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ORIGINAL ARTICLE

Perceptions of open innovation at CERN: an explorative study

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ABSTRACT

Innovation is seen as a crucial factor to drive businesses to grow, stand out and to meet customer needs. However, most research on open innovation focuses on commercial businesses. Here, we study how research institutes, specifically CERN, establish innovation as their driving force, primarily through internal and external openness. To explore how interdisciplinary collaboration and open innovation is perceived by CERN's constituents, mixed-form interviews have been conducted. A majority is found to be in favour of interdisciplinary collaboration, and acknowledges the impact of open innovation. Future work may continue to explore the validity of these sentiments among a wider audience.

Keywords: Open innovation; interdisciplinary collaboration; employee sentiment analysis; research institutes; explorative study.

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INTRODUCTION

Innovation has been a topic of critical importance to businesses as they seek to achieve and defend a competitive advantage within their market segment. In recent years, businesses have sought to accelerate innovation within their organisation, by allowing for wide distribution of internal knowledge, while drawing on external ideas to ensure the growth of a company's technology (Chesbrough, 2003). This paradigm has come to be known as *open innovation*, a philosophy that identifies that even the most capable R&D organisations must draw from external knowledge sources as a core tenet of innovation (Chesbrough et al., 2006).

While this approach has been extensively studied for commercial businesses, which seek to make profit, little research has been conducted on the nature and benefits of open innovation within research institutes. In this treatment, we refer to *research institutes* as being research-oriented intergovernmental organisations (IGOs, e.g. CERN, ESA), governmental research agencies (e.g. DLR, CNRS, NASA), and federally funded research and development centres (FFRDCs, e.g. JPL, Department of Energy National Laboratories). Enkel et al. (2019), show that companies have increasingly opened up to the concept of open innovation, but the main modes of innovation still remain a mix of open and closed innovation, given the risk of knowledge loss and higher coordination costs. Additionally, the paradigm of open innovation is limited in its scope given the protective nature that commercial industry exhibits towards its business. As far as the authors' knowledge goes, no research has been identified that focuses on open innovation dynamics within non-profit organisations or research institutes. Szajnfarber and Ziegel (2007) have studied the innovation dynamics within a large intergovernmental organisation (IGO), namely the European Space Agency (ESA), where they have identified the difficulty in applying traditional methods to gauging the scope of innovation, as such an organisation does not see an inherent market-pull, nor does it have a well-pronounced customer segment. These difficulties have led to the desire to explore what open innovation constitutes within one such research institute, namely CERN, and what inherent benefits it brings in terms of progress and development within the organisation.

The aim of this paper is to underline how an open environment and culture, both inside and outside a company, contributes to the creation of innovative products or services, taking as an example one of the most famous and prominent centres of scientific research: CERN. Specifically, how does this institution differ from other organisations in terms of openness? And to what extent does interdepartmental collaboration prevail within this institution? We will be exploring the notion that research institutes enjoy an advantage with respect to for-profit organisations, in that they receive ceaseless backing from stakeholders and are mandated to produce opportunities for industry and academia, thus being exempt of generating any material profit of its own. Both through interviews as well as past case studies, we will be investigating the topic of open innovation in relation to research institutes at both an individual level, as well as on a grander organisational level. Finally, we will conclude our treatise of the matter by hypothesising on future topics of interest, as well as striking differences between scientific research institutes

and for-profit organisations in terms of the openness of their organisational structure and knowledge infrastructure. Here, recommendations for fostering open innovation and future avenues of research at experimental facilities, such as CERN's IdeaSquare, will be presented.

THEORETICAL BACKGROUND

Since the last few decades, innovation played a crucial role in our society, representing the central pillar of any company, a necessary element for its long-term survival (Henderson, 2017). Indeed, innovating not only means creating new ideas, but it also regards the way of processing issues in the overall organisation, adapting new business models to achieve the best product and service version (Tohidi, 2011).

In order to gain the right sustained competitive advantage among all the others, different researches demonstrated that an openness both inside and outside the firm is an essential element (Jameson, 2019). "Not all smart people work for us. We need to work with smart people inside and outside our company" (Chesbrough, 2003). This sentence lets us understand how being open might procure to firms a greater potential for finding opportunities which might have been unexplored, in a sense combining the already known and the unknown that lies beyond (Branderburger et al., 1995).

But how may this openness affect research institutes? Studies done by Reed *et al.* (2012) fully demonstrated that open innovation can give enormous benefits in terms of R&D efficiency, cutting down innovation costs. In this way, the firm can easily profit from open-booked collaborations as a competitive advantage. As discussed by Chesbrough (2015), open science brought to open innovation a way that allows for higher and faster translation in discoveries and development.

Additionally, recent open innovation models suggest that innovation can be created without knowledge boundaries, thereby bringing people together and letting them unconditionally participate (Von Hippel 1988, 2005). This was inspired by the open source software and hardware movement in which internal projects are turned into external open source ones. For governmental research agencies such as NASA, this has led to internal knowledge flows and external knowledge flowing in (Lifshitz-Assaf, 2018). Open source software and hardware has instigated many developments that would otherwise not have taken place, were there no openness in the nature of the software. Powell (2015) suggests that open hardware and software form a bridge for different communities to leverage and expand on these open resources in their own unique way. As opposed to classical organisations, research institutes aim both at valorising and expanding their capabilities through open source projects, thereby capturing external value, while enriching others outside the organisation; this particular notion gives rise to the idea that open source and open innovation are simultaneously pursued by research institutes, yielding a synergistic approach to accelerating development. Their combined manifestation is commonly known as *knowledge* or *technology transfer*.

Focusing on the case of NASA, open innovation has ostensibly caused a great increase in the rate at which scientific breakthroughs are made, despite limited resources being allocated to these endeavours; these breakthroughs are predicated on an increased rate and volume in which data is disseminated. As a matter of fact, Altman *et al.* (2015) argue that the decrease in information processing cost has a decentralising effect on the locus of innovation, and the way in which organisations manage their innovation processes. As such, over recent years, innovation has started to shift towards communities over which firms have no full control, as is exemplified by NASA's Technology Transfer program and CERN's Knowledge Transfer program (Nilsen and Anelli, 2016).

Nevertheless, many companies are quite sceptical in being so open to the external environment, raising high barriers to protect their own intellectual property. There are still different debates if this behaviour might be correct or not: indeed, it may both lead to advantages such as temporary monopoly positioning, stimulation of tacit knowledge, more appropriability of technology but also drawbacks, for instance preventing proper diffusion of the idea and lower profits (Shilling, 2017). Irrespective of the conclusion to this discussion, non-profit research institutes such as NASA and CERN have shown unprecedented levels of open innovation and its returns, thereby underlining the benefits of being a public entity, as here intellectual property is put to the use of the community at large (McDevitt et al., 2014).

METHOD AND DATA

The authors have attended a three week-long summer school at the CERN premises, giving them full freedom to interact with local employees and gauge their experiences and thoughts on the organisation. To evaluate the impact of the presence of an open environment on innovation, we have conducted several freeform interviews. These interviews were conducted in a two-stage fashion: first, the interviewee was asked about their day job and job-related experiences, after which the contents of the interview homed in on actual sentiments on the organisational structure and individual values relating to innovation. The second part, which aimed at gaining insight on individual opinions on innovation within the organisation, was constructed in such a way so as to find out how interviewees felt about:

- The extent to which interaction with other departments is encouraged;

- Their representation within the greater discussion on the heading of their project;
- The effect of diversity on the enrichment of a project;
- The enrichment benefit of their project through interdepartmental collaboration.

Elaborating on the foregoing, the first part of the interview aimed at priming the conversation in a casual manner, such that the interviewee did not feel as though they had to respond on behalf of CERN, but rather comment on their own experiences and values. To this end, each conversation was structured such that specific topics on the interviewee's profession were touched upon, revealing insights on work culture and the extent of interdisciplinary cooperation within the organisation. These insights would not have presented themselves if a rigid list of questions would have been adhered to.

The second part of the interview actively sought to procure insights on the nature of interdisciplinary collaboration and freedom to innovate. At this point, the interviewee was told about the aim of the questions, such that a discussion around these topics could be had. This approach was found to be insightful, and gave rise to discussions and information that would be hard to gather otherwise.

Given the esoteric nature of the interviews, we have aimed at extracting anecdotal evidence that we may relate to certain organisational trends with reference to openness and innovation. As a consequence, the answers to our research questions arise both from the unstructured part, as well as the targeted part of the interview, ensuring that no response bias was part of our final conclusions. The possibility of participation bias was chiefly precluded by ensuring that a diverse set of people are represented within our study.

Data

In order to extract meaningful conclusions from our study, we aimed for a diverse pool of participants. This included people from different departments, departmental levels, age and working experience outside and inside CERN. A total of 37 people participated in our experiments. These people were selected such that the ratio of researchers and technical personal was balanced. The gender ratio was approximately 65% male to 35% female. No scaling or ranking was applied in the remainder of this report to quantify the results; instead, qualitative features were identified and highlighted in relation to their mutual occurrence between participants, with those that were mentioned most often being considered as representative for the larger organisation. This was done by extracting core perceptions from all interviews, which adhered to an identical core set of questions.

RESULTS

The central question focuses on how open innovation is stimulated in IGOs such as CERN and what makes this different from non-IGOs. Based on our study, we derived two main observations based on the points given in the previous section. A majority (74%) felt a great extent of interaction with other departments and felt a strong benefit of interdepartmental collaboration in their projects (63%). In particular, many interviewees highlighted the inherent benefits of working in an advanced research/work environment with people from many different backgrounds, this being a prerequisite for broadening one's professional knowledge and gaining insight into best practices adhered to by others as part of past experiences. This was particularly underlined when talking to a representative of the CERN Fire Brigade, who mentioned that cross-border expertise was readily shared among the diverse set of members of the Brigade, this leading to extensive innovation and refinement of operational practices.

In greater detail, the particular form of interdepartmental collaboration that was pursued during the interviews differed strongly from its classical, project-related counterpart. Indeed, here the focus has been on a freeform approach of collaboration, in which ideas are created through chance encounters with people from seemingly unrelated backgrounds, as their insights might often bring forth new, unorthodox, perspectives. Such collaboration is seldom seen in classical organisations with a fixed goal, but can be readily observed at universities; faculty often collaborate with colleagues from other departments, thereby advancing their field in directions that would not be possible otherwise. This leads us to believe that the atmosphere at CERN was largely reminiscent of this academic setting, which differs greatly from what is seen in classical organisations.

Many have also shared the sentiment that communication with colleagues from other departments was widespread. This was readily ascertained by the authors, when we were gladly redirected by employees from seemingly unrelated departments to the actual subject experts we were seeking. This is only attributable to a flexible organisational structure that allows for, and encourages, interaction between all employees, a privilege that is readily accepted by employees across the board. To relate this notion of interdepartmental collaboration to open innovation, we raise the observation that CERN employees have been exceedingly willing to extend help to those who are not from the organisation, either through email exchange or in person. While email exchanges imply that the employee has been given due notice before actual interaction, direct interaction through conversations with employees over lunch was also found to be of exceptional ease.

This dichotomy between on-site engineering and research has been found to be reflected in the very structure of CERN. Having spoken to representatives of security at CERN, the authors have found that there is a fine balance between a university campus-like and an industrial environment at CERN, as there is both developmental research, as well as implementation of such research as part of large-scale experiments on site. Such a mix of academic and industrial components is seldom found in the private sector, but brings with it unexplored benefits by closing the gap between theorists and practicing engineers, allowing for rapid validation of ideas on both sides. In particular, rapid turnover rates in terms of iterating through different research ideas and experiments is attainable by virtue of this dichotomy, and is much reminiscent of R&D groups in industry, although this approach is much broader in scale and ingrained in the very structure of CERN. The absence of obstructions in rapidly implementing ideas lies at the core of open innovation; the key is to create value by removing obstacles and uniting practitioners from different fields.

Through interviews, it was quite evident that researchers feel that the environment at CERN proves to be an excellent ground to develop new ideas and techniques in relative academic serenity, while being able to reach out to engineers and other staff to directly ascertain the feasibility of the concepts they are developing.

DISCUSSION AND CONCLUSIONS

In conclusion, the present research, albeit limited in scope and size, has provided an insight into the relation between openness and innovation at CERN. Given the nature of the open innovation processes at CERN, there is a great degree of cross-pollination between industry and CERN, with both parties benefiting from mutual knowledge transfer, as found from discussions with knowledge transfer representatives that manage industry collaborations with CERN. This collaboration differs from classical subcontracting, as it stems from the fact that industry collaborations arise chiefly in the scope of knowledge transfer, where the company generates value through an exchange of ideas and insights, as opposed to doing so by delivering goods or services. This, in the authors' view, constitutes a higher level of interaction between commercial industry and research institutes, bringing direct benefits to both parties, by virtue of a bi-directional flux of ideas.

In addition to this fruitful interplay with commercial industry, the structure of CERN aims to be close to that of a university campus, where discourse and exchange of ideas are greatly encouraged. To much avail, this has reflected itself in the many conversations the authors have had, both informal and formal, with employees having contacts across a wide range of departments, yet another aspect that would not readily present itself in corporate structures. Given the research-oriented nature of the institution, and the large number of visiting scientists, a fresh influx of knowledge is maintained, which is seen as a major perk by many interviewees.

Additionally, the fact that CERN focuses on conducting fundamental physics research, makes for yet another striking difference with conventional businesses. The nature of this research results in fewer returns for involved businesses, where technologies can only be adopted in an indirect manner, thereby making close collaboration between scientists and in-house engineers of prime essence. This cross-pollination allows for shorter design cycles, and is a catalyst for more advanced innovation, as it brings together knowledge from different backgrounds that is requisite to solving complex problems of this calibre.

In retrospect, the present research methodology has brought to attention several limitations that are to be addressed in future studies. First, the limited sample size has imposed an inherent restriction on the data acquired. In particular, in future studies, more effort is to be made to include a diverse audience, including administrative workers, engineers and scientists, such that a broader spectrum of the organisation is studied.

Tying closely with this, is the form in which interviews have been held as part of this study. The authors recognise that a panel-based approach in which multiple people are interviewed at once may be more beneficial, as discussions between the panellists may spark further insights into the nature of interdisciplinary collaboration and open innovation at CERN. Evidently, CERN's IdeaSquare would make for the perfect venue for this form of research, as panel discussions and interviews may readily be held, and the space makes for an approachable venue in which people from different backgrounds may discuss their views on innovation.

Finally, more departments within CERN are to be included in a future study. At present, departments at the Meyrin campus have been studied, however, many other departments are located at the Prévessin campus. Future work is to include these employees, so as to study the effect and implications of spatial separation and interaction between campuses in relation to cross-campus collaboration. These additional aspects will provide new insights and strengthen the core observations of the present research, as well as pave the path towards more generalised open innovation studies across various organisational forms.

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