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PRACTICES OF THE CIRCULAR ECONOMY IN *COMMUNITY SOURCE* PROJECTS: A PRELIMINARY STUDY

PRAKTYKI W ZAKRESIE GOSPODARKI O OBIEGU ZAMKNIĘTYM W PROJEKTACH *COMMUNITY SOURCE*: BADANIE WSTĘPNE

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Abstract: Nowadays, the 'Circular Economy' (CE) is a modern topic that benefits business, society, and the environment. So far, the application of the CE has been restricted to certain areas that do not include the field of Information System development. From this point of view, the 'community source' model can be considered as an area to investigate the practices of the CE in Information System development. The community source model is a new model in software development that is intermediate between two well-known models (closed and open source systems). The practices of the CE found in projects that follow the community source model is then a potential area of scientific interest. A project was launched to comprehensively analyse this phenomenon. This paper presents the results of the preliminary study to initially explore the CE practices in community source projects. During the fieldwork, community source projects in EU countries were surveyed. The preliminary study concluded that practices such as recycling and resource-sharing are those that can arguably be found in these projects. As a term, a new kind of material has emerged, 'soft material' along with the typical kinds of material previously identified in the CE, namely biological and technical materials. The paper also briefly discusses the strategy of circular community in dealing with e-waste management.

Keywords: circular economy, soft materials, community source, collaboratively-developed information system, CD-ERP model, strategy of circular community, three-level closed cycle.

Streszczenie: *Community Source* to nowoczesny temat, który przynosi korzyści biznesowi, społeczeństwu i środowisku. Do tej pory stosowanie CE było ograniczone do pewnych ob-

szarów, które nie obejmują dziedziny rozwoju systemów informatycznych. Z tego punktu widzenia model *Community Source* można uznać za obszar do badania praktyk CE w rozwoju systemów informatycznych. CE to nowy model w rozwoju oprogramowania, który jest pośrednikiem między dwoma dobrze znanymi modelami (systemy zamknięte i otwarte). Potencjalnym obszarem zainteresowań naukowych są praktyki CE występujące w projektach wykorzystujących model *Community Source*. Uruchomiono projekt kompleksowej analizy tego zjawiska. W artykule przedstawiono wyniki wstępnych badań, których celem było zbadanie praktyk CE w projektach *Community Source*. Podczas prac terenowych przebadano projekty wykorzystujące model CE w krajach UE. Wstępne badanie wykazało, że praktyki, takie jak recykling i dzielenie się zasobami, prawdopodobnie można znaleźć w tych projektach. Pojawił się nowy rodzaj materiału – „miękki materiał", wraz z popularnymi typami materiałów wcześniej zidentyfikowanymi w CE, a mianowicie „biologicznymi" i „technicznymi". W artykule omówiono również wstępnie strategię *Circular Community* w zakresie postępowania z e-odpadami.

Słowa kluczowe: gospodarka o obiegu zamkniętym, materiały miękkie, źródła społecznościowe, wspólnie opracowany system informacyjny, model CD-ERP, strategia *Circular Community*.

1. Introduction

The field of Information System (IS) has already become a major functional area of business (Anandkumar, 2017). Currently, ISs are found everywhere aiding information creation and sharing within organizations (Rainer & Cegielski, 2011). Indeed, IS plays a vital role in e-business and e-commerce operations, enterprise collaboration and management, as well as in strategic success of businesses, which are crucial in today's global environment (Anandkumar, 2017). Information Technology (IT) architecture and infrastructure provide the basis for all ISs in an organization (Rainer & Cegielski, 2011). James and Marakas described IT as a very basic and crucial ingredient for any business to succeed in today's dynamic global environment (O'Brien & Marakas, 2011).

Issues of IS development play a central role in this field. It has certainly been prescribed in the journey towards successful ISs. There are numerous views on IS development, as the development itself involves various risks and uncertainties (Rocha et al., 2011). It is argued that successful IS development is most likely to be achieved by the adoption of a formalized system of development methodologies. However, the implementation of methodologies in practice has been rejected. There are possible reasons behind such rejection, including: following methodologies has resulted in low productivity, methodologies often lack contingency/emergency plans, methodologies have in many cases turned out to be too inflexible to allow requirements to be changed and inappropriate for solving given issues in a particular situation. Only a few methodologies critically address important social, political and organizational dimensions of development; methodologies remain influential and new ones are also being designed (Stolterman, Fitzgard, & Russo, 1996). Galviņa

and Šmite's findings showed that there is no universal development methodology appropriate for all projects and organizations. Each organization has to choose the most appropriate one for their situation (Galviņa & Šmite, 2011).

Currently, organizations find themselves in a rapidly and intensively changing environment, which leads them to a crossroads situation: *Should they buy commercial ISs or develop in-house apps?* The former may be hard to customize based on the organization's specific desires, while the latter are often too ambitious, and many organizations find it impractical to acquire the necessary competence for developing software themselves (Liu, Sean, & Tu, 2015). The community source approach provides a practical alternative to these solutions by combining effectively the benefits of in-house development and outsourcing. This approach aims to pool organizational resources to develop open source apps, which dramatically reduces the development costs in organizations (Liu & Qiang, 2011).

'Community source' is also described as 'community-based open source'. It was first proposed by Wheeler and defined as an open-source project that is governed by a group of educational institutions or even firms (Wheeler & Hilton, 2012). Using the community source approach, a consortium of partners share their financial efforts and human resources to complete a project managed through a standard model of consortium governance (Hanganu, 2008). In particular, community source is a new model in software development that is intermediate between two well-known models (closed and open source systems). It is an open-source system that is developed collaboratively (either in its entirety for all beneficiaries or with some functions limited to a pre-defined group). Although it may occur that the developed system is introduced as an open-source system for any beneficiary who is willing to benefit from the system, the difference is that both the administration and the development costs are shared among the beneficiaries. Administration and the sharing of costs are determined in the form of levels, where rights and duties are defined. E-municipality management systems and university management systems are examples of this type of system.

The community source as a term was first widely used in higher education (HE). HE is a sector based on knowledge-sharing and collaborative development described as the perfect fit for HE. Indeed, a model based on the community source model can be viewed as a means of knowledge-sharing, alongside other means of sharing, such as sharing costs and human resources (Liu, Hansen, & Tu, 2014; Liu, Sean, & Tu, 2015). Consortiums of universities have existed for a long time in the HE sector, such as the CINECA project in Italy which dates back to 1969 (Vertiv, 2018), while the community source paradigm itself was first applied and officially introduced by the KUALI and SAKAI projects in the United States (Alves, Miranda, Morais, & Alves, 2012; Ignjatovic & Jovanovic, 2013; Liu, Sean, & Tu, 2015). Other similar projects have been deployed in a variety of universities worldwide including the USOS project and MUCI consortium in Poland. Furthermore, Sakai and Kuali reported a large number of implementations, both locally in the US and internationally.

Many institutes have asked to join these two projects, which indicates that the Kuali and Sakai projects are based on a successful model. It shows the success of the collaborative approach in general (Wheeler & Hilton, 2012).

The author has worked on a similar project conducted in the Libyan context. A model based on the community source paradigm has been developed, namely: the Collaboratively-Developed Enterprise Resource Planning (CD-ERP) Model. Due to the unique characteristics of Libyan higher education which lacks reliable systems to use as a base, ERP has been added to the model to avoid building the system from scratch. During the study, the author also discovered that it is advised by some similar international projects to start with an existing code for early gains and to avoid negotiations over the basic components of the system. For more information please refer to (Almigheerbi, Ramsey, & Lamek, 2019, 2020).

Nowadays the principle of the circular economy (CE) is a trend in which products and materials are kept in continuous use to avoid creating waste, which should regenerate natural systems. In other words, materials are being recovered from old products and re-used as inputs for production for as long as possible (Fogarassy & Finger, 2020) (EIB, 2020). Possibly, a question that could have arisen by now is what links the community source model to the CE. If one looks at the basic concepts of the CE, they can also be observed in the community source projects such as resource-sharing and code-recycling. The following sections in this paper present and explain this relation.

2. Research issue

The literature indicates many studies that dealt with the CE, but it has barely touched the surface. There is a lack of models that would allow for assessing the long-term consequences of the CE in general. This has led to a failure to study the possibility of separating economic activity from the energy and materials used. In particular, the practice of the CE has hardly been considered in the domain of IS (to the best of the author's knowledge). Limited practices (e.g. recycling) are already being supported within the IT sector to reduce the amount of e-waste and extend the life of materials. This should enhance generating growth and employment. Likewise, the infrastructures and platforms are provided to support CE practices, especially those emerging in the retail and service sectors (like eBay, Allegro, etc.).

Attention has been given to a type of CE practice that is found almost everywhere. The IS development itself can, however, be a potential area where the CE practices could be found. One of the approaches to IS development is the community source model (collaborative model). In community source projects, recycling and sharing are essential aspects. Hence, the author attempted to explore this new topic and tried to relate the practices found in community source projects to the concepts of the CE. The practices of the CE in community source projects are of great importance

as a research question. This paper is a preliminary study to find an answer, as more investigations will be carried out at later stages during the overall study.

3. The methodology

Methodology, as defined by (Dawson, 2002), is the philosophy or the general principle that guides researchers in their studies. The field of ISs, by its nature, is intrinsically located within the realm of both the social sciences and the technical sciences. Thus the scientific paradigm adopted by the natural sciences is appropriate to study ISs, whereas Holl and Fachhochschule described ISs as a prolific area for applying epistemology – the theory of knowledge (Fachhochschule, 2019). In this preliminary study, epistemology is used together with an emphasis on the positivist and interpretive approaches. The author used the qualitative methods within a positivist paradigm by conducting comparative case studies from EU countries (projects that follow the community source model) under the assumption that these cases might differ, and taking into consideration the observations from the literature.
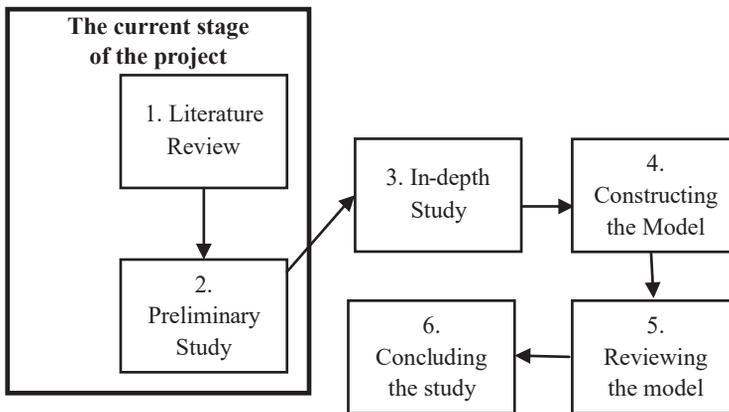
Fig. 1. The master plan of the research project

Source: authors' own work.

  This paper presents the results of the preliminary study of the ongoing project (*Stage 1 and 2, as illustrated in Figure 1*). The ongoing research deals with the technological, managerial, and economic features of the community resource projects in EU countries. The current stage (the preliminary study) was investigated during the period from January to October 2020. It consisted of personal interviews with the leader of the USOS project in Poland in January 2020. The author continued to discuss further issues through emails with the project leader of USOS, as well as through a documentary review. More cases were also surveyed, including: the CINECA project – Italy, the Sigma Suite and the CRIS Argos Suite – Spain, the

FS university consortium – Norway, the Oodi project – Finland, HISinOne Project – Germany, AMUE Consortium – France, and the LADOK project – Sweden. Moreover, the author was in contact with the aforementioned projects through emails in which they answered questions related to their projects. The documents provided by these projects were also considered.

The methodology used can be summarized as follows: (1) the author started by conducting a literature review; (2) through the literature review, the author was able to list possible CE practices; (3) the list was used to develop the interview questions for the preliminary study; (4) the participants were interviewed to verify the existence of CE practices in the community source projects under study; (5) in-depth analysis was carried out; (6) the final results were checked with the participants for the final review; and (7) the conclusions of the preliminary study were drawn.

4. Findings and discussion

Examining the literature and fieldwork during the preliminary study, the following CE practices are indicated among those found in community source projects.

4.1. Keeping materials and products in use

Keeping materials and products in continuous use is a basic concept of the circular economy, and is also found in community source projects. Some of these projects started their system using existing codes (previously developed in-house apps). This kind of practice is a good example that shows a very basic concept of the CE found in community source projects. Indeed, it is common practice in projects following a community source model to build a system on the existing code that works at least fairly well. It is argued that this can prevent long negotiations about basic architectural decisions, as well as increase the likelihood that the project can achieve rapid success (Courant & Griffiths, 2006). Talking about why these projects keep using the same code brings us back to the CE again. Such a practice is also considered in the CE in which materials should be used as long as possible which should result in cost-saving. Accordingly, both concepts of the CE "not to create waste in the first place" and "reuse of products' can be found in community source projects as a way to keep materials and products (codes) in use. This leads to the following sub-section explaining the term 'soft-material'.

4.2. Soft-material

As illustrated in Figure 2, materials can be biological and technical in the CE. However, if one tries to relate the CE principles to the IS development (particularly the community source model), the term soft-material then emerges.

Fig. 2. Circular economy system diagram

Source: Ellen MacArthur Foundation. (February 2019). Retrieved from https://www.ellenmacarthur-
foundation.org

As mentioned above, some community source projects reused the software codes that work fairly well to achieve rapid success and early wins. Materials (software codes) are kept in use. This kind of material cannot be described as biological nor technical material. Accordingly, it can be described as soft-material which is basically a type of material, but in virtual form (e.g. data, software codes, etc.) as a distinguished from physical materials. The term also appears in recycling discussed in the next subsection.

4.3. Recycling

As mentioned earlier in the CD-ERP model developed in the study for the Libyan context, the author suggested using ERP packages as a base for the integrated university system in Libya to avoid building the system from scratch. It also appears to be a somewhat CE practice. In other words, the outputs/products "ERP" will be reused in another system "Libyan Context". Perhaps the concept of 'not creating waste' is not clear enough in this example. In the first place, the ERP packages are not waste since they are already being developed and utilized widely. The concept of "recycling or reusing the product" is, however, obvious.

4.4. Sharing resources

Another practice of the CE can arguably be found when members (organizations) of the consortium (in the community source projects) pool and share their resources. Indeed, it can be argued that it is based on the idea of sharing resources among members of the consortium to develop their own ISs. For instance, the existing systems or infrastructure of one member are available to other members in the consortium. Sharing also exists in Human Resources whereby experts from different members of the consortium are brought together in one project.

4.5. Consuming products

In the CE, questions arise as to why it is necessary to own products traditionally. There is no point in owning a single-use product while one can rent it. Likewise, one must not forget that the concept of IT has shifted from building to consumption. Both Cloud Computing (CC) and Multi-Tenancy have been considered as sustainable and promising solutions to the challenges associated with shrinking IT budgets and escalating IT needs. Cloud Computing and Multi-Tenancy are widely used in community source projects. Generally, this shift has led to the concept of IT as a Service (ITaaS), where every single IT resource, activity, and infrastructure is viewed and visualized as a service (Raj, 2011). In CC, services can be requested, customized, paid for, and used independently. In other words, computing resources available on demand, which is another practice of the CE, namely: "consuming products rather than owning them" found in community source projects.

Another technology that could arguably be linked to the term 'consuming products' is multi-tenancy software architecture. Multi-tenancy is an approach to software architecture that enables a single instance of a software app serving multiple customers, referred to as tenants. There are some benefits of multi-tenancy, such as the maintenance of apps becomes easier and cheaper (Bezemer & Zaidman, 2010), the utilization of hardware is also improved (Bezemer & Zaidman, 2010; Kabbedijk, Pors, Jansen, & Brinkkemper, 2014). Consequently, these two benefits reduce the overall costs of running the apps, as well as giving the ability to share infrastructure and the operational costs of the data centre (Jani, Kumar, & Shah, 2013). Another practice of the CE is found in sharing resources, which is consequently reflected in lesser utilization of hardware. Multi-tenancy has been adopted by some community source projects, while it was also included in the CD-ERP model.

4.6. The Strategy of Circular Community

Although there are several strategies for dealing with e-waste management in community source projects, they are not thorough enough. The circular community is a better-controlled strategy for recycling within community source projects. Indeed, there is another concept in these projects that could be seen as a benefit, which is the use of the consortium power in favour of rethinking buying and using IT products (physical products such as computers) that can drastically reduce the consortium's production (as a whole) of its carbon footprint, with a smaller budget,
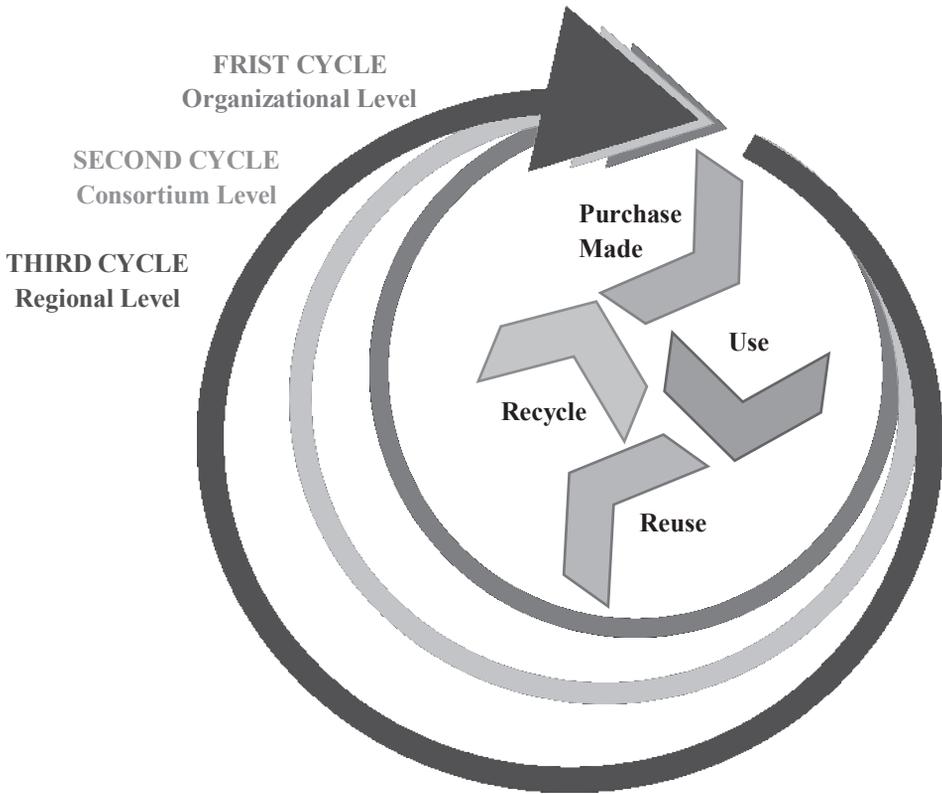
Fig 3. The Strategy of Circular Community (The three-level closed cycle)

Source: authors' own work.

and without affecting the performance. Indeed, consortium members can attempt to recycle their products within the consortium itself in a 'closed cycle'. It is important to mention that usually recycling could not be sufficient because only a very small amount of global e-waste actually reaches recycling facilities, with a minimal amount of recycled materials. The rest of the materials may be sent to landfills that will pollute the land, and may also be incinerated, which will increase the carbon footprint. In other cases, they could be illegally exported to countries where organizations do not implement the CE, especially since the e-waste legislation is weak or non-existent there. Hence, the controlled recycling of materials within the consortium could be seen as a better strategy. The strategy could allow for a committee in the consortium to control the recycling loop in which the e-waste will be transferred from one member to another within the consortium itself, i.e. 'the closed cycle', before deciding to export the e-waste outside the closed cycle (the consortium). The strategy will be centred around keeping the 'cycle' closed as long as possible before breaking the loop by exporting the e-waste outside the closed

cycle represented by the consortium members. This strategy could also be expanded, from the 'closed cycle' within the consortium at national level, to a broader concept that involves another 'wider closed cycle' of other consortia at regional level (e.g. European level).

In other words, the recycling of e-waste will be performed in a strategy called the three-level closed cycle in community source projects, as shown in Figure 2. The first level is within the organization itself (each member of the consortium) which is the typical recycling. The second level is at consortium level (national level), where the consortium members should maintain the use of e-waste within the members as long as possible, which is called the 'closed cycle', before exporting it outside the consortium 'breaking through the second cycle'. Indeed, any member that no longer needs a particular product could make it useful for another member in the consortium. The third level is regional level (e.g. European level) in which the consortia at regional level will carry out the concept of the "wider closed cycle". In this concept, an alliance of consortia at regional level will apply a strategy similar to 'the closed cycle', like the one at national level, to a wider or regional cycle. This three-level strategy is not limited to e-waste of physical products, but could be applied to soft-material (e.g. software, apps, etc.) as well. The philosophy behind this strategy is not to break through any level until the very end. Thus, products will be valued at three levels for their potential further use (or even remanufacturing) for as long as possible.

4.7. Reducing pollution

Based on the above, these CE practices found in community source projects can reduce pollution, bring us to a fundamental concept of the CE. Imagine a consortium of organizations sharing its resources in various ways, such as one member providing its infrastructure to the other members, adopting innovative technology such as CC, or multi-tenancy. Moreover, in community source projects, a consortium usually has one core-centre for all members that contains the mainframe computers or servers (rather than each member having its own). As is known, mainframe computers are power-intensive, therefore the core-center found in community source projects results in less power usage. Additionally, the strategy of circular community is projected to reduce organizations' carbon footprint. These indicators should show the decrease in the number of devices, networks or infrastructure in use, etc. Hence, these types of practices are projected to accordingly reduce pollution.

5. Conclusion

This paper discussed the results of the preliminary study (the first stage) of the ongoing research which deals with the technological, managerial, and economic features of the community resource projects in EU countries. The community source is a new model in software development that is intermediate between two well-

known models (closed and open source systems). The head of the USOS project was interviewed, while other projects were contacted using different means. In this preliminary study, the practices of the CE that exist in these projects were discussed.

Based on the results of the preliminary study, fundamental practices of the CE such as keeping materials and products in continuous use, recycling, sharing resources, and consuming products, are among those that can be observed in community source projects. For instance, members in the consortium in community source projects share their resources which is a CE practice. Moreover, software codes are being reused as a kind of recycling. The reuse of software codes has led to a new term, soft material. Soft material is a type of material that is not biological or technical as is the case described in the CE. Additionally, more productive utilization of inputs should bring about a cost-saving of materials. A reduction of pollution is also considered as a concept or even a benefit of the CE that also occurs in community source projects, especially those practices in community source projects which reduce the use of the infrastructure such as having a one core-centre for the consortium. As a result, economic growth could be achieved through the lower cost of utilization of the infrastructure found in these projects.

The community source model is an inspiring example of replacing linear products and systems with circular ones. As stated before, this study is a preliminary phase of ongoing research to investigate community resource projects. The current findings will be used for future research. In later stages, more in-depth study and analysis are planned to answer questions such as "how did these community resource projects benefit from the practices of the CE?", and "what are the long-term consequences of using the CE practices on community resource projects?" Eventually, the intention is to develop an agent-based model to study this topic. Furthermore, it is planned to investigate the applicability of the circular community strategy in real life.

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