CRITICAL ASSESSMENT OF THE DEVELOPMENT OF OPEN INNOVATION USING ACTOR-NETWORK THEORY APPROACH

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Abstract

The purpose of this paper is to critically assess the effects of the open innovation approach in the situation of a crisis on the development of technological innovation eRouška, a Bluetooth-enabled app designed to facilitate COVID-19 contact tracing.

From a methodology point of view, the paper is based on a triangulation approach combining 8 semi-structured contextual interviews and an explorative case study. The paper also uses Actor-Network theory as a research method to investigate the situation without preconceiving an interpretation.

This study is among the first ones to empirically explore the effect of the crisis on an open innovation project. It suggests that the crisis has both positive and negative effects on innovation progress and that this effect is variable in time. The study also suggests the existence of open innovation projects not initiated and managed by a public sector institution. It expands the view on open innovation barriers by describing personal barriers to innovation. It confirms the usefulness of the ANT approach to studying technological open innovation projects in the public sector. It also contributes to the open innovation research in the public sector by studying a multi-actor network project.

Key words: open innovation, technological innovation, crisis management, public sector innovation, Actor-Network theory

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Introduction

With the emergence of turbulent problems, such as terrorism, international migration, global warming, and the newest challenge, COVID-19, the governments find their usual ways of working inflexible, slow, and unable to react timely and appropriately (Ansell et al., 2020). Openness is a good strategy to face turbulent problems requiring a dynamic approach. In firms,

increasing openness was proven to positively impact their dynamic capability and resilience (Ahn et al., 2018). To solve the newly emerged problems, the governments need to develop new solutions – they need to innovate (Ansell et al., 2020).

The open innovation (OI) concept has been coined by Chesbrough who suggested that to succeed in innovating, private sector organizations need to manage the knowledge inflow and outflow and stop relying purely on their internal R&D and commercialization process (Chesbrough, 2003). This open approach to innovation is also assumed to be applicable in the public sector innovation (PSI). Diverse stakeholders benefit from the public value created in the PSI, and they should thus be motivated to join the process (Torfing, 2019). Additionally, recent advancements in digitalization facilitating the connection between the public sector and other stakeholders spurred the interest of governments in open innovation (Mu & Wang, 2020).

The existing research of OI in the public sector has focused on barriers and enablers (Cinar et al., 2019; Mu & Wang, 2020), typologies (Mu & Wang, 2020; Vries et al., 2016), and objectives and outcomes (Vries et al., 2016). Yet, little is known about these topics in a condition of crisis.

The goal of this paper is to critically assess the effects of the OI approach in the public sector on the development of technological innovation in a crisis. This is illustrated by the case of eRouška, a Bluetooth-enabled contact tracing app developed in Czechia in response to COVID-19 pandemics. eRouška represents a unique case of technological innovation in the public sector in crisis. The case also responds to the calls to research OI in the public sector within a multi-actor setup (Bekkers & Tummers, 2018; Cinar et al., 2019; Mu & Wang, 2020).

To reach its goal, the paper sets the following research question: How was the idea acceptance, stakeholder engagement, quality of the eRouška app, and its sustainability influenced by the situation of COVID-19 pandemics? The answer is provided using the Actor-Network theory (ANT) as a research method to investigate the situation without preconceiving an interpretation (Pollack et al., 2013).

Literature review

Public sector innovation is deemed to bring solutions to newly emerging problems (Ansell et al., 2020; Vries et al., 2016) and improve the quality of public service (Vries et al., 2016) by enabling the governments to work smarter, not harder (Albury, 2005). Yet, as the concept of innovation has been brought from the private to public sector only recently, the innovation projects still face many barriers.

Albury suggests that challenges stem from the two inherent characteristics of PSI: 1) there is a higher level of scrutiny that usually comes earlier in the process compared to innovation in the private sector, 2) there are higher risks of negatively influencing individuals and communities when it comes to PSI (Albury, 2005).

Cinar et al. (2019) made effort to systematize the findings from studies of barriers in PSI. In their first study, they identify four types of PSI barriers: 1) organizational barriers, 2) interactional barriers, 3) innovation-specific barriers, 4) contextual barriers. Organizational barriers include ineffective administration process activities, resistance or lack of support from specific actors, lack of available resources, rigid structures and culture and lack of skills, knowledge, and expertise (Cinar et al., 2019), poor skills in change management, few rewards and incentives to innovate, over-reliance on current high-performers, the culture of risk aversion and delivery pressures and administrative burdens (Albury, 2005). Interactional barriers between different actors take the form of lack of shared understanding, lack of effective network governance, inadequate communication between the actors, unclear accountability and funding burden, turf-fights, lack of trust, the difference in competencies and culture, public doubt or opposition, user resistance, inadequate involvement, conflicting missions, and goals and tendering and contracting issues (Cinar et al., 2019), power imbalance, weak connections to citizens (Mu & Wang, 2020). Interactional barriers were cited as most frequent by Cinar et al. (2021). Innovation characteristics-based barriers stem from perceived attributes of innovation, such as incompatibility with existing values, experiences, and needs, complexity, switching costs, lack of interoperability, platform and software problems, and inflexibility. Contextual barriers are represented by laws, regulations, and policies (Cinar et al., 2019). In their second study, Cinar et al. add a fifth group of barriers – insufficient resources, both financial and human (Cinar et al., 2021). Apart from insufficiency, the short-term allocation of budgets hinders PSI (Albury, 2005).

Mu & Wang (2020) argue that barriers are different for traditional open innovation projects and digital open innovation projects. They highlight that digital OI and new technologies meet adaptive barriers going beyond technology adoption, calling for a new form of leadership, adjusted SOPs, new professional expertise, suitable hardware and software skills, and equipment on the public sector side. On the citizen side, the digital divide in skills and knowledge of digital plays an important role – for some, integrating new technologies into their routines may be virtually impossible. Additionally, digital OI represents challenges on data governance, quality, semantic interoperability, privacy and confidentiality, lack of appropriate legislation, and sustainability of prototypes (Mu & Wang, 2020).

The impact of situations of a crisis on PSI lacks the broader and deeper attention of researchers. Ansell et al. (2020) suggest that innovation is a solution in times of crisis caused by novel problems and Torfing (2019) hypothesized that the urgency of a problem can help innovation succeed. Research, although fragmentary, thus suggests that innovation in crisis is desirable and that urgency of such crisis can have a positive effect on the innovation outcome.

Ahn proposes that in firms, openness can induce desired dynamic approach and increase resilience (Ahn et al., 2018), which might be beneficial in times of crisis. Thus, the concept of openness in PSI under the conditions in crisis should also be beneficial to the innovation project.

In PSI, open and collaborative approaches are often considered interchangeable (Bekkers & Tummers, 2018; Bommert, 2010; Mu & Wang, 2020). The definition of both open and collaborative innovation in the public sector is relatively vague, often just referring to the involvement of multiple external stakeholders, such as citizens, NGOs, companies, and other public sector organizations in the process (Bommert, 2010; Mu & Wang, 2020; Torfing, 2019). Chesbrough`s definition of OI in the private sector offers more insights describing the OI process as one that is distributed, based on purposively managed flows of knowledge through organizational boundaries, and uses pecuniary and non-pecuniary mechanisms corresponding with the organization`s business model (Chesbrough & Bogers, 2014). For Chesbrough, the open innovation is represented by collaboration with smart experts for outside the organization, close cooperation between internal and external teams to create value, profiting from ideas from outside, designing an appropriate business model for the innovation project, maximizing value from mixing internal and external ideas and active management of IP (Chesbrough, 2003).

Methods

To explore the eRouška story, ANT principles were used to trace the ties between the actors in the project. First, ANT enabled the analyses to respect that there were no pre-set relationships in the team (Pollack et al., 2013) which is reflecting the open setup of this innovation project. Second, appropriate to the technological innovation, the ANT accepts that both human and non-human actors may have the ability to act, that they have an agency (Law, 2009). This is an important consideration in this case. The research question assumes the crisis plays a role. The public sector consists of individual and institutional actors. The overview of barriers to innovation presented earlier assumes the technology plays a role, as well as laws, SOPs, users, competing goals, finances, etc. Using the ANT approach, none of these actors is denied the ability to act. Third, ANT is a dynamic approach. It uses the concept of the translation process to capture how actors are disentangled from existing networks and how they are engaged in

new ones, a state that is never resistant to another disengagement, engagement, and re-engagement (Callon, 1984). As the research tracks progress of an innovation project, the ability to trace a process rather than create a snapshot (Pollack et al., 2013) is beneficial to the analysis.

This research is based on 8 semi-structured interviews to present an exploratory case study of the eRouška project, covering approximately the period March 2020-April 2021. Following the ANT approach, snowball sampling was used. 6 interviewees were volunteers and 2 the public sector representatives. 4 were part of the project until the date of the interview, 3 left the project after the first release and 1 stepped in the project after the first release and stayed until the day of the interview. Due to the COVID-19 restrictions, the interviews were conducted and recorded using MS Teams. As the eRouška team is highly skilled in IT, the online meetings represented well their work style and posed no major issues. The interviews were transcribed verbatim, the quotes are adjusted to support the readability of the text.

The interviews were coded and analyzed in MAXQDA. Respecting the ANT approach, inductive coding was used, starting with initial codes which were clustered into categories in the subsequent rounds of coding (Skjott Linneberg & Korsgaard, 2019). These were later organized to represent the progress of the project concerning the openness of the innovation and the crisis.

Findings

eRouška app was a direct response to the novel coronavirus and its mode of proliferation in the population. The idea originated in a group of volunteers called COVID19CZ. This group was initiated by the Czech IT and tech entrepreneurs at the beginning of March 2020 when the first cases of novel coronavirus were confirmed in the Czech Republic.

Accepting the external idea by the public sector

Due to lobbying efforts and the fact that the search for solutions to the COVID-19 crisis was on the daily agenda of media and politicians, the idea-initiators from the volunteer tech-against-coronavirus group COVID19CZ were able to bring this idea up to and accepted by top politicians in the Czech Republic (I1, I5). Especially support from the Prime Minister and Minister of Health Affairs proved to be instrumental to eRouška support by the public sector employees.

> *If people, who were supposed to help us, didn`t act, Prime Minister hurried in and did what they called a "Good morning" visit and made sure people understood how he wants things done. (I2)*

This spotlight was not only instrumental at the beginning of the process but also later when the state support organization NAKIT was taking over the eRouška development (I5). The support weakened when the Minister of Health Affairs was exchanged for a new one, and completely disappeared at the end of 2020, when the first vaccines were approved, and vaccination was newly perceived as they solution to the pandemics (I3, I5).

This pressure, combined with the legislative rules of the State of Emergency, enabled some processes that would usually take months (or longer) to be sped up, such as signing a contract with a company managing the data flow between eRouška and Hygienic Stations (I1, I5).

However, this political support also had its negative side. Some of the Prime Minister`s opponents called the app "the government`s snooping app" (I1, I2, I3) and also as the Hygienic Stations are directed by regional politicians, often affiliated to Parliament opposition parties, this might have acted against eRouška wide acceptance (I2).

In addition, throughout the project development, as the virus spread through the society, it was further uncovering the need for this project for additional public sector groups, such as the hygienists, who were reluctant to trust new technologies at first. It was also instrumental in changing some of the existing procedures and advocating for a broader digitalization of the whole epidemic-tracking system.

> *We faced opinions such as "this must be done by a qualified professional, not a system". Fast forward a couple of months ahead, the epidemic increases 10-fold and suddenly, the change is accepted, because it can`t be done the old way. (I3)*

However, the massive spread of the virus was also playing against eRouška acceptance within the public sector. As both the Ministry of Health Affairs and Hygienic Stations were overwhelmed by attempting to manage the activities in response to the epidemic, their capacity to support this emerging project was diminished. The Hygienic Stations were used to working with pen and paper, and so suddenly using eRouška and Smart Quarantine required a lot of effort from them (I1, I2, I3). Both of those institutions are optimized for other activities than handling a situation of this type and extent and work in a decentralized manner. They were neither able to scale their effort, nor were they willing to let others help (I3, I5).

Stakeholders engagement to develop eRouška

The virus was instrumental to the formation of the COVID19CZ innovation network consisting of volunteers and company representatives. The motivation to join the group was twofold, on one hand, the volunteers were eager to contribute toward the general spirit of solidarity in which

citizens were helping any way they could (sewing masks, preparing refreshments for doctors, shopping for seniors, etc.) (I1, I2, I3, I4, I6), on the other hand, it was also a reaction to fear, a distraction from distressing news (I2, I4).

> *Everybody was sewing masks, but I can`t sew, I can only develop apps,*
> *so I jumped in. I was afraid, but at least I was programming to help. (I4)*

In addition, the emerging virus also created space in volunteers` calendars to join the project – and devote a significant amount of time to the cause, often full days and weekends of work (I1, I2, I3, I4, I6, I8).

> *As the situation graduated in March and events got cancelled, I lost one*
> *work project that keeps me busy. I pondered about what to do with this*
> *tine capacity when the COVID19CZ group started an onboarding*
> *activity for volunteers. (I1)*

In some other cases, volunteers were allowed by their companies out of altruism to work full-time on the eRouška project for a certain amount of time (I6). This way, the virus enabled the volunteers to create a motivated, high-performing team.

The presence of the virus in society opened doors for further cooperation also outside the COVID19CZ group. Radios provided advertising space, agencies created advertising materials for free, an important Czech YouTuber published a video on the importance of eRouška (I1).

> *Whatever you needed, there were people on Slack (author note: a project*
> *management tool used by the COVID19CZ group) who could do it for*
> *you. Whatever you needed, voilá, here it was the next day. (I6)*

Effect of ambitious expectations on quality of eRouška 1.0

Two contributing factors caused that eRouška lost its credit with the public (I1, I2, I3, I4, I5). First was that the politicians presented eRouška as salvation instead of what it is – a complementary technology to a wider set of measures (I3) which increase the expectations. The second contributing factor was that the eRouška team was under a pressure to release the application as soon as possible which negatively influenced the quality of the first release.

First, they knew that to get Czechs to download the app, they need to release it in a timely matter. Second, the media and the politicians were impatiently expecting the app release. By the time of the first release, eRouška was supposed to be running already for two weeks.

> *If we managed to launch eRouška in March, we would have reached a*
> *million downloads in a couple of days. But we launched only during*
> *Easter (author`s note: mid-April). Easter was a mental breaking point*

> *for the society, the state of emergency ended, nobody wanted to think*
> *about the virus anymore. (I1)*

Under the time pressure and without any formal resources provided by the state, the eRouška team didn`t have the capacity for proper stress tests (I4). Once the app was available in Playstore, thousands of people headed to download it, causing technical issues in the registration process.

> *eRouška appeared in Playstore at 9 am and at 10 am it was in all the*
> *news. We soon reached the registration SMS gate limit, also due to some*
> *technical mistakes we did, and the process failed. (I4)*

In addition, the early users complained it drained battery, it wasn`t available on iOS and it required special settings to run on the background of the phone.

Sustaining the project beyond the first release

After the first release, the energy from the team evaporated. It became clear that the volunteer team wasn`t able to sustain the project any further (I1, I4, I5).

Two factors played against the cohesion of the volunteer team. First, after the intensive work they did in the past 6 weeks, their personal and social obligations couldn`t be suspended for much longer (I1, I2, I3, I4, I7). While during the first 6 weeks quarantining one-self was a standard, and thus the volunteers didn`t have to choose between other activities and work on eRouška, after Easter, eRouška had to compete with their returning personal and social obligations. In addition, as eRouška became an object of political disputes and it became clear that there is no wide acceptance among the public sector officials and the public in general to support eRouška, this discouraged the volunteers even further (I1, I2, I5). Last, contracting the virus affected the volunteers and limited their capability to work for the team (I2, I4).

As the energy of the volunteer team was dwindling, eRouška was still a PR flagship of the Smart Quarantine narrative promising there will be no coronavirus-related national lockdowns in the future. The Government was motivated to sustain eRouška. To continue, eRouška needed to be re-build to fit a newly emerged Apple-Google protocol which could remove most of its technical issues described above as well as bring worldwide interoperability to eRouška.

Thus, NAKIT (National Agency for Communication and Information Technologies affiliated under Ministry of Interior) representatives, who were until now only assisting the eRouška team in a few technical matters which needed to be done by the public sector officials with the official stamps and titles, suggested to take over the eRouška team and professionalize it. The majority of the original volunteer team still active by May 2020 was offered an

independent contractor contract that matched their competitive hourly rates. This professionalization and the new Apple-Google protocol provided enough motivation for most of the team to stay.

> *The new Apple-Google protocol convinced me. It was going to be big and worldwide, so I wanted to stay on the team. (I4)*

They were also able to continue working the way they were used to – 100 % online, with periodical stand-up calls, using Slack and Google Meet as primary communication channels (I3, I4, I5, I6, I7). As the team originated mostly as a self-organized entity, the NAKIT project managers didn`t interfere.

> *They are self-starters, they don`t need to be managed. I only supported them in the admin tasks so they can continue working undisturbed. (I7)*

This approach was appreciated by the team and enabled them to continue to work to release eRouška 2.0 on Apple-Google Protocol and add other features, such as the international EFGS protocol in January 2021. As of 26th April 20201, the app was installed by 1,6 million users, reporting almost 340 thousand risk encounters (*eRouška*, 2021).

> *Even if eRouška saved just 30 or 50 lives, it was worth it. (I8)*

Discussion

This study shows that the eRouška project met several parameters of open and collaborative innovation and the influence of the crisis on the project.

Open innovation in public sector

The openness of the project is illustrated by characteristics such as involvement of a large network of external stakeholders, seeking acceptance by the Government, and assistance from the public sector employees. The project also aimed at altering public sector processes from outside, thus mixing internal and external approaches. eRouška 2.0 also utilized external technology of Apple-Google protocol and it was published as an open-source app. All of these principles are in agreement with OI principles (Chesbrough, 2003).

However, contrary to the definition of OI by Chesbrough and Bogers (2014) and typology by Mu & Wang (2020), the project wasn`t at first purposively managed by any of the public sector organizations. It was managed by the innovation network leaders and volunteers. Only after the first release, NAKIT took a lead to professionalize the team and develop eRouška 2.0. It confirms Torfing`s (2019) assumption that since the public sector provides public value to the external stakeholders such as citizens, companies, NGOs, etc., these external stakeholders are motivated to contribute more to PSI than to private sector innovation from which it is the

private company who benefits the innovation. This paper, therefore, contributes to the PSI research by extending the discussion also to projects initiated outside of the public sector organizations.

This study also suggests expanding the view on barriers to open innovation in the public sector. First, a new category of challenges should be considered when dealing with OI in the public sector – personal barriers. These concern personal obligations and priorities of actors involved, as well as their political affiliation or assumption on the efficiency of public sector governance. In this case, the virus cut the private contacts, locked families at home, and stopped many work projects, thus enabling the volunteers to join the team. Yet, this was a unique situation, and the personal barriers should be considered by both theoreticians and practitioners of open innovation. While the sample here is limited, the importance of this finding is accentuated by the fact that it was men, women, with and without children, single, and couples who mentioned the role of the personal barriers in their involvement in the project.

Second, concerning organization barriers (Cinar et al., 2019), they should be considered separately for the external and internal teams. For example, in this project, while the activity of the internal teams was mostly paralyzed by the crisis, confirming that the public sector is unable to react timely to turbulent problems (Ansell et al., 2020), the activity of the external team was facilitated by the crisis. This might suggest that openness has a positive impact on the dynamic capability and resilience of companies (Ahn et al., 2018) and also of the public sector.

Role of the crisis

Torfing (2019) assumed that the urgency of the crisis would help innovation succeed. This article shows that the urgency of the crisis had both positive and negative effects on eRouška. For the overview, see Table 1: Overview of the effect of the crisis on the eRouška project.

At first, without the crisis represented by the pandemics, there would be no sufficient ground to develop the app. Second, the urgency of the situation as represented by the media in March 2020, helped the formation of the team of volunteers as well as the supportive network of other external contributors. It also positively influenced the acceptance of the idea by the politicians pressed to find solutions to the crisis. Additionally, as the COVID-19 spread through the population, it helped challenge existing procedures and ensure some buy-in from the hygienists.

Contrary to Torfing`s (2019) assumption, the urgency of the situation also complicated the progress of the eRouška project. The extensive pressure combined with the limited resources of the OI network behind eRouška resulted in launching a technically immature and improperly tested app. This led to the loss of trust in the eRouška app. The urgency of the crisis negatively

impacted also the hygienists and Ministry of Health Affairs workers` capacity to adopt or support the eRouška. Work overload and the public scrutiny of their every move made them less open and capable to accept the new solution. Overall, this evidence challenges the assumption that a sense of urgency has a positive impact on the success of the innovation.

The study also shows that there was a variability of the effect of the crisis on the eRouška project in time. At first, the crisis acted as a unifier, activator, an enemy that the citizens, private and public sector unite to combat. Yet, as time passed, this effect disappeared. Interestingly enough, this variability doesn`t seem to correspond to the media attention, the number of infected or deceased, the used capacity of hospitals, or any other factor.

To summarize, the crisis supports ideation and idea acceptance, it also helps to kick off the development process by activating a wide range of stakeholders willing to contribute and to overcome some of the bureaucratic hurdles. Yet, the crisis hinders the quality of the output and the capacity of some of the key stakeholders to adopt and use the innovation. In addition, the effect of the crisis is not constant, and it has a time-limited effect.

Tab 1: Overview of the effect of crisis on eRouška project

eRouška development progress	Impact of crisis	Overall impact of crisis
Idea development and acceptance	+ new challenges to PS officials + state of emergency limiting bureaucratic barriers + politicians receptive - PS officials having no capacity	Positive ++
Development	+ removal of personal barriers + unity against the virus	Positive ++
Quality at launch	- pressure on early release - "noisy" launch - high expectations	Strongly negative - - -
Sustainability of the project	+ continuous political support - personal barriers re-emerging	Neutral 0

Source: author

Actor-Network theory approach

This research used ANT as an exploratory framework to study an open innovation project in the public sector in a crisis. ANT proved instrumental in the analysis of the eRouška case. It facilitated assigning the agency to several non-human actors (Law, 2009) – the virus that provided space and motivation for the project, the failing technology that harmed the trust in the project or the Apple-Google protocol that gave eRouška a second chance. The notion of network instability and constant renegotiations happening between the actors (Callon, 1984).

Tracing the translation process throughout the time uncovered the variability of the virus impact on the progress of eRouška project.

Conclusion

This study is among the first ones to empirically explore the effect of the crisis on an open innovation project. It suggests that the crisis can have both positive and negative effects on innovation progress and that this effect is variable in time. The study also suggests a broader look at open innovation in the public sector, one that is including projects not initiated by a public sector institution. It expands the view on open innovation barriers by describing personal barriers to innovation. It confirms the usefulness of the ANT approach to studying technological open innovation projects in the public sector. It also contributes to the open innovation research in the public sector by studying a multi-actor network project.

There is a limited possibility to generalize the findings from this single case study. Yet, the conclusions presented here should inform future research of open innovation in the public sector in crisis. For example, research designed to link the variability of the crisis impact to tangible crisis measures would be beneficial for both theorists and practitioners within PSI. The fact that similar contact-tracing apps were developed throughout the world using different approaches to innovation calls for comparative case study design. Controlling for the innovation need and content, researchers could compare development approaches between countries and also innovation outcomes. Another limitation present in this study is retrospective bias. Expanding the studied data with media coverage analysis and team communication notes might provide a more objective picture.

Acknowledgment

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