A FRAMEWORK FOR AN OPEN EDUCATION SUPPLY CHAIN NETWORK

Barbara Class[1][a], Felicia Soulikhan[2][b], Sandrine Favre[1][c] and Naoufel Cheikhrouhou[2][d]

[1]*TECFA, Faculty of Psychology and Educational Sciences, University of Geneva, Pont d'Arve 40, 1211 Geneva 4, Switzerland*
[2]*Geneva School of Business Administration, University of Applied Sciences Western Switzerland (HES-SO), 1227 Geneva, Switzerland*

Barbara.Class@unige.ch; Felicia.Soulikhan@hesge.ch; Sandrine.Favre@etu.unige.ch; Naoufel.Cheikhrouhou@hesge.ch

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Abstract: Open Education (OE) as a concept has been around for some years. Yet, a part from Open Educational Resources and Open Science, teachers and researchers are usually not aware of it. The aim of this paper is to conceptualise OE from the perspective of supply chain management (SCM), implicitly positioning it in the world of opens, the commons, the state and the market. Within a design-based approach, the concepts related to OE and SCM are presented, discussed and integrated in a novel framework dealing with the management of OE ecosystem. Findings show that keywords of the Open Education Supply Chain are cocreation, agile design and authority. The framework invites to create value from resources in a holistic way, balancing the commons, the state and the market in each stakeholder.

1. INTRODUCTION

"Knowledge is open if anyone is free to access, use, modify, and share it — subject, at most, to measures that preserve provenance and openness" (OpenKnowledgeFoundation, no date).

Open movements are numerous, all spreading from a "non-open existing entity". For example, Open Science stems from science as conducted in the last decades and which showed its limits. Open Source Software was one of the first open movements that gave the tone in the computing community. Open Scholarship, Open Galleries, Libraries, Archives and Museums (Open GLAM), Open Source Hardware, Open Government, Open Enterprises, Open Knowledge are but examples towards the open movement.

To ground the knowledge economy started by the Bologna process (Huisman et al., 2012), winds of change are blowing on education. For a quick reminder, the Bologna process aimed at harmonising the different European higher education systems to facilitate mobility and employment across countries. In parallel, 20 years ago, a consequent reflexion started, laying the legal ground for opens and commons to exist: the Creative Commons (Stacey & Hinchliff Pearson, 2017). Both the Bologna process and the Creative Commons foundations make OE possible and realistic today.

The overall objective of this paper is to suggest a framework for Open Education (Stacey, 2018) in the perspective of digital supply chain management (Garay-Rondero et al., 2019). Education rests on numerous distributed actors and conceptualising it from supply chain (SC) perspectives makes sense, especially for Open Education (OE), which represents an emerging sustainable paradigm shift.

It is a timely issue to consider SC in education to imagine how institutions and different stakeholders will be able to implement OE (i.e. deliver open badges; create open certifications). To do this, it is important to overcome the costs of innovation and

[a] https://orcid.org/ 0000-0002-5461-2307
[b] https://orcid.org/0000-0002-9743-7000
[c] https://orcid.org/ 0000-0002-1340-1802
[d] https://orcid.org/0000-0003-2497-2528

connect the different opens together. The ultimate goal being to achieve an "Open Ecosystem" in which the different components interact and support each other in interconnected ways (FOSTER, 2018; Santos-Hermosa, 2019; Stacey, 2018). OE is THE example where all these "Opens" can interconnect. The first reason is related to the fact that stakeholders in education are usually involved in all three major resources' users and value creation players – the commons, the state and the market. The second reason is that education is everywhere and can potentially be connected to hardly any open movement.

The paper is outlined as follows. First, a methodology is presented followed by the development of the research background with a discussion of the 21st century skills and value creation. The framework of supply chain management (SCM) for OE is finally presented and its features are discussed with some examples.

2.   METHODOLOGY

The idea presented in this position paper - conceptualise OE as a SCM - originates from a research project. It is a Swiss National Science Foundation (SNSF) funded project on OE called *Open Education for Research Methodology Teaching across the Mediterranean* (Class, 2020; Class & Akkari, Accepted). Methodologically speaking, it utilises Design-Based Research (DBR) (McKenney & Reeves, 2019). DBR is iterative and starts from a problem encountered by practitioners – in this case, higher education teachers' implementation of OE practices. Starting from the literature and from a partnership between researchers, teachers and stakeholders, it seeks to build a solution that is theoretically backed. The process consists of identifying the problem, suggesting solutions, designing a prototype, evaluating scientifically the prototype and extracting design rules to guide the next design cycle. Cycles repeat until sustainable solutions are found at the levels of practice and theory and it is for this reason that DBR is known as « use inspired basic research » (Stokes, 1997). Theoretical and practical contributions are relevant beyond the local context and provide insights for other similar contexts.

Focusing on the conceptualisation of OE in SC perspectives helps understand who is involved and how and model potential use case scenario. The framework and scenario stem from the literature review and form solutions that will later be operationalised in prototypes and evaluated. The sub-research question associated to this piece of research is: How can the conceptualisation of Open Education in terms of supply chain contribute to providing concrete answers to Open Education practices in higher education?

3.   21 ST CENTURY SKILLS AND VALUE CREATION

3.1   21st Century Skills

It is a given that a certain percentage of jobs in 2030 have not been invented yet - 9% (according to McKinsey cited by Reynolds Lewis, 2019). The literature (Rios et al., 2020; van Laar et al., 2020), organisations like the World Economic Forum, and the market (WorldEconomicForum, 2016) agree on a set of skills that need to be trained despite being able to train for specific skills required for a known job (Figure 1 and Figure 2).

WEF 2016: Prospection marketplace skills for 2020

classified starting from the most demanded skill

Complex problem solving
Critical thinking
Creativity
People management
Coordinating with others
Emotional intelligence
Judgement and decision making
Service orientation
Negociation
Cognitive flexibility

Figure 1: Prospective most demanded skills for 2020 (WorldEconomicForum, 2016)

Rios et al. (2020) Skills needed

classified in terms of recurrence in articles

classified in terms of job advertisement

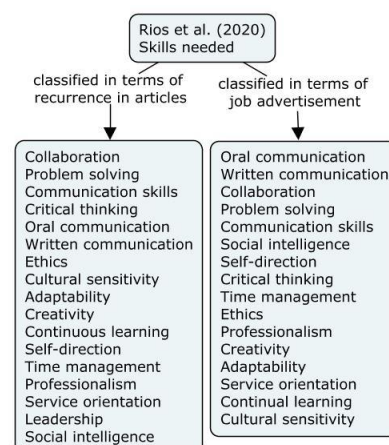|	
Collaboration	Oral communication
Problem solving	Written communication
Communication skills	Collaboration
Critical thinking	Problem solving
Oral communication	Communication skills
Written communication	Social intelligence
Ethics	Self-direction
Cultural sensitivity	Critical thinking
Adaptability	Time management
Creativity	Ethics
Continuous learning	Professionalism
Self-direction	Creativity
Time management	Adaptability
Professionalism	Service orientation
Service orientation	Continual learning
Leadership	Cultural sensitivity
Social intelligence	

Figure 2: Skills needed according to the literature and to the market's demands (Rios et al., 2020).

How to capitalise on skills to create value remains a relevant question in an ecosystem where change is the rule.

3.2 Value creation

Value is shared by both concepts central to this paper - SC and OE. Value can be defined from many perspectives but the way social learning - best known as learning within communities of practice - defines it is in line with OE and is selected for this position paper. Value is defined in terms of agency and meaningfulness of participation. More precisely, participating is perceived as conducting to a difference that matters. Looking with finer granularity at value, it can be decomposed in four different actions which happen in a linear modality.

Generating value in the sense of moving towards making a difference is the first action. Translating this generated value is the second action and consists in transforming something of value. This action is a pivot articulating value and social learning. Framing social value represents the third action and consists in formulating expectations for the creation of new value. Finally, the fourth action, which is evaluating social learning, seeks to investigate the difference learning is making or not (Wenger-Trayner & Wenger-Trayner, 2020, pp. 44-45).

Communities of practice and commons share concepts like value and agency. As a matter of fact, commons are understood as meaningful actions undertaken by a certain number of citizens, who want to exercise their agency, and get organised for a given cause outside of the state or the market (Stacey & Hinchliff Pearson, 2017). Commons, when concerned with learning are quasi synonymous of communities of practice. Authors have been working on communities of practice for more than 30 years (Lave & Wenger, 1991; Wenger, 1998) and they now strive to better understand value (Wenger-Trayner & Wenger-Trayner, 2020). Value is to be understood as a set of six phases of a cycle within the larger four actions mentioned above (Figure 3).
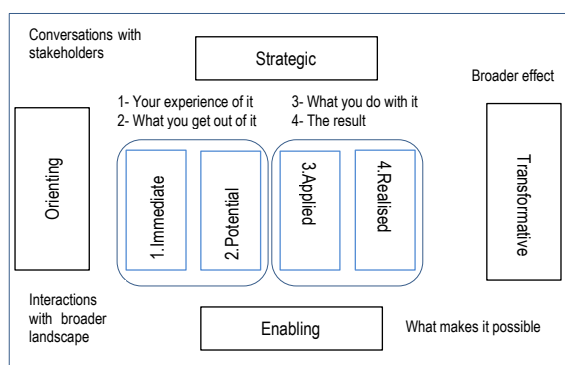

Figure 3 : Value creation according to Wenger & Wenger (2020, p. 75).

The first one is *immediate value* – gathering what happened and personal experiences from activities and interactions. The second one is *potential value*, knowledge capital – what has been produced and which value will potentially be realised in the future. Third comes *applied value* – changes in personal practices ensuing from leveraging knowledge capital. The fourth is *realised value* – what aspects of one's performance achievements are affected by using knowledge capital. The fifth is *enabling value* - learning how to enable learning and the sixth is *strategic value* - negotiating learning imperatives. The seventh is *orienting value* - situating the social learning space in the broader landscape and *transformative value* - recognising broader and/or deeper transformations social learning can leverage (Wenger-Trayner & Wenger-Trayner, 2020; Wenger et al., 2011). Enabling, orienting, strategic and transformative values act more on the macro level and build upon more individual values situated at a micro level - immediate, potential, applied and realised (Wenger-Trayner et al., 2019; Wenger-Trayner & Wenger-Trayner, 2020).

4. OPEN EDUCATION

Social learning spaces are related to open learning in the sense that it is realised outside of formal institutional frameworks. Engagement, agency that individuals leverage to make social learning happen are very present in Open Education. In higher education, OE issues are addressed in reference to the European framework suggested by Inamorato dos Santos et al. (2016). This framework consists of 4 transversal dimensions (technology, strategy, leadership, quality) that drive the 6 core educational practices identified as openable (content, pedagogy, recognition, collaboration, research and access).

Concerning core educational practices, in accordance with Stacey (2018)'s roadmap, OE is discussed in terms of Open Educational Resources (OER) – how to produce, adopt and adapt them (Stracke et al., 2019; Weller et al., 2018), and in terms of OE practices - teaching openness (Nascimbeni et al., 2018) and conceptual perspectives (Cronin & Maclaren, 2018). Issues of Open Admission, Open Recognition, Open Assessment and Open Credentials are discussed at the theoretical level (Wiley, 2017), and at the cultural change level (Chiappe et al., 2016). Open Education Practices (Cronin, 2017), assembling them all and Open Competencies (Wiley, 2017) are also discussed. OE practices can only take place if all interconnected components are present and active - Open Admission, Open Competencies, Open Educational Resources, Open Assessments and Open Credentials (Wiley, 2017).

The feedbacks from the field, in the form of concrete experiences with OE, are starting to be shared (García-Holgado et al., 2020). Concerning quality, a first OE quality framework, in reference to ISO/IEC 40180, has been suggested (Stracke, 2019). At the strategic and leadership levels, major OE enablers are i) a clear policy priority assigned to OE; ii) an awareness-raising on OE, targeting leaders and educators; and iii) capacity-building in OE for educators and other stakeholders (Inamorato dos Santos et al., 2017). Finally, concerning technology, projects like QualiChain[5] work on smart open badges solutions and a reflexion on technological compliant solutions is on-going (Coëtlogon, 2019).

5. SUPPLY CHAIN MANAGEMENT

5.1 Physical supply chains

Value is targeted by supply chains. Supply comes from offering support. Etymologies of the concept in French and English are very complementary, related to offering support backed with mathematical reasoning [6]. SC principles usually consist of designing, managing and controlling physical, information and financial flows. The idea is to consider OE as complex service SCs in which learners exercise their agency to create their own academic path. Through a number of academic nodes, which may create known problems such as bottlenecks, inadequate workload/capacity ratio, etc., diverse and creative paths can be created. The rationale is to consider the principles of SCM concept apply for OE ecosystems.

Constructs of SCM entail four components. First comes the SCM components divided into *structural management components* - e.g. planning and control methods, workflow activity structure, organisational structure, communication and information flow facility structure, knowledge management, and *behavioural management components* - e.g. management methods, power and leadership, risk and reward, culture and attitude, trust and commitment. Second comes the SCM processes - e.g. customer and supplier relationship management, manufacturing flow management, product development and commercialisation. Third comes the SC network structure - e.g. upstream suppliers, distributors, end-users. Finally comes the SC flows - e.g. material flow (inbound), finished products/goods flow (outbound), services flow, information flow, knowledge flow, financial resources flow, return flows of goods/services (Garay-Rondero et al., 2019).

At the market level, obstacles associated with SCs are usually lack of competence, lack of visibility, malfunctioning models, out-dated technologies, and long response times (Queiroz et al., 2019). Business managers must thus constantly improve their processes, anticipate and adapt to increasingly changing customer preferences in a 4.0 economy where digital technology and disruption has taken competition to the next level (Koh, 2017).

5.2 Digital supply chains

A Digital supply chain (DSC) is defined as a set of interconnected activities that take place interactively between suppliers and customers, and which are processed using new technologies (Büyüközkan & Göçer, 2018). DSC has the potential to offer a range of practices that can significantly reduce costs, increase product availability, improve access to information, and enhance the responsiveness, collaboration capabilities, visibility and resilience of the entire SC. In addition, two topics are discussed: i) the implementation of digital technologies in the DSC to leverage new relationships between suppliers and customers; and ii) the roles these technologies have in transforming SC capabilities and operational performance (Ehie & Ferreira, 2019). Moreover, impact such as the integration of physical flows with digital technologies in a DSC has shown to improve visibility, responsiveness, robustness and resilience, while

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[5] https://qualichain-project.eu/

[6] https://www.lalanguefrancaise.com/dictionnaire/definition/logistique; https://www.etymonline.com/word/supply

enabling the optimisation of organisational performance (Gunasekaran et al., 2017).

The different models existing in the literature are inspiring for an educational context but would need consistent adaptation to comply with the needs of OE, e.g. consider the learner as a co-actor in the chain and not as a consumer of a ready-made product; consider the chain as a network to break its linearity.

5.3 Goals of Commons, the State and the Market

Two questions need to be addressed. The first relates to the use of resources: how to use them? And the second relates to the goals of different stakeholders towards resources: what are the goals of each stakeholder towards resources? The market aims at maximising the utility of a resource to, in turn, maximise monetary value. The state has different goals and aims at balancing the market to cater for social and cultural needs of citizens. The commons have yet different goals: they seek to maximise "access, equity, distribution, participation, innovation, and sustainability" (Stacey & Hinchliff Pearson, 2017, p. 7).

The main principle for commons is a principle of abundance (and not scarcity). For example, the open source movement has gained recognition for its unique community efforts of reliability, scalability and quality through independent peer review. Giving control to citizens has given rise to a new way of measuring value, namely one associated with a network effect. Value is measured through the number of people who participate and use a given product (Stacey & Hinchliff Pearson, 2017).

The different open movements are an invitation to get involved as stakeholders instead of being a "passive recipient" of something prepackaged for by a supplier who knows exactly what is needed. This operationalises into value creation system in which multiple parties are adding value into a process. Value is involved in complex networks between suppliers and customers and is constructed in these interactions. In addition, the created value is best understood as an offering rather than a product. An offering is an artefact designed to more effectively enable and organise value co-production (Stacey, 2020). The idea of making change and heading towards sustainability is also present in the open movements (Chan et al., 2020).

6. TOWARDS A PHYSICAL AND DIGITAL SUPPLY CHAIN FOR OPEN EDUCATION

The academic landscape has been undergoing important changes in the last decades. From privileged knowledge providers, universities turned into a factory mode where society dictated immediate competences needed. A dialogical perspective is now emerging, where universities and societies network to build societal value and human worth, considering higher education a place to develop academic professional learning and citizenship (Norgard et al., 2019). In relationship to this changing landscape, social forms of learning in the sense of commons and communities of practice are developing and raise increased interest (McDonald & Cater-Steel, 2017).

The idea presented in the paper is to make use of the principles in managing SCs and networks and adapt them to OE issues. There are three main layers of SCM to be considered: i) the design phase of the SC, which consists of developing 'roads' and 'nodes' through which physical, information and financial flows will be managed; ii) the planning phase of the flows, through advanced planning systems; and, iii) the control of the different flows at the operation level.

Some basic and fundamental principles from digital supply chain management are adapted to OE. The flows considered are the flows of the different participants involved in an educational system, no matter their academic background or their geographic location. The nodes considered are the different educational institutions taking part in any given training – undergraduate or postgraduate programme within the educational world. The main principles are featured in terms of flow management, bottleneck management and queuing networks management.

Flow management: A flow in OE is constituted of students requesting to participate to courses in order to get credits, certificates or diplomas. They are considered as intelligent agents that could influence their own path and dynamically change it according to their own interactions with the remaining intelligent agents. Therefore, a dynamic management of the Open Education Supply Chain (OESC) is needed.

Bottleneck management: The OE nodes could be either physical (face-to-face training) or online (on-line training) or blended (both online and face-to-face). Therefore, bottlenecks in the OESC can occur when the number of open positions for participants/students is limited with respect to the number of participants requesting the use of a specific

node. This issue is much more important in the case of face-to-face presence requested by some institutions. Therefore, bottleneck management principles are considered in that case, with solutions that can vary from the increase of the physical capacity of a specific node to the dynamic rerouting of the agents to different nodes that can provide the same educational level and quality needed.

Queuing networks management: In the case where the participants request physical facilities, scheduling techniques could be used.

Moving away from linear processes (Stacey & Wiley, no date), talking of an Open Education Supply Chain seems more appropriate. The framework should be completely disruptive, redefining components, processes, network structure and flows in reference to Garay-Rondero et al. (2019)'s work above mentioned.

At this preliminary phase, the physical and digital SC for OE would start at stage 5 of the innovation maturity model for technology adoption by teachers (Eduvista, 2010-2014) - empower stakeholders. Stage 5, is about redefining and innovating use with technology, supporting new learning services, moving towards agile teaching and considering learners as co-designers of the learning journey.

This would reflect the paradigm shift that is undergoing in higher education. This shift is somewhat similar to the one that occurred in the Middle Ages when universities were created. At that time, knowledge started to step out from the sole religious powers to spread into civil powers. Today, with the Internet, the globalisation and the different Open movements, knowledge is stepping out from universities. It is stepping out of universities that represent the state to spread into the Commons, i.e. the civil society.

Key concepts of the OESC are: cocreation, agile design and authority. Authority because stakeholders who deliver training content, evaluate competences, etc. must be recognised as competent for doing what they are doing across market, commons and state. Cocreation of learning paths, learning activities, etc. are guiding principles to empower learners as active and intelligent agents, co-creators of their learning experience. Agile design is closely related to co-creation and relates to ideas about 21st century skills needed but do not have a ready-made answer.

Trying to feature out roles in such an ecosystem, universities, in partnership with commons, could be the ones accountable for i) creating competence frameworks, ii) identifying Technological Pedagogical and Content Knowledge (Mishra & Koehler, 2006) per micro domains and iii) assessing knowledge and competences. Learners could be developing active leadership to decide upon their learning, knowledge and competence development

paths. The market, in partnership with commons, could be the ones who decide where to lead human mankind on the earth (e.g. ecological and sanitary crises) and create new jobs accordingly.

To summarise, as shown in Figure 4, each stakeholder is a unified entity composed of parts that have been kept separate till now (cf. colours of the circle indicate the mainstream of each entity). These different entities interact and work closely together to create aligned value from resources.
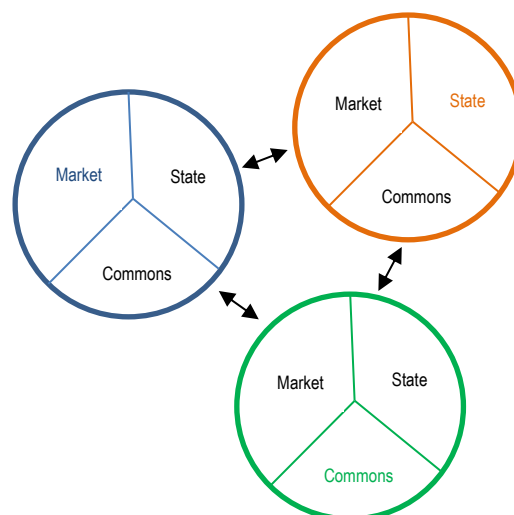

Figure 4: Towards an Open Education Supply Chain

7. CONCLUSION

This paper suggests that it is possible to conceive an Open Education Supply Chain at the theoretical level. Key to the SC is the idea of generating value, which is also at the heart of open movements. Generating value is done in a process of four steps: moving forward while making a difference, translating the generated value, framing social value and evaluating value (Wenger-Trayner & Wenger-Trayner, 2020).

Traditionally, SC's role is designing, planning, managing and controlling physical, financial and information flows. Considering OE as service supply

chains empowers learners. They can make use of agency to create their own academic path within which they can develop skills and knowledge. Advantages of digital supply chains are reduced costs (e.g. textbooks published as Open Educational Resources are totally free), increased product availability (e.g. the same textbook can be downloaded as many times as wished), improved access to information (i.e. the only condition to access it is possessing a device that is connected to the Internet) and enhanced responsiveness, collaboration capabilities, visibility and resilience of the entire supply chain (e.g. the textbook can easily be augmented and users alerted).

The concept of Open Education Supply Chain makes sense, because the paradigm shift takes knowledge outside of universities, bringing it to the commons. Three main levels have to be considered: the design phase of the supply chain, which consists of developing graphs consisting of networks of 'roads' and 'nodes' through which flows can run; the planning phase, which develops learning paths and skills as objectives; and, finally, the control of the different flows at the operation level, which calls for re-routing and scheduling within the network, considering the potential huge number of learners.

The framework is an attempt to tackle the complexity of the OE ecosystem that calls for institutional autonomy of the 'Universities' and for self-management when it comes to learners. This research work will be completed by implementing the conceptual Open Education Supply Chain into a prototype to evaluate the challenges when put into practice. In parallel, future research could analyse existing but not yet fully unveiled Open Education Supply Chains.

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