Open creative workspaces impacts for new product development team creativity and effectiveness

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Abstract

Purpose – The purpose of this paper is to further explore the relationship between new product development project teams and their workspace regarding the impact of the physical (space variety, indoor environmental quality, large meeting room, workstation) and sociotechnical environments (project commitment, IT environment) on their creativity and effectiveness.

Design/methodology/approach – The authors gathered data on an enterprise’s ten multidisciplinary teams operating in diverse workspaces by four means: over 40 interviews and four months of observation, secondary data and a survey with 645 responses.

Findings – For teams co-located on site and abroad, employees express that proximity in open space is paramount even considering the augmented density. The relationship between team effectiveness and team creativity is strong and bidirectional (correlation $\beta = 0.40^{***)}$, but the patterns of relationship between these two variables and certain dimensions of the physical and sociotechnical environment are different. There is a positive and direct impact on team effectiveness, but to a lesser degree on creativity which, in turn, positively influences team effectiveness. Moreover, creativity intervenes (mediator variable) between project commitment, satisfaction with large meeting rooms and the IT environment on their relationship with team effectiveness. When the authors added a direct link between the variables and team effectiveness, the model explains 47.1 per cent of the variance.

Research limitations/implications – The scope of the data is somewhat limited by the time that the company and its teams could allocate to this paper.

Practical implications – The arrangement of space reinforces employees’ sense of belonging to their team as measured by project commitment which along with satisfaction with the large meeting rooms and IT environment influence both team effectiveness and creativity. Managers could consider these three elements as levers for action. Space variety (or balanced layout) is also a way to support team creativity.

Originality/value – Even if open spaces are frequently used, the literature on creative spaces is dedicated mainly to an individual. This paper delivers some results and evidence on the concrete and simultaneous impacts of the workspaces on creativity and effectiveness of multidisciplinary new product development (NPD) team.

Keywords Innovation, Team creativity, Team effectiveness, New product development team, Open space, Space variety, Team-based workspace

Paper type Research paper
1. Introduction
Innovation is key today, and companies often rely on a project-based organization, in other words, on multidisciplinary teams to increase their flexibility and, thus, adapt to environmental changes in technologies and markets (Kumari, 2017; Ross et al., 2008). This flexible way of work adds to task complexity, and to support these teams, several organizations add to their toolkit architectural or physical elements complemented by sociotechnical changes in the workplace. Indeed, open spaces (different names are often adopted: innovative, collaborative or creative) matched with several other complementary spaces provide performance-enhanced work environments, maximizing team creativity and effectiveness (Chadburn et al., 2017; Manca et al., 2018). Several authors suggest that the same space layouts may be used to support creativity – which may in turn influence effectiveness – while favoring also effectiveness (Kratzer et al., 2008; Coradi et al., 2015). Moreover, the focus is often on the individual, not the team (Appel-Meulenbroek et al., 2018). Therefore, we attempt to assess several antecedents divided into two dimensions: physical (space variety, indoor environmental quality, large meeting room, workstation) and sociotechnical environments (project commitment, IT environment) of creativity and effectiveness at the project team level to determine whether companies benefit by adopting open, creative spaces with multiple and diverse layout designs to sustain either team creativity and effectiveness. Are they essential as De Paoli and Ropo (2017, p. 165) suggest, or just good cards among others?

This article begins with a review of the literature on open spaces for new product development (NPD) by multidisciplinary project teams. We then present our methodology, which is based on ten case studies using interviews, observations, secondary data and a survey. Next, we present the analysis and interpretation.

2. Literature review
Flexible and open spaces, like it is conceived today, first appeared in the 1970s. Since then, the number of workspaces designed for individuals has decreased, whereas density and common areas have increased (Hills and Levy, 2014). This article focuses primarily on spaces that support innovation activities in the form of NPD within an enterprise.

2.1 Team creativity and team effectiveness in innovation
Innovation can be described as the translation of ideas into new products, services or processes that an organization can market or use (Mumford et al., 2002). Effective innovation management requires the ability to juggle knowledge and resources (Hurmelinna-Laukkanen, 2011) stemming from the team or from external members (Tang and Ye, 2015). A full definition of the team, adopted by many, is proposed by Kozlowski and Bell (2003, p. 334):

Collectives who exist to perform organizationally relevant tasks, share one or more common goals, interact socially, exhibit task interdependencies, maintain and manage boundaries, and are embedded in an organizational context.

Multidisciplinary teams can pool effective solutions and launch successful products (Kalluri and Kodali, 2014). Such teams use developmental methods, like agile stage-gate (Cooper and Sommer, 2016), as well as robust and flexible tools to organize and carry out their tasks, and this requires an environment that fosters effective communication (Kratzer et al., 2008). For example, team members can display planned activities on the walls of their “war rooms” or spaces that are set aside for teams to work on specific projects. These rooms are meant for sharing and storing information to facilitate usage by all members of the team.
Today’s work teams need to be creative to support their organization sustainability (Rothe et al., 2012). Furthermore, creativity is not only necessary for innovative work; it is also needed for routine work (Shalley and Gilson, 2017) so that every aspect of the work could be subject to “space” support. “Creativity is the individual’s use of knowledge and practical experience, and willingness to work with others—within the constraints of the environment and its resources—to solve problems” (Slocombe, 2000, p. 167). Recently, Amabile and Pratt (2016) refined a model that links individual creativity and organizational innovation while placing skills at the project level. Creativity is, therefore, a social process based on the individual’s skills and knowledge that integrate with those of other team members to achieve the project (Kratzer et al., 2010). Although creativity and innovation are sometimes mixed up, they represented different concepts. Indeed, creativity is focused on the generation of novel ideas, whereas innovation aims at the successful implementation of creative ideas within R&D or NPD team projects (West, 2002). Creativity is viewed as a contributor to innovation, one input to innovation. In this sense, team effectiveness is also an important input to innovation (Kalluri and Kodali, 2014).

For companies that develop new products, real estate management and architectural and layout designs that support creativity could, therefore, yield significant benefits. Innovative workplace design influences and is influenced by the organization, its creative processes (Kallio et al., 2015; Keeling et al., 2012) and the management of the project of which coordination and integration are paramount to gain positive results (Pekkinen and Kujala, 2014). The results can be qualified of success and team could be performant, productive, efficient or effective. Each of these words covers a slightly different reality, although the last two are more precise on the dimensions evaluated. To study the effectiveness of a team, a broad research stream is based on an “input-process-outcome” model developed and described for the first time by McGrath (1964). The output for an effective team is characterized by:

- product delivery or the results that the team achieves;
- greater team capacity or team viability, growth in team capacity; and
- individual team member learning or team member satisfaction, which can improve organizational performance (Hackman, 2002; Delgado Piña et al., 2008).

Team effectiveness is then more organization long-term-oriented than project success. Our underlying hypothesis assumes that the enabling characteristics of the workspace are positively related to creativity, which in turn, promotes team effectiveness. In addition, the workspace may wield a direct effect on team effectiveness and hence, organizational performance.

The next sections are divided along Wineman et al.’s (2014, p. 1110) category who suggest “that innovation is a process that occurs at the intersection of social and physical space, and moves toward a sociospatial science of design for innovation”.

2.2 Physical spaces: indoor environment quality (IEQ), workstation, large meeting room and space variety
Companies and researchers have long been interested in how physical and chemical dimensions of workspaces impact an employee (Vischer, 2008). Perception of IEQ can translate the impact of ambient and spatial conditions at the workstation level (Vischer, 2007; Keeling et al., 2012). Ambient conditions include lighting, noise, air quality, air movement, temperature and humidity (Sundstrom and Sundstrom, 1986).
The physical spatial conditions include individual workstation size, furnishings, equipment, privacy, the degree of partitioning and the degree of workstation personalization. Chadburn et al. (2017) add to this list an easy access to various services. These physical characteristics of the workplace are known to impact employee satisfaction (Brunia et al., 2016) and emotional well-being, as well as communication (Kristensen, 2004), all of which could positively impact performance (Hua et al., 2010).

The transdisciplinary and collaborative work required to develop new products and services calls for spaces that support dynamic interactions on the one hand, and intense, focused individual work on the other (Hua et al., 2011; Coradi et al., 2015). We call it “space variety” or balanced layout, and it is one of the key factors for innovation (Chadburn et al., 2017; Lee, 2016; Harris, 2016; Blakey, 2015). According to Hua et al. (2010), meeting rooms of different sizes should be provided to accommodate the various types of meetings that the teams hold, and they should be located near the workstations (Lee, 2016). These spaces are increasingly integrated to form a coherent whole around the open space. Meeting spaces are subdivided into informal meeting and formal meeting spaces and even spaces where the outside penetrates the workplace like an art gallery. In the same time, moving service-related areas outside the open workplace can ward noisy activities (Hua et al., 2010). The decrease in desk space can cause the worker to perceive an inadequacy which leads to a diminished commitment (Morrow et al., 2012). On the other hand, for people who do not have effective strategies to isolate themselves from noise and distractions, there is a decline in productivity and satisfaction, while for people who can effectively block environmental stimuli when needed, there is an improvement in satisfaction and morale (Maher and von Hippel, 2005; Chadburn et al., 2017).

If there is a business strategy for spaces, this is generally viewed as a form of organizational support that fosters collaboration (Wineman et al., 2014). For example, open workspaces allow team members to work side-by-side and cross paths at random, which improves information exchange and knowledge sharing and helps get the whole team on the same page (Wineman et al., 2014; De Paoli and Ropo, 2017). On the other hand, spaces with no particular function and secluded spaces that can accommodate one or two people are useful for letting the mind wander or to work intensely without distraction, these spaces designed for introspection or concentration allow team members to percolate original ideas (Coradi et al., 2015), while “doodle” space allows team to exchange and brainstorm (Lee, 2016).

2.3 Sociotechnical spaces: project commitment and IT environment
The second dimension of the spaces supports the social and organizational interaction; it spreads the messages on the organizational culture and the practices and behaviors considered important. Several impacts, all related to innovation, can be felt in terms of culture, individual control, flexibility, collaboration, knowledge sharing and commitment to the organization (Rothe et al., 2012; Bosch-Sijtsema and Tjell, 2017).

Project commitment fosters individual acceptance of and strong belief in the goals of a team, a willingness to engage and the desire to maintain membership (Hoegl et al., 2004; Ehrhardt et al., 2014). It is also a measure of the strength of the employee’s affiliation with shared goals and values (Ehrhardt et al., 2014; Mowday et al., 1982). Good workspace management can encourage a sense of belonging, promote emotional and organizational commitment and prompt professional and social interactions (Jaitli and Hua, 2013). These are the desired outcomes that act to foster team cohesion and productivity (Haynes, 2008; Brunia et al., 2016; Jaitli and Hua, 2013). The organizational and project commitment can be influential in shaping performance outcomes for teams (Ehrhardt et al., 2014). For example, a
team member’s motivation to find and use knowledge placed at the team’s disposal, but often unused, can increase a team’s creativity (Khedhaouria et al., 2017; Gray and Meister, 2004).

Many studies have attempted to discover the impact of using IT for NDP, but often with inconsistent results (Barczak et al., 2007). Searching for specific influence, Barczak et al. (2007) found that IT for NPD and the IT infrastructure (defined as the combination of reliable services that are shared throughout the firm and coordinated, usually centrally (Weill et al., 2002)) are particularly useful for collecting information and sharing it, which leads to greater market success. It seems that organizations are becoming increasingly reliant on IT, including social media, to enhance communication between team members (Delerue and Sicotte, 2017) and to support innovation for the best-performing firms (Marion et al., 2016). IT environment is sometimes assimilated to virtual community of practice (through team collaboration software or platform like Slack[1] or Confluence[2]) that helps manage knowledge and individual attention (Anders, 2016). Workplace connectivity and intelligence are key in an emerging technological environment where visual and auditory sensors keep track of individual practices and replicate teamwork sessions (Oksanen and Ståhle, 2013). On the contrary, IT inadequacy to become more mobile (with laptops, Wi-Fi and robust client-server architecture), adapted to teams and accessible from all spaces while ensuring the required level of security greatly, reduces the flexibility necessary for successful work in open spaces (Manca et al., 2018).

All the factors of physical space and sociotechnical space are known to show influence, even if not always positive or measurable. Moreover, some studies have shown the importance of considering the interaction between these factors to obtain a more accurate portrait (Maher and von Hippel, 2005; Kämpf-Dern and Konkol, 2017; Bosch-Sijtsema and Tjell, 2017). For this purpose, Figure 1 shows the different elements that are studied.

What emerges from the literature review is a fairly recent accumulation of knowledge about the effects of factors and sometimes subsets of them, but the interactions are less explored, especially because of the difficulty of collecting data. The methodology that is described in the next section is a mixed one, which brings a different light and we hope, a fruitful one.

3. Method
We conducted case studies of ten NPD teams in a large, innovative hi-tech company. The company operates worldwide, and it faces fierce competition. The industry, electronic entertainment, is high-technology-intensive, and the products have a sophisticated, creative

![Figure 1. Spaces related to team outcomes](image-url)
edge. Its diversity of platforms and sophisticated technology require a cutting-edge multidisciplinary workforce and up-to-date tools and work processes. Its performance depends largely on the quality of the environment it provides for its workers and teams, who must operate in close collaboration to one another on site and abroad; each studied team is a mix of co-located sub-teams and one or more co-development teams of the other sites of the company. We used a variety of data collection methods, including 40 semi-structured interviews, four months of active on-site observations and 11 months of collaboration; a secondary data analysis; and a survey.

Our first interviewees work in the CRE department and indoor design team. We also interviewed individuals from the relocation department (working for CRE), a staffing person at the strategic level, as well as the IT director and his assistant (who is responsible for the IT equipment in the various spaces); this represents seven interviews in total. As for our team interviews, we have conducted 24 interviews with the NPD teams, including three with R&D teams and five with persons from administrative services. The sampling provides a good representation across decision-making levels and functions. During the interview phase, access cards and offices were loaned to the team whose five trainees (post-PhD, PhD and masters level) and one researcher spent an average of two to four days per week on site. A large number of documents were provided to help us better understand the internal organization in terms of processes, history and culture. Secondary data, observation and interviews were very useful to gain insight for the design of the questionnaire, but also for the grounded interpretation of the results.

The questionnaire was designed to evaluate on a factual basis variable found in recent studies on spaces and their influences. The questions probe respondents’ perceptions of and satisfaction with the environment and spaces, as well as the intensity of team activities and results. More particularly, space variety probes satisfaction with the availability of different spaces for team work; project commitment notes the attachment to the representation of the project in space; satisfaction with large meeting rooms is chosen because they are the most used by teams and the most representative of the type of formal meeting within the framework of a project. Each variable is formed with the means of two to seven questions on a five-point Likert scale. The preliminary analysis shows scale reliability, with Cronbach’s α ranging from 71.1 to 88.8 per cent, which is satisfactory. The analysis is based on 645 respondents from all teams for an individual response rate of 44.6 per cent. We made a confirmatory factor analysis that further qualified our variables. Table I shows the response rate and several characteristics.

In the quantitative phase, the company’s upper management supported this research initiative by distributing the survey by intranet email. The email contained a link to the questionnaire webpage, which was hosted by the university.

4. Results and discussion
With the constant need for proximity, successful workspace management requires the flexibility, planning and creativity to build effective spaces for each team and employee function. Team members are encouraged to move around through the use of mobile furniture. The purpose of possible reorganizations is to enable individuals to group together quickly. Larger redevelopments are orchestrated by the real estate department (a service comprising 16 employees and calling upon subcontractors); the team members turn off their computers in the evening and deposit moveable objects in storage boxes integrated into the layout. In the morning, they arrive at their new location and are immediately operational. This efficiency is supported by an adapted infrastructure that was installed as renovations took place (each computer requires a high-speed link and a large bandwidth needing to be
**Table I.**

Responses rate and several characteristics of the teams

<table>
<thead>
<tr>
<th>Team</th>
<th>Nb. on site</th>
<th>Nb. responses</th>
<th>Nb. completed responses</th>
<th>Type of team</th>
<th>Density M2/work-desk</th>
<th>Project phases</th>
<th>Type of team</th>
<th>Density M2/work-desk</th>
<th>Project phases</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>440</td>
<td>267</td>
<td>154</td>
<td>NPD</td>
<td>57.68</td>
<td>NPD</td>
<td>NPD</td>
<td>57.68</td>
<td>NPD</td>
</tr>
<tr>
<td>2</td>
<td>345</td>
<td>90</td>
<td>40</td>
<td>NPD</td>
<td>44.44</td>
<td>NPD</td>
<td>NPD</td>
<td>47.69</td>
<td>NPD</td>
</tr>
<tr>
<td>3</td>
<td>330</td>
<td>50</td>
<td>45</td>
<td>NPD</td>
<td>57.69</td>
<td>NPD</td>
<td>NPD</td>
<td>66.84</td>
<td>NPD</td>
</tr>
<tr>
<td>4</td>
<td>230</td>
<td>187</td>
<td>125</td>
<td>NPD</td>
<td>41.67</td>
<td>NPD</td>
<td>NPD</td>
<td>71.43</td>
<td>NPD</td>
</tr>
<tr>
<td>5</td>
<td>112</td>
<td>80</td>
<td>35</td>
<td>NPD</td>
<td>41.67</td>
<td>NPD</td>
<td>NPD</td>
<td>94.21</td>
<td>NPD</td>
</tr>
<tr>
<td>6</td>
<td>95</td>
<td>84</td>
<td>84</td>
<td>NPD</td>
<td>41.67</td>
<td>NPD</td>
<td>NPD</td>
<td>72.34</td>
<td>NPD</td>
</tr>
<tr>
<td>7</td>
<td>116</td>
<td>47</td>
<td>34</td>
<td>R&amp;D</td>
<td>72.34</td>
<td>R&amp;D</td>
<td>R&amp;D</td>
<td>64.67</td>
<td>R&amp;D</td>
</tr>
<tr>
<td>8</td>
<td>90</td>
<td>67</td>
<td>64</td>
<td>R&amp;D</td>
<td>38.72</td>
<td>R&amp;D</td>
<td>R&amp;D</td>
<td>64.67</td>
<td>R&amp;D</td>
</tr>
<tr>
<td>9</td>
<td>300</td>
<td>109</td>
<td>80</td>
<td>R&amp;D</td>
<td>94.21</td>
<td>R&amp;D</td>
<td>R&amp;D</td>
<td>72.34</td>
<td>R&amp;D</td>
</tr>
<tr>
<td>10</td>
<td>195</td>
<td>81</td>
<td>51</td>
<td>R&amp;D</td>
<td>94.21</td>
<td>R&amp;D</td>
<td>R&amp;D</td>
<td>72.34</td>
<td>R&amp;D</td>
</tr>
</tbody>
</table>

Notes: §Standards of the Marketing Research and Intelligence Association; (z) Mean and standard deviation of several different areas per team.
wired; Wi-Fi is reserved for management and phones). On average, NPD employees move twice a year. Another very visible element is the variety of meeting rooms, relaxation areas or testing spaces and cafeterias.

In some work environments, employees just take the first available standard workstation in the morning (Hoendervanger et al., 2016). This is not the case at this company because most workstations are highly customized to each team member’s tasks, so employees are deliberately assigned at a highly tailored workstation and to maximize communication within and among sub-teams (McElroy and Morrow, 2010). All NPD directors want smooth transitions between phases for his/her team which increases and decreases as it goes. Conflicts over space arise in part because space allocation is viewed as a cryptic message from top management, a kind of judgment of a team’s or individual’s work. In addition, because the team size varies over the course of a given project, the director and project managers attempt to continually optimize the space. When employees are brought on board of a project, they need to be briefed on the work’s progress. What could be more effective than locating them with the rest of the project team? And to stay abreast of developments to respond appropriately and timely, the project management can opt to keep a steady eye on things:

A well-located workspace for me? Right in the middle of my team’s area. I have to be accessible. My people shouldn’t have to make an effort to reach me. I had to move from my previous location – too far from my people (project manager).

We observed that the team members were satisfied with the level of communication and coordination that proximity to their colleagues facilitated. Over the years, CREM has clearly demonstrated its willingness to apply a continuous learning system to adapt the workspaces to the teams’ needs, so they can work more effectively. These changes ranged from partial refurbishment to complete reconstruction. But, have they managed to bring about significant changes for the teams? When the study survey was initially administered, two teams had not yet been set up in recently renovated spaces, and all the workspaces differed widely according to the phase of each team and the addition of various spaces throughout the years. Table II presents the means and standard errors (five-point Likert scale) and the significance levels for a mean difference analysis with recently renovated team space (or not) as the factor. We wanted to know whether there were differences between the impacts produced by the recently renovated spaces compared to those that were not.

The members of all ten teams perceived team creativity, project commitment and the IT environment similarly. Both spaces that have not been renovated show certain deterioration of IEQ conditions, furniture that is worn out and does not move and a virtual absence of meeting rooms (teams go to the other floors for their meetings). The layout of the other teams is variable, but all have meeting rooms and relaxation areas; much, if not all of the furniture can be moved; there is a much more innovative design, of a much higher quality, and for some, with an obvious spectacular effect. In line with Chadburn et al. (2017), all the other factors were perceived differently, including team effectiveness. So, there are many differences brought about by the new arrangements at the level of the physical elements (IEQ, space variety, large meeting rooms and workstations) which probably reflect on team effectiveness.

When present, the arrangement of space reinforces employees’ sense of belonging to their team. Several people speak about space personalization to strengthen project commitment in the same vein as Jaitli and Hua (2013). At first glance, it may sound somewhat trivial, but it is an element taken really seriously. Employees see the current approach to workspace design as evidence of a corporate culture that values freedom, self-expression and
Descriptive and test

<table>
<thead>
<tr>
<th>Descriptive and test</th>
<th>Team effectiveness</th>
<th>Team creativity</th>
<th>Space variety</th>
<th>Project commitment</th>
<th>IEQ</th>
<th>Satisfaction with a large meeting room</th>
<th>IT environment</th>
<th>Workstation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two teams in + 5 years space without renovation</td>
<td></td>
<td></td>
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<tr>
<td>N</td>
<td>184</td>
<td>183</td>
<td>188</td>
<td>187</td>
<td>188</td>
<td>109</td>
<td>187</td>
<td>188</td>
</tr>
<tr>
<td>Mean (Standard error)</td>
<td>3.68 (0.71)</td>
<td>3.78 (0.76)</td>
<td>2.89 (1.08)</td>
<td>3.52 (1.16)</td>
<td>2.98 (0.76)</td>
<td>3.53 (0.87)</td>
<td>3.64 (0.79)</td>
<td>3.23 (1.06)</td>
</tr>
<tr>
<td>Eight teams in 2-4 years renovated space</td>
<td></td>
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<tr>
<td>N</td>
<td>433</td>
<td>430</td>
<td>439</td>
<td>434</td>
<td>440</td>
<td>437</td>
<td>437</td>
<td>442</td>
</tr>
<tr>
<td>Mean (Standard error)</td>
<td>3.8 (0.71)</td>
<td>3.8 (0.70)</td>
<td>3.54 (1.09)</td>
<td>3.54 (1.04)</td>
<td>3.28 (0.80)</td>
<td>4.01 (0.77)</td>
<td>3.66 (0.85)</td>
<td>3.76 (0.89)</td>
</tr>
<tr>
<td>Means comparison significance</td>
<td>0.03***</td>
<td>0.93 n.s.</td>
<td>0.00****</td>
<td>0.79 n.s.</td>
<td>0.00****</td>
<td>0.00****</td>
<td>0.66 n.s.</td>
<td>0.00****</td>
</tr>
</tbody>
</table>

Notes: n.s. = non-significant; *p < 0.10; **p < 0.05; ***p < 0.01; ****p < 0.001; Yes – there is a difference between teams; No – there is not any detectable difference. The same pattern of differences applies to all the teams and all project phases.
exploration, which reflects the findings of Kallio et al. (2015). When employees were asked in an interview which aspects fostered better performance (i.e. those that resulted in good performance and were effective), it turns out that proximity is very important for everyone. It should not be forgotten that delocalized team work is part of their reality every day.

During our study stay, a few employees complained that the lighting hinders their ability to work with computer screens, while others working in areas lacking natural light reported feeling a loss of energy. The majority of employees work with earphones to mitigate ambient noise and enhance their concentration. These earphones often have a microphone for ongoing conversations between members of a team, even when these colleagues are a few feet away or across from each other.

Small improvised meetings of two or three employees are often conducted around workstations. There is a working protocol in the open spaces to regulate noisier-than-necessary behavior, and architectural elements (such as partition walls between two teams, acoustic panels on the ceiling, slightly flexible floor coverings) are added for this purpose. It appears that the effort to concentrate, despite the noise and distraction, increases the cognitive load and has already pushed some people to leave the company.

For the next analyzes, we have conducted OLS regressions with creativity and effectiveness as dependent variables with and without team cluster with no distinct results, so we have aggregated all respondents. Table III shows the strength of the relation between variables with the correlations. All questions refer to the team and ask for the degree of satisfaction with different spaces (e.g. the air quality is excellent) or actions and reactions of the team (e.g. my teammates often develop and promote new ideas).

All variables are strongly correlated to effectiveness, including creativity, which is less correlated with any other elements. Satisfaction with large meeting rooms and space variety are strongly correlated with satisfaction with the workstation, as well as the IEQ, suggesting that the renovations considerably improved the environment or that a positive perception on one of these factors influences the others. The respondents associate the open space with their workstation and the spaces variety (0.64****), so it could be a good idea to compensate the reduction of the workstation by a variety of spaces (Hua et al., 2010; Appel-Meulenbroek et al., 2011). Project commitment is strongly correlated with team creativity and effectiveness in line with Ehrhardt et al. (2014) and Brunia et al. (2016), and weakly to IT environment but to neither of the other.

<table>
<thead>
<tr>
<th>N = 645</th>
<th>Mean (standard error)</th>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>F4</th>
<th>F5</th>
<th>F6</th>
<th>F7</th>
<th>F8</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1. Creativity</td>
<td>3.77 (0.61)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>F2. Team effectiveness</td>
<td>3.85 (0.69)</td>
<td>0.40****</td>
<td></td>
<td>\</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F3. Space variety</td>
<td>3.34 (1.12)</td>
<td>0.16****</td>
<td>0.40****</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F4. Project commitment</td>
<td>3.53 (1.08)</td>
<td>0.23****</td>
<td>0.30****</td>
<td>0.05 (ns)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F5. IEQ</td>
<td>3.19 (0.80)</td>
<td>0.12****</td>
<td>0.31****</td>
<td>0.45****</td>
<td>0.07 (ns)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F6. Large meeting rooms</td>
<td>3.92 (0.81)</td>
<td>0.20****</td>
<td>0.44****</td>
<td>0.50****</td>
<td>0.07*</td>
<td>0.36****</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F7. IT environment</td>
<td>3.66 (0.84)</td>
<td>0.22****</td>
<td>0.46****</td>
<td>0.36****</td>
<td>0.15****</td>
<td>0.25****</td>
<td>0.43****</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F8. Workstation</td>
<td>3.60 (0.98)</td>
<td>0.08**</td>
<td>0.50****</td>
<td>0.64****</td>
<td>0.05 (ns)</td>
<td>0.50****</td>
<td>0.49****</td>
<td>0.43****</td>
<td></td>
</tr>
<tr>
<td>Cronbach’s α</td>
<td>0.83</td>
<td>0.85</td>
<td>0.89</td>
<td>0.83</td>
<td>0.74</td>
<td>0.88</td>
<td>0.87</td>
<td>0.75</td>
<td></td>
</tr>
</tbody>
</table>

Notes: *p < 0.10; **p < 0.05; ***p < 0.01; ****p < 0.001; correlation strength interpretation based on Sawyer and Ball (1981): weak < 0.13; moderate < 0.26; strong > 0.26
The workstation variable is strongly correlated with the other variables like team effectiveness and IT environment, except for team creativity and project commitment. The wider pattern of relations suggests to take good care of the workstation to enhance the experience and effectiveness of team members.

The analyses so far show the relationships between two variables, but we need to reflect the complexity of reality, and for that, the method of structural equations modeling (SEM) can consider all the relationships that researchers specify in a model. Figure 2 presents the structural equation results of the model where all variables are linked to team creativity which is then linked to team effectiveness. The arrows show the direction of the relationship tested, and the numbers show the strength. Finally, the asterisks show the level of significance with the same scale as in the tables.

The indices of model quality are satisfactory. Note that all the factors are significantly related to team creativity with an explained variance ($R^2$) of 10.6 per cent. Creativity influences very strongly and positively team effectiveness ($0.408^{****}$) with an explained variance of 16.6 per cent. This result supports the generally accepted thesis of the effects of physical environments (Malinin, 2016) and social environments (Wineman et al., 2014) influencing creativity to attain efficiency.

Although the relationship between workstation and creativity ($-0.176^{***}$) is negative in Figure 2, Table III shows a positive correlation, albeit weak. This suggests that team creativity deploys in other spaces, for example, in different types of meeting and concentration spaces (space variety $0.117^{**}$ and large meeting room $0.110^{**}$). Project commitment ($0.193^{****}$) has the strongest influence on creativity, followed by IT environment ($0.145^{***}$); whereas project commitment has been shown to influence performance (Ehrhardt et al., 2014) and effectiveness in Table III, results in Figure 2 indicate that project commitment influences creativity as well. In addition, the IT environment shows a strong influence on creativity (second under project commitment), in line with its recognized contribution to innovation (Marion et al., 2014).

Inspired by Amabile and Pratt (2016), we tested to see if part of the influence of the environment variables on effectiveness could go through creativity. In fact, the results show that creativity is a partial mediator of the impacts of project commitment, large meeting rooms and IT environment on team effectiveness: part of these variables’ impact goes through creativity. This means that the study of the direct relationship of project commitment, large meeting rooms and IT environment on effectiveness gives a weaker result than their influence is in reality.
We went on to explore the impacts of all the factors to determine their direct contribution to team effectiveness. This model depicted in Figure 3 explains 47.1 per cent of the variance in team effectiveness (11.6 per cent for team creativity), with satisfactory indices of model quality. The level of explained variance ($R^2$) is very high for a complex phenomenon like this one. We test also the impact of team effectiveness on team creativity and find a strong significant relation (coefficient of 0.334****).

In this analysis, space variety and IEQ show no influence on team effectiveness, despite the high correlations in Table III and the positive impact on team creativity in both models of Figures 2 and 3. It leads us to think that it is the activities linked to creativity that are mostly supported by the diversity of other spaces.

As we have just noted, compared to the other dimensions, IEQ has only a weak influence on creativity. However, most studies stress that this variable yields a strong impact on individual productivity and organizational performance (Chadburn et al., 2017; Vischer, 2008). One explanation can be that improving layouts can raise expectations of increased comfort and well-being. By improving elements that are, in fact, less fundamental than those that affect employee health, management creates the impression that the basic elements are also enhanced: well-being is a whole experience (Keeling et al., 2012). Another explanation could be that IEQ is more favorable to creativity than effectiveness. More studies are needed to investigate this surprising result.

Workstation has a negative effect on team creativity, but a positive effect on team effectiveness. Colleagues often gather around a workstation to chat about a daily matter of the work, but individual work is the main activity that takes place there. Therefore, the variable workstation affects effectiveness more than creativity.

The second model (Figure 3) shows that satisfaction with the large meeting rooms, IT environment, and project commitment influence both effectiveness and creativity. Moreover, they are mediated by team creativity. This combined effect suggests that managers could consider these three elements as levers for action. As an example, one artistic director told us that “meeting rooms are decision accelerators”.

Project commitment shows crescendo results: from slightly distinctive in the correlation matrix (bivariate) to moderately influencing in Figure 2 to be among the most influential elements in the model of Figure 3, project commitment is also mentioned in the interviews like an element considered important and which would not be very expensive to support by the organization. Indeed, most interviewees mentioned in one way or another that the space can reinforce their sense of pride in their project or the company, amplify and reinforce their sense of belonging to the right place (this company among the others in the industry).
5. Conclusions
Our objective was to assess the influence of workspaces on creativity and effectiveness of project teams working on NPD. Our analyses show a weaker relationship model with team creativity than with team effectiveness, even if the space adjustments aim, among other things, to create conditions conducive to creativity.

The analysis of the interviews underscores the proposal that team members should be located close at hand, where they can see and hear each other, so they can work more effectively. Similarly, Coradi et al. (2015) stress the importance of proximity and visibility. In this company, the widely shared feeling of the importance of proximity is parallel to the reality of teams dispersed around the world. It also appears that IT plays a key role in fostering both creativity and effectiveness (Anders, 2016; Marion et al., 2014). The results are consistent throughout analyses. To stay effective in any circumstances, IT should follow the team in any meeting room with the same access and capacity than at the workstation.

Space variety allows the team members to choose the place and type of support they need for each project task and interactions (Bosch-Sijtsema and Tjell, 2017), thereby helping maximize creativity as shown by the SEM models. However, space variety does not appear to influence team effectiveness even if the bivariate correlation is high.

In addition to directly generating impact, creativity influences the relationship (mediator variable) between team effectiveness and IT environment, large meeting rooms and project commitment. Still, our analyses show a weaker relationship model with team creativity than with team effectiveness. Besides, Table II shows that effectiveness is different depending on whether the teams occupy renovated or non-renovated spaces, while creativity remains similar. It is possible that our measures are partly responsible: creativity being more difficult to seize.

One surprise involves the analysis of the satisfaction with the workstation, which negatively affects team creativity but produces a positive effect on team effectiveness. This effect should probably be investigated further because the open area is where employees spend the most time. Lastly, there is a general agreement in the company about space capacity to influence team member commitment, which in turn, influences heavily team creativity and effectiveness. It would, therefore, be a profitable investment to promote the customization of projects on the walls and spaces of teams.

This opportunity to examine several teams within a single company comes with a few limitations. The questionnaire was not as rich and exhaustive as we would have liked. Also, a feedback from all interviewees on the results of the analyses would have produced richer data, but we had to restrict ourselves to CRE management for feedback. Nevertheless, we are extremely grateful for the openness afforded by the company management, which granted us access to a substantial store of valuable information.

Employees interpret the space in which they work and the overall space occupied by their company as messages of the consideration in which they are held and more generally as a reflection of the organization’s culture, particularly with respect to the importance of work and innovation. The workspace should be optimally adapted so as to reach the company’s functional and psychological targets, not only those concerning the privileged working of teams but also their contribution to the company’s competitiveness and sustainability. We believe this could inspire employees to use more their workspaces and to pool their efforts to achieve better coordination, communication, creativity and the pleasure of being part of an effective team. Our results point to the need to delve deeper into how workspaces contribute to creativity and effectiveness. Nevertheless, our research is consistent with previous studies on spaces and their significant effects on NPD project
teams. As De Paoli and Ropo (2017, p. 165) advance “[...] workspaces may make a real impact on creativity and innovation – not only be a management fad”.

Notes
1. Slack Technologies.
2. Atlassian Co.

References
Blakey, J.D. (2015), The Impact of Workspace on Innovation, (3702901 Ed.D.), Brandman University, Ann Arbor.


Further reading


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