The impact of Industry 4.0 on the processes of social innovation

SANDOR KARAJZ, Ph.D.
Associate Professor
UNIVERSITY OF MISKOLC
e-mail: karajz.sandor@uni-miskolc.hu

SUMMARY

Our previous research into this topic has proved that technical developments significantly affect processes and effectiveness of social innovation. The current process of this development is called Industry 4.0. The first part of the study deals with industrial evolutions and the process of Industry 4.0 is interpreted. The second part of the study presents national and international examples and good practices in order to examine the relationship between digitalisation and social innovation. The results of Industry 4.0 reveal that there is an increasing number of solutions for social innovation that are based on digitalisation and automation. The current digital revolution is radically changing societies and opening up new opportunities for social innovation. Industry 4.0 results in social innovation solutions that use artificial intelligence to improve and optimise processes.

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INTRODUCTION

Digitalisation is the greatest achievement of Industry 4.0. Since it is a global process, having a better understanding of international experiences and best practices contributes to more accurate and more detailed impact and relationship analysis. As digitalisation grows in space, the role it can play in social innovation processes becomes increasingly important. In the 21st century, the concepts of digitalisation, competitiveness and innovation are closely interrelated, influencing and stimulating processes. We can reasonably assume a causalrelationship between digitalisation and the effectiveness of social innovation. These relationships show the role that digitalisation must play in successful social innovation and the directions of social and economic development needed for success.

Industry 4.0 is increasingly intertwined with information technology and automation and is resulting in fundamental change in production methods. The emergence of a new technical environment will create new social challenges that will trigger the renewal of social innovation processes. Learning international experiences and best practices from other countries can help model social innovation more effectively. This study looked for best practices that investigate social innovation from the perspective of digital transformation and development. These international examples can be utilised in domestic practices. This study presents the factors in digitally-aided social innovation processes that increase efficiency compared to conventional social innovation. The analysis of digital social innovations in international practice helps us make comparisons and determine efficiency and success factors. Digital social innovations highlight the potential of digital technologies to identify social needs and to solve social problems effectively. This study extends the conventional social innovation model with aspects of digitalisation. They contribute to a better understanding of modern social innovation processes by applying a new operational mechanism.

INDUSTRY 4.0 AND DIGITALISATION

Describing Industry 4.0

One of the important tasks of industrial production is to improve the quality of life in society. In doing this, industrial production attempts to meet social expectations, which results in continuous development and industrial evolutions in the event of major technological changes. All industrial revolutions defined so far aimed to meet consumer demand for a higher quality with the new technologies available. Industrial revolutions are processes that change the tools

available to people in order to make their daily lives easier and open the way to more complete control over human's physical environment.

Considering the current global economic and social changes, the claim that we are living in the days of the Fourth Industrial Revolution is difficult to question. The term Fourth Industrial Revolution and Industry 4.0 is used in different ways in professional terminology (Nagy 2019). There are some people who mean the same process while others differentiate between the two terms in various aspects aspects. This study adopts the second standpoint and differentiates between the two terms. However, it is important to maintain the idea that Industry 4.0 is a result of the Fourth Industrial Revolution.

Industry 4.0 is a concept that attempts to respond to emerging technical and economic challenges by basically digitising industrial – and expending default – economic and social processes. The German government was the first to use the term Industry 4.0 in 2011, when it announced its industrial development program for 2020 (Zhou et al. 2015). Industry 4.0 is not just about upgrading technology but also about business.

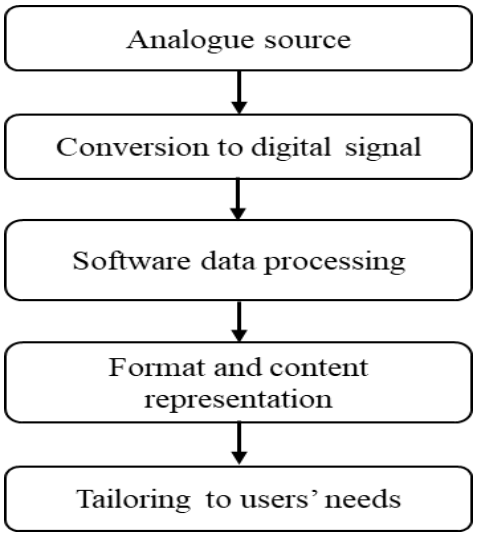
Industrial robots and automation processes appear in the second half of the twenties century, but the Internet appeared later, which created the possibility of networking. It is considered that Industry 4.0 is based on digitalisation and data. The computer is just a tool that carries out the digitisation process. The Internet and technological advances are creating a constantly connected network of people, machines and companies. By continuously sharing data from value creation processes, a fully customised product can be produced.

The concept and processes of digitisation und digitalisation

We need to distinguish between the concepts of digitization and digitalization. Digitisation is the conversion of changing the analogue to the digital. Digitalisation is how this new digital world will impact people and work.

A digitization process can be formulated very simply, since it is a process of converting analogue signals to digital signals. Figure 1 shows this process. After the conversion process, the data are tailored to users' needs. The digitisation process is performed in three steps: Conversion, software processing and form and content exploration. The achievements of digital technologies are seen as natural in our day-to-day life. GPS maps are used for orientation and navigation. Digital media is used for various purposes. Tickets and products are bought online. Digital photos are looked at on mobile phones. These and thousands of other activities could not be carried out without digitalisation.

ince the toolkit for digitisation opportunities is constantly evolving, the interpretation of digitisation is also constantly evolving. Digitisation today means something completely different than several years ago. Nowadays it has a more complex interpretation. In many cases, processes previously understood as digitisation are already considered as a basic skill. Thus, digitisation is considered an appropriate term only for more complex operations. Figure 2 presents elements of a complex interpretation of digitisation, which can already be called digitalisation. Even if a detailed analysis is not performed and only the elements are considered, the complexity of digitalisation can be observed. Digitalisation is present in every area of life. It means online presence, data and information exchange between device and person (Kollár & Poór, 2016).



Source: author's work

Figure 1. Conventional digitisation process

The socio-economic importance of digitalisation is enormous. It is one of the pillars of Industry 4.0, the Fourth Industrial Revolution and affects all areas of life. It helps and accelerates our daily lives, relationships and work. Also, it promotes and stimulates learning and entertainment and contributes to the quality of life. In addition, it fosters autonomy and innovation and transforms them in order to achieve growth (Siemens, 2018).

In 2016 and 2018 Siemens surveyed the digitalisation of the corporate sector. A digitalisation index was created, which is an aggregated index in the following categories:

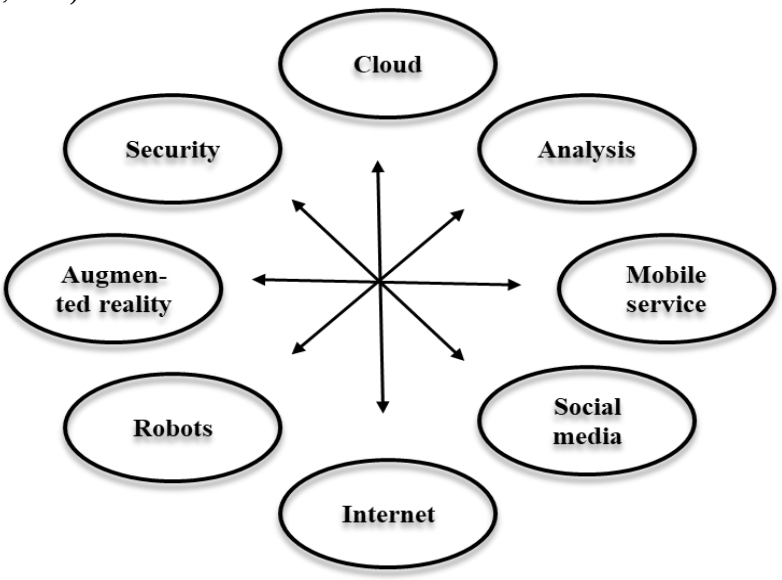
- Importance of digitalisation within the company,
- current level of digitalisation,
- the preparedness of the company for innovation,
- digitalisation plans and opportunities.

ompanies graded factors on a scale within a 1-5 range. The digitalisation index of companies was 3.5 in both 2016 and 2018, which did not seem to indicate any shift. In 2018 small companies were also surveyed. Their index was lower (3.2) than the average, which indicated that if small companies had been included in the survey in 2016, the aggregated index value would have been lower. It can be assumed that the digitalisation level actually increased during the two years. In 2018

the index of medium-sized companies amounted to 3.5 and the large company index increased to 3.7. (Siemens, 2018).

Companies considered the conditions for digitalisation as having improved in 2018. Fewer factors hindering the implementation of digitalisation were revealed. As for a corporate approach, small companies considered smaller IT investments as a digital improvement, whereas large companies regarded more complex and large-scale investments as a digital improvement. (Siemens, 2018).

Although the Siemens survey sampled different companies, its methodology can be adopted to investigate digitalisation of social innovation. The four categories (importance, level of digitalisation, preparedness for innovation and digital plans for the future) are essential conditions for providing effective and efficient digital solutions for innovative resolutions of societal constraints.



Source: Kollár & Poór (2016)

Figure 2. Complex interpretation of digitalisation

CHARACTERISATION OF SOCIAL INNOVATION

The definition and process of social innovation

Over the past decade, the academic literature on social innovation has significantly increased. The issue of innovation as a means to solve current complex societal challenges has received considerable attention from both governance and politics. The first debates on social innovation are closely linked with Moulaert et al., who attempted to provide a summary of the available literature on social innovation (van der Have & Rubalcaba, 2016). However, it is important to note that social innovation is not a completely novel concept. As Drucker noted, the notion of social innovation goes back almost two hundred years. Likewise, Godin claimed that social innovation began to be used as an independent concept only in the 21st century (Edwards-Schachter & Wallace, 2017). Contemporary sociologists consider social innovation to be a way of creating and implementing social change (van der Have & Rubalcaba, 2016).

Three interacting dimensions of social innovations are identified (Moulaert et. al, 2005):

1. unsatisfied social needs
2. changes in social relations
3. improvement of socio-political capabilities and access routes to resources.

The above dimensions are reflected in the following definition: social innovation can be seen as a new approach, attitude, paradigm, product, procedural process and practice that provide solutions to societal problems and needs while new values, attitudes, societal relationships or, perhaps, new structures start emerging (Nemes & Varga, 2015, p. 434).

The sociological approach needs to be distinguished from the economic approach since the former focuses on societal practices and the latter is an outcome-oriented approach focusing predominantly on societal impacts in line with practices of international organisations. An economic approach is presented in the definition provided by Pol and Ville. They noted that social innovation is different from business innovations, which are generally motivated by profit maximisation and neglect social impacts (Pol & Ville, 2009). In the Hungarian literature, Kocziszky et al. offer another definition. According to them, social innovation provides new or novel responses to problems of a community with the aim of increasing community prosperity (Kocziszky et al., 2017, p. 16).

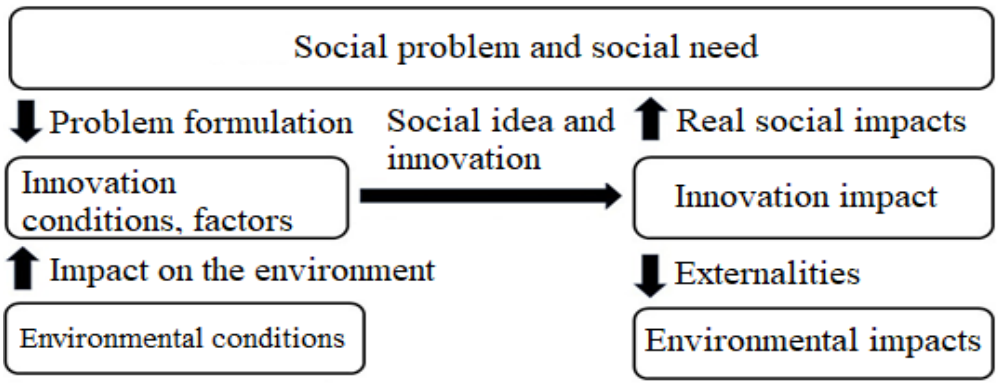
The European Committee uses the definition of social innovation provided by Caulier-Grice et al. according to which "social innovations [are] new ideas (products, services and models) that simultaneously meet social needs (more effectively than alternatives) and create new social relationships or collaborations" (Caulier-Grice et al., 2012, p. 18).

Considering the definitions mentioned above, this research defines social innovation as a non-profit activity aimed at a novel and innovative solution to a social problem. Social innovation is considered to be a non-profit activity because primarily actors of the non-profit sector are involved in its implementation, novelties are in line with social goals, and therefore, non-business interests prevail in the processes. During social innovation, innovations are implemented that are primarily aimed at changing social norms, values, and relationships.

The process of social innovation has received considerable attention in the academic literature (Mulgan et al. 2007; Nicholls et al. 2015; Schmitz 2016; van der Have & Rubalcaba 2016). Figure 1 presents a selected model in detail. In this social innovation model, a societal constraint or/and a need generates social innovation. However, it is impossible to start social innovation without clearly identifying the social problems to be addressed. The innovation process starts only when prerequisites for innovation (innovators, appropriate social drive and organisational conditions) are met. The next step involves implementing social innovation, which results in measurable social inputs, outputs and impacts and is embodied in real, concrete societal impacts. Environmental (community, political, institutional and supporters') conditions have a considerable impact on prerequisites and capabilities of innovation. However, the reverse is also true, since social innovation also influences the environment externally (positively or negatively).

Indicators of social innovation

In the social innovation model, input and process indicators on the innovation factor side and the output, result and impact indicators on the innovation impact side can be linked to processes, which allows us to perform quantitative impact analyses by defining and quantifying indicators.



Source: author's based on Schmitz (2016)

Figure 3. Process of social innovation

Levels of social innovation

The primary aim of technical innovation is profit maximisation without considering societal impacts. According to Pol and Ville, an innovation is termed a social innovation if the implied new idea has the potential to improve either the quality or the quantity of life (Pol-Ville 2009). Thus, social innovation is a non-profit activity that aims to provide innovative and novel solutions for community problems.

Similar to economic innovation, social innovation can happen at different levels (micro or organisational, meso or regional, and macro or national levels). From the micro-level perspective, social innovation is built bottom-up by civil organisations and non-profit businesses to address social demands and needs in a novel approach. The objective of bottom-up organisational processes – similar to those built from other levels – is to meet community needs and solve local problems. An effective implementation of social innovation requires an innovation-friendly micro-environment.

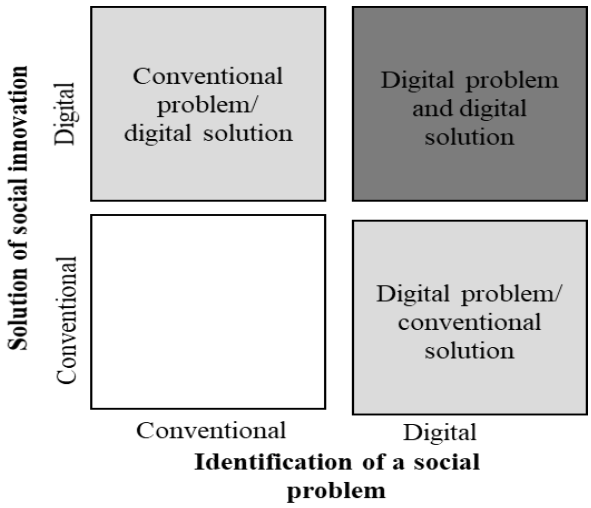
At the meso level, regional institutional systems and regional societal challenges are the focused. Social innovation plays a crucial role in managing economic and societal handicaps resulting from regional disparities and in creating catch-up opportunities. The evolution of processes over time and space also plays an essential role in social innovation. The role of novel ideas and solutions is of great importance in peripheral regions because the solutions of societal constraints in these regions require a completely novel approach. Since the innovation potential in peripheral regions is

low, innovation has a different character. Thus, fostering of innovation requires different tools than in developed regions and has different impacts on competitiveness. In macro-level social innovation, government measures trigger innovation.

DIGITALISATION AND SOCIAL INNOVATION

Social innovation means development and application of new ideas (products, services or models) that meet social needs, create social relationships and form new collaborations (European Commission, 2013, p. 6). If it is assumed that the primarily aim of problem solving is not profit generation, but rather improving social well-being, then "Social innovation is a non-profit activity that aims at providing novel and innovative solutions to social problems." (Karajz & Kis-Orloczki, 2019, p. 2)

Over the past few years digital transformation – in addition to profit-oriented activities – has significantly affected social and non-profit areas. Digitalisation – apart from providing a better information flow between social actors and networking – provides opportunities to develop new social products and services. Digitally aided social innovation or digital social innovation (DSI) is a new process that uses digital technology to address social challenges.



Source: Geser (2017)

Figure 4. Typology of social innovation from a digital aspect

Figure 4 presents Geser's typology (2017) based on two factors from digitalisation aspects. Digital technologies can be used to identify, understand and provide solutions to a problem. Thus, four types can be distinguished. The blank square represents conventional social innovation. If digital technologies are used in the process of problem identification and/or problem solution, we can speak about digital social innovation. It is obvious that in the broader sense, the identification of a social problem is also an element of the problem-solving process.

DIGITAL SOLUTIONS IN SOCIAL INNOVATION – INTERNATIONAL PRACTICES

It is observed that digitalisation provides innovative ways to identify social innovations and find solutions to them. However, the effective application of digital methods is impossible without social reforms, active engagement and participation of social actors. The scepticism of citizens about technological innovation often hinders the spread of new technologies. Thus, it is essential to persuade citizens of the favourable effects of innovative technologies. The huge amount of data (Big Data) that is available to people and organisations is a source of a major concern and fear. However, this Big Data enables accurate collection and relevant analysis of social needs in order to increase social well-being.

The international literature about digital social innovation offers plenty of examples of successful implementation of digital technologies and its positive effects. The aim of this paper is to present some effective practices as new opportunities for solving social problems by using digitalisation.

Decidim

Decidim is a free open-source software that enables stakeholders to participate actively in the governance and decision-making of cities and organisations. It is therefore also called the 'e-democracy platform', which helps to strengthen civic participation. The system was developed in Barcelona and is now used by dozens of cities (Helsinki, Loiret, Nancy, Merida, Tuusula, etc). It is suitable for strategic planning, participatory processes, convening meetings, assemblies, launching citizens' initiatives or submitting a participatory budget. It enables users to prepare, shape and accept local decisions over the Internet. Not only municipalities, but also civil organisations, public or private institutions or other communities can benefit from it because they can make their decisions in a transparent manner with the fullest possible knowledge of the related information and in the most democratic manner possible. (https://www.edemokracia.hu/?module=news&action=show&nid=246046#MIDDLE)

With the help of Decidim, a strategic plan was drawn up in Barcelona in 2016 in cooperation with the city citizens. Elements of the strategic plan were embodied in an operational action plan containing 7,000 citizens' roposals.

One of the major benefits of the platform is its traceability, with members being able to monitor the status of implementation of approved proposals at any time (https://decidim.org/).

Considering its structure, it consists of so-called attendance spaces, which are as follows:

- participatory processes that are capable of creating (de)activating processes;
- meetings where the composition, place and time of the decision-making bodies can be known and the participation is ensured;
- consultations that allow discussions to be launched and the results of votes to be reported;
- initiatives that can be used to generate initiatives.

In Hungary, the eDemocracy Workshop Association has introduced two social and administrative innovations to Hungary in the framework of its 'Strengthening Local Government Integrity' project, based on the practices of Barcelona and Helsinki. They are intended to (http://www.urbact.hu/node/451/):

- strengthen and extend the democratic functioning of municipalities,
- enable broad civic participation,
- socialize the preparation of local decision on the internet,
- conduct effective, transparent online consultations, thereby enhance the transparency of democratic functioning and the meaningful participation of citizens.

Sharing cities network

The sharing cities network was established in North America, but several European cities (Amsterdam, Athens, Vienna, Gothenburg, Lisbon, Naples, etc.) have joined the movement. In Vancouver, Canada's most active city, residents share their cars, tools, or even their gardens. Also, they offer their empty driveways and homes. This 'way of life' will not work without changing people's perceptions. (http://karbonkalkulator.hu/hir/megosztas-es-kozos-hasznalat-forradalma-zajlik)

Societies today are based on private property whereas a 'shared lifestyle' is based on the shared use of goods and assets. Consequently, the attitudes of society members need to be adjusted to these changes. This behaviour results in better and more intensive use of resources. Also, it can be an effective tool for global climate protection, which is the greatest challenge of our time. Sharing should not be only seen as a renunciation of private property, but as a new source of revenue by sharing unused resources. Social change is based on trust and a sense of responsibility, namely on trust in the others the things are shared with and a sense of responsibility for what is shared. If these behaviours are not properly integrated into the values of societies, various control tools (fines, exclusion from common use, etc.) are needed to operate the system.

Plum Labs

Plum Lab start-up has developed several tools and applications that are used to measure and share air pollution data for a specific area. The mobile application is called Flow, a personal air quality tracker which allows monitoring air pollution data measured by other users. Plume Labs collaborated in another project and launched the Pigeon Air Patrol. Pigeons were fitted with sensors that measured air quality in different boroughs across London. The data are shared on the Internet and the residents can track their exposure to air pollution. Five air categories are distinguished: fresh, average, poor, very poor, and dire. (https://plumelabs.com/en/)

One Farm

The One Farm project was started in the Netherlands targeting sustainable crop production. Its goal was to provide affordable and fresh food by launching new and innovative crop production technology. It is estimated that by 2050 the world population will have increased by over 2.8 billion people and close to 70% of the world's population will live in cities. A 50% increase in agro-industrial activity is needed to meet growing needs, whereas the useful area of arable land is diminishing rapidly across the globe due to environmental pollution. The main idea of the project is vertical farming, which has the potential for crop production since it can be operated not only by one person, but also by a local community (https://www.onefarm.io/).

Airlabs

Airlabs, a start-up company in London, developed a bench (Clean Air Bench) which creates clean air zones. Clean air is dispensed from under the armrests and other grilles in a semicircular structure where a filter system was installed. The system filters the air, traps pollutants and at the same time cleans the air around the bench (https://hu.euronews.com/2017/02/22/levegot-startupok-a-varoslakokert/).

FabCity

The FabCity initiative was launched in 2014 when the then mayor of Barcelona called upon the cities to produce everything they consume by 2054 and become self-sufficient. As many as 34 cities responded to the call in 2019. This initiative can be successful only if the network is operated, the knowledge and the technology is shared by the cities joining the project (https://fab.city/).

Digi.me

Digi.me was founded in 2009. It developed an application that ensures data protection in cases when personal data is used in applications and services since the control over data remains in the owner's hands. No one can see the imported data since they can be shared only with the owner's consent (https://digi.me/what-is-digime/).

CONCLUSIONS

Elements of new technology in Industry 4.0 – primarily digital technologies and Big Data – have opened up new perspectives in every field of life. The development of computers and network technologies has made it possible for people at different levels of society to interact. Also, since socio-economic processes and data are shared, an efficient and competitive system has been established where there is an opportunity to optimally meet the needs. Digital technology has appeared even in technological and social innovation. After investigating the process of social innovation it can be claimed that digital technologies can be relied on when the problem is identified, delimited and solved. Thus, if digital technologies are used for identification and/or a solution, this means digital social innovation.

Although there are still few good examples of digital social innovation in Hungary, there are many good practices in the international arena. Since independent problem solving skills and role-taking activities are poor in Hungary, the spread of digital technologies is slow in social innovation. The transformation of Hungarian society is likely to be slower than in more developed countries.

The international examples presented also demonstrate that the use of digital technology significantly changes social perceptions and values. However, a change in the value system is also a prerequisite for effective execution. New technology is used primarily to solve and address more democratic governance and sustainability issues in social innovation.

First reading the presented examples may seem to be e digital techniques that help solve social problems. However, the opportunity offered by digital technology is changing the mindset of those involved, their attitude to the problem, and is making them feel that they can actually and effectively do something to solve the problem. In the case of Decidim, digital technology has multiplied the number of people who make significant contributions and participate in strategy formulation and urban governance. (https://decidim.org/) The other examples presented were for solving other types of social problems. The “sharing city network” provides an alternative way to use resources efficiently by applying the sharing method. There are several solutions (Plume Labs, OneFarm, Airlabs, FabCity) that deal with the efficient use of environmental factors (air, farmland) and provide an answer to the problem of sustainability. There is also an application (Digi.me) that solves an important problem of today’s privacy. The presented examples come from different areas, thus, the solutions are also different. What is common in them is that stakeholders are actively involved in solving problems. This initiates self-impulsive processes during which people’s social sensitivity increases, thus providing an opportunity for the social system to develop in the right direction.

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FREE OPEN-SOURCE PARTICIPATORY DEMOCRACY FOR CITIES AND ORGANIZATIONS
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