. The project is framed by seven intensive working periods throughout the five months, where all the teams work co-located in a shared environment (College des Ingénieurs in Turin or CERN IdeaSquare in Geneva), helped by mentors, professors, scientists and experts. The rest of the time is freely managed by the teams to accomplish the required tasks before the next working period. In this context, teams experience different type of teamworking in different sceneries: co-located and remote teamwork.

This paper aims to highlight the process experienced within this program. Emphasis is given to how the process has been managed by the authors: which type of teamwork has been selected for each task, the spatial distribution of team members, the division of labour in each phase. Failures and difficulties encountered will be also highlighted. This paper aims at showing the members' internal perceptions of teamwork when involved in innovative design projects.

The intention is the unpacking of the design thinking process, letting its specific phases be seen from the inner perspectives of its participants. Nevertheless, some results could be taken as best practices or simply just as a case-study on how to tackle future similar projects. Besides, the selected parameters could be useful for further applications.

Besides the actual solutions found and the data collected, the purpose is to visualize the steps taken by the team so far. The interest is to show how each activity has been experienced and managed by the team.

The research questions are:
- What are the variables affecting our teamwork's performance?
- Which is the best type of teamwork for each phase of this multidisciplinary project?

The hypothesis is that different phases of the process encourage different type of teamwork to be the most suitable to effectively accomplish the required tasks.

THEORETICAL BACKGROUND

Much research in the field tackled the problem of teamwork's performance, trying to understand which factors influence the design thinking process in teams working on innovative projects. Some scholars focused on the spatial/geographical distribution of team members, i.e. virtual vs co-located teams (Hoegl et al., 2007; Zenun et al., 2007; Yang et al., 2008), others pointed out the relevance of the physical environment in shared workspaces (Moultrie et al., 2007; Thamhain, 2010). Also, the team size seems to affect the performance of teamwork: smaller the teams better the teamwork according to Martin Hoegl (2005). Larger teams are more likely to face poor communication, fragmentation, and free riding (Haas, Mortensen, 2016).

Co-location, i.e. "the degree to which all team members are in direct vicinity to eachother over the duration of the project" (Hoegl, Proserpio, 2004), has been proved to affect effectiveness and collaboration. Co-located teams appear to deliver better performance (Zenun et al., 2007; Hoegl, Proserpio, 2004.; Hoegl et al., 2007). A 2015 research pointed out the unique advantages of colocation, strongly declaring that colocated teams are twice as productive than remote ones (Olson et al., 2002). Nevertheless, remote working is a valuable solution for the accessibility of knowledgeable people regardless of their geographical position (Orvis, Zaccaro, 2008). In virtual teams, individual trust and team cohesion become crucial factors in managing effective coordination (Ravi et al., 2016).

Moreover, a 2017 explorative research, aimed at showing the difficulties encountered by teams during a multidisciplinary design project similar to the one here analysed, outlined that co-located activities were always perceived as easier compared to remote activities in all type of tasks to accomplish (Utriainen, 2017).

The experience made so far is aligned with the above-mentioned statements: co-location, group size, physical environment were all factors which influenced our perceived teamwork's efficiency and overall quality. Nonetheless, in our case another influential factor has been taken into account: the organization of the team or the division of labour, i.e. how each task has been managed and accomplished by the team. During the project, we decided for each task if and how to split the work among the colleagues: working individually, in sub-groups or all together at the same time. This played its role, in our opinion, in the failure or success of each deliverable.

In the next section spatial distribution and team organization will be used as the main parameters to assess the effectiveness of our teamwork.

METHOD AND DATA

The 4-months project carried out so far (February to May 2019) have been analysed under the lens of organization and spatial distribution of teamwork.

The team was composed by seven scientists with different nationalities (Italy, Nigeria, Brazil) and backgrounds (5 engineers, 1 mathematician, 1 architect).

During this period, different ways of grouping the team were made, depending on specific situations or tasks.

Organization of teamwork included:

- **"One-team"**, where everyone worked on the same task at the same time.
- **Sub-groups,** where the team has been split into two or three groups with its own tasks and responsibilities.
- **Individual work**, where everyone worked on a task.

With respect to spatial distribution, the team worked:

- **Co-located**, where everyone worked in the same physical location, notably College des Ingénieurs, Turin or at IdeaSquare in CERN Geneva).
- **Remote**, where everyone worked in a separate place and all communication occurred virtually through videoconferencing and shared apps).

Data were collected through anonymous self-report questionnaire among the team members on the individual perception on the quality of teamwork during different phases of the project.
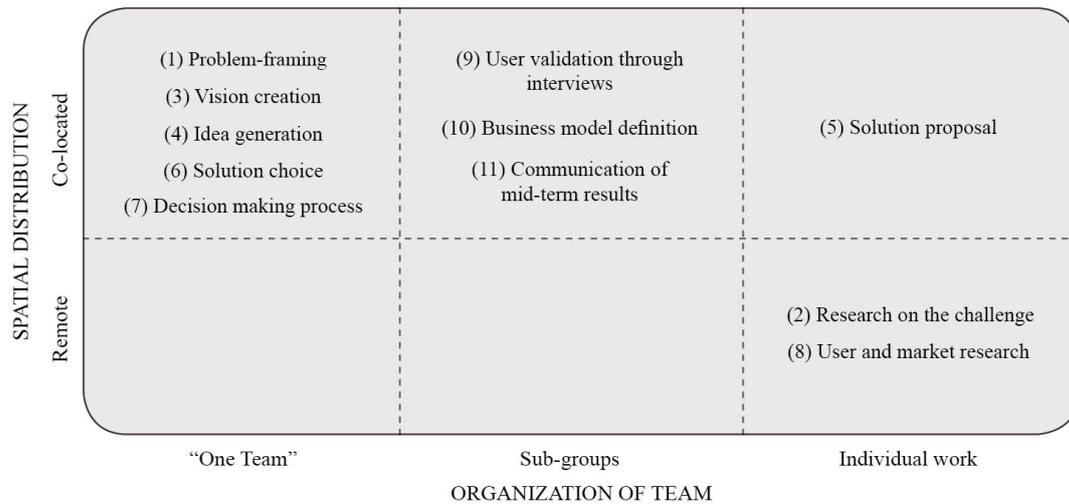
The phases of the project considered are the ones achieved so far by the team: *Emphasize, Define, Ideate.* These phases required the accomplishment of these main tasks:

- Problem framing (1)
- Research on the challenge (2)
- Vision creation (3)
- Idea generation (4)
- Solution proposal (5)
- Solution choice (6)
- Decision-making process (7)
- User and market research (8)
- User validation through interviews (9)
- Business model definition (10)
- Communication of mid-term results (11)

The questionnaire was structured in two parts.

As an introduction to the actual questionnaire a glossary was provided explaining the meaning of each variable and task. In this way, each team member was aware of the characteristics of each scenario.

Then, for each task the team was asked, based on his/her experience, what is the most effective combination for teamwork considering organization (individual, sub-groups, all-in) and spatial distribution (co-located or remote). A graphical matrix representation was used to express the preferences and to avoid a long list of

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Fig. 1: The perceived most effective combination of spatial distribution and organization of team for each task of the project.

questions. Each member was asked to place each task in the matrix where he/she recognized the greatest effectiveness in the combination of teamwork variables. The average perceptions are showed in the results section in Figure 1.

Moreover, a second part of the questionnaire has been used to contextualize the first graphical result. In this part we deepened the understanding of team's perceptions.

Strengths and weaknesses of each type of teamworking (*individual, subgroups, all-in*) and location (*co-location, virtual*) have been questioned in order to understand the reasons why an organizational mode or spatial distribution would be perceived preferable than another one in terms of work quality.

A series of questions were asked in order to understand the overall agreement on specific conditions of each scenario. A scale of response has been set between 1 to 4 where 1 meant "totally disagree" and 4 "strongly agree".

In the next section, the output of the questionnaire is explained.

RESULTS

The questionnaire's results suggest the following evidences, in accordance with Figure 1:

- 85% of the team agreed that most of tasks of *Emphasize* and *Ideate* phase should be worked all together in the same place, speeding up and strengthening the decision process.
- The whole team agrees in considering the Research phase as critical and preparatory to boost and improve the common brainstorming process. This task is to be performed autonomously and remotely in order not to influence others' opinion bringing original contributions to the discussion.

- The *Ideate* phase should be conducted dividing in subgroups working in parallel on different tasks. Moreover, since the tasks are usually interconnected, it is better that the subgroups work in a co-located space.

"One-team"

"One-Team" organization should be adopted for tasks where the presence of all the members is crucial, for example for brainstorming, idea generation and for all decision-making. Particularly in the initial phases of the project (*Empathize, Ideation*), when the goal is still unclear and nebulous, working all together allows for alignment and a unified direction.

This organization mode, anyway, depends much on the spatial distribution: co-location is essential to work on the same task since it makes it easier to cooperate and communicate effectively.

The main problems encountered when trying to work remotely all together were, in fact, the difficulties in visualizing others' thoughts, the reduced attention and the lack of leadership in clearly setting future objectives.

Subgroups

Working in subgroups should be preferred to accomplish tasks whose deliverables had been previously clarified. This is the most effective way in terms of time and quality of work to apply in the final phases of the design thinking cycle and for research tasks (Business model definition, User validation through interviews, Communication of mid-term results). The subdivision of tasks allows to allocate each team member according to his/her more relevant skills. When the problem is well-defined and the favourite solutions are chosen, the following steps become more standardized and deliverables appear more distinctly. While shifting from the creative thinking to the actual creation part of

the process, the amount of work increases and the allocation of (human) resources become decisive.

Individual work

Individual work could be the most effective way to accomplish tasks related to the research activity. In fact, it allows collecting the highest amount of raw data and information before discussing with the broad group. Research on the challenge (2) and on the user market (8) are the task where individual work is perceived as the most effective.

Moreover, we found useful also to work individually for the solution proposal phase (5), after or before the "One team" sessions, to enable everyone's creativity without being biased or influenced by the other's ideas.

Co-located work

Co-location meant for the group to have constant support from other colleagues, mentors, and experienced professionals. This allowed an easier and faster way of validating ideas, of asking feedbacks and of improving initial solutions by presenting them to people external to team. Anyway, in certain situations it also proved to dilute overall attention and slow down the work to some extent. In fact, while it is the best way to empower creative thinking, if applied for all the project phases it could be a waste of resources and time.

Remote teamwork

Remote working created difficulties in communication due to a detrimental slowness of sharing thoughts and receiving assistance from mentors or experts. Moreover, virtual meetings of the whole team were found to be a challenging moment.

Nevertheless, it proved to be effective in all the research stages: we used it to assure maximum scope of research to frame the problem, to look for solutions, to divide the work. It is useful also to alternate co-located work in order to refresh the minds and collect different inspirations, and to avoid an enclosed environment around the team. Remote and individual work also guarantee higher speed in accomplishing the task, but only if the task has been previously very well-defined.

DISCUSSION AND CONCLUSIONS

This paper analysed the process of design thinking followed by a team in the framework of an interdisciplinary project contest. The work of 4 months has been analysed by selecting specific phases of the project, characterized by different workspaces, environments, timing constraints and requirements.

Each phase with its particular activities was evaluated under the lens of spatial distribution and organization of the team. The purpose was to assess the effectiveness of

a type of teamwork compared to another one and to understand when applying one with respect to another.

Co-located and remote work combined with different subdivision of tasks ("One-team", subgroups, individual work) have been analysed.

Based on the results obtained, this paper concludes that:

- The first phases of design thinking required to be co-located, thanks to the openness and permeability of the environment, the richness of social connections, and the ease of communication it enables. In the first steps, the team needs to be on the same line regarding the direction to choose, both on technical and emotional sides. The physical and simultaneous presence of all the team member is essential to achieve the predefined results.
- Subgroups, even in remote forms, are preferable in the final stages, when a possible solution has already been chosen and must be prototyped, validated and communicated. In fact, if remote working has proved to be less productive and even detrimental during the *Empathize* and *Ideation* processes, it is still preferable under time-pressure. Dividing the tasks among team members, the work is fastened because decisions are taken by less people.

Based on the work done so far, our approach towards the next two phases will be different and more aware. *Prototype* and *Testing* will be tackled by subdividing the team in small groups on each task, trying to work in a co-located environment. Since the results are limited to the phases already concluded, at the end of *Prototype* and *Testing* a better understanding will be acheived.

Despite the subjectivity of the research, the attempt was to rationalize and to abstract best practices from our personal perspectives. The results could be seen as a starting point for wider researches on the topic. The critical factors highlighted in the paper, i.e. spatial distribution and work organization, could be of shared interest for further analysis on the *perceived* efficiency of teamwork.

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