This paper was presented at The XXXIII ISPIM Innovation Conference "Innovating in a Digital World", held in Copenhagen, Denmark on 05 June to 08 June 2022.
Event Proceedings: LUT Scientific and Expertise Publications: ISBN 978-952-335-694-8

Towards regenerative, circular practices with transparency as catalyst

Marco Verkooijen*

Avans University of Applied Sciences,
Onderwijsboulevard 215, 5223 DE 's-Hertogenbosch, the Netherlands.
E-mail: mgwa.verkooijen@avans.nl

Karen L Janssen

Avans University of Applied Sciences,
Onderwijsboulevard 215, 5223 DE 's-Hertogenbosch, the Netherlands.
E-mail: kl.janssen@avans.nl

* Corresponding author

Abstract: When value chains pursue regenerative and circular practices, transparency is crucial to force decisions about the (re)design of products and processes. This study identifies the challenges that value chains face in their transformation to a transparent chain. We find that close alignment between functions as chemists, product developers, quality experts and logistics people is highly required as decisions have to be taken on (safety of) product constituents, product quality, disassembly and reuse of products and logistics. It is therefore crucial that provided information is released, understandable and reflective of reality. However, data appeared to be highly fragmented across a multitude of systems. It is first and foremost a matter of getting companies on par when it comes to digital maturity. Here it is essential to investigate the integrity of the sources. Establishing a single point of information where all information with high security standards is brought together contributes to effectively tracing products and their components in a transparent chain. For transparency, it is important that different access rights are provided to the specific stakeholder groups accordingly.

Keywords: Regenerative circular economy; Value chains; Transparency; Traceability; Management Information Cycle; Decision making; Stakeholders alignment; Digital maturity; Single point of Information;

This paper was presented at The XXXIII ISPIM Innovation Conference "Innovating in a Digital World", held in Copenhagen, Denmark on 05 June to 08 June 2022.
Event Proceedings: LUT Scientific and Expertise Publications: ISBN 978-952-335-694-8

1 Introduction

Our economic system is built around interconnected flows of goods, services, capital, technology, knowledge and investment through a linear, degenerative, take-make-waste approach, which has a significant contribution to the reduction of biosphere. If companies and their value chains are not able to create collective engagement in order to transition towards a new regenerative, circular economy, there will be calamitous consequences as regards our planet's equilibrium. It is now time for a new paradigm shift. Companies need to focus on sustainable development to achieve a sustainable competitive advantage that benefit the planet by restoring technical materials and regenerating biological materials to extend the life cycle of products with the least possible waste. Today, most materials and products are not designed for circularity. Transparency in value chains is therefore crucial to justify safe and sustainable operations and to force decisions about the (re)design of products and the way these are processed. In other words, insight into (product-, material-, component-, process related) information by value chain partners is highly required to safely re-use and recycle materials in a circular economy. Therefore, an optimized and synergetic data flow through the value chain needs to be organized.

This leads to following research question:

What challenges do value chains (that pursue regenerative and circular practices) face when they aim to make the transformation to a transparent chain in order to effectively trace products and their components and how can digitalization support this transformation?

This research contributes to knowledge in the field of transparency in value chains explicitly in the context of circular, regenerative practices. Although, track and trace solutions are applied in 'traditional' take-make-waste chains, purposes and therefore information needs and involved stakeholders appear to be different compared to those in circular, regenerative chains.

This research is conducted by a single, exploratory case study as part of a two years Avans' managed project, in which Dutch companies (especially SMEs) from the entire textile chain work together with Indian companies to design and record the process of a regenerative, circular system in which cotton is reused multiple times before it finally returns safely to the biosphere. We build on a framework based on both Schnackenberg and Tomlinson (2016) who define transparency as a three-dimensional construct (perceived disclosure, clarity and accuracy) and the Management Information Cycle of Choo (2002) in which the stages are described to come from information needs to information use and finally to adaptive behavior.

2 Literature

Linear, degenerative, take-make-waste economy

According to the World Economic Forum (2020) there is a reduction of biodiversity: since 1900, 20% of native species has been lost. In the marine environment, approximately 50% of the live coral cover of reefs has been lost since the 1870s. The global extinction rate is accelerating. Biodiversity loss was rated the second most

impactful and third most likely risk for the next decade. The current rate of extinction is tens to hundreds of times higher than the average over the past 10 million years—and it is accelerating. Biodiversity loss has critical implications for humanity, from the collapse of food and health systems to the disruption of entire supply chains".

Our economic system is strongly built around interconnected flows of goods, services, capital, technology, knowledge and investments through a linear, degenerative, take-make-waste approach. According to the United States Environmental Protection Agency (EPA), since 1970 about 90% of the increase of CO2 emissions (which is mainly the cause of the reduction of biosphere) is due to fossil fuel combustion, industrial processes and agriculture. Scientists warned that these changes may result in calamitous consequences as regards our planet's equilibrium (NASA, 2021).

Transition to a (sustainable) regenerative, circular approach

Transitions to new business practice are needed. According to the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES, 2019), we need "transformative changes across economic, social, political and technological factors" (IPBES, 2019: pp. 5). One does no longer has the luxury of just being less bad. In figure 1 below, required steps from conventional to regenerative economy are presented, showing that regeneration goes far beyond sustainability (Fullerton, 2015).

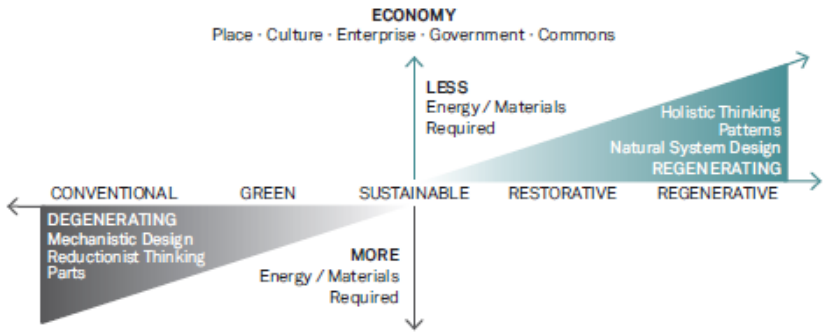

Figure 1 Stages of development, from conventional to regenerative economy according to Fullerton (2015).

Farooque et al. (2019) describe regenerative, circular value chain management as the integration of circular thinking into the management of the value chain and its surrounding industrial and natural ecosystems. It systematically restores technical materials and regenerates biological materials toward a zero-waste vision through system-wide innovation in business models and value chain functions from product design to end-of-life.
It is superfluous to mention that systematically restoring technical materials and regenerating biological materials towards zero waste require proper insight in the use of value chain's products, components, materials and the way these are processed.

Transparency

Challenging factors in the circular economy are cooperation, trust, and transparency (Zhang et al., 2021). Therefore, to achieve sustainable results, collaboration, and openness between organizations within networks and value chains are required. This is confirmed by Centobelli et al. (2021) who conclude that trust, traceability, and transparency emerge as critical factors in designing circular blockchain platforms in supply chains.

Especially in the textile branch premature initiatives w.r.t. transparency in the field of sustainability have already been taken. Van der Stoel (2021) points out that a suitable traceability system in the textile supply chain should be able to trace the environmental and social impact to measure and calculate the products and trace the composition of the final product and that the collected data should be stored in a digital product passport. Product passport are important for transparency (Adisorn et al., 2021). These developments are also identified as a topic on the level of the European Union (EU) within the “European Green Deal” (European Commission, 2019) and the “Circular Economy Action Plan” (European Commission, 2020). They indicate that for the digital product passport, a key question will be how to organize an optimized and synergetic data flow with the existing framework. The question is which criteria and precise data requirements should be addressed by a digital product passport.

Ellsworth-Krebs et al. (2021) endorse the relevance of data management. In their article about the circular economy infrastructure they state that information and communication technologies are recognized to be sufficiently mature to support traceability for reusable packaging at large scale. However, issues of data management, data integration, trust and collaboration in this complex ecosystem remain under-explored.

This is confirmed by Centobelli et al. (2021) asserting that digital technologies have increased the amount and accuracy of data collection, yet little progress has been made in data integration and utilizing this to operationalize circular supply chains.

In sum, it is primarily not about IT solutions when value chains pursuit regenerative and circular practices and aim to make the (digital) transformation to a transparent chain, but initially about the way the data in the chain is managed, exchanged and transformed to meaningful information.

3 Method

Research design

This research was conducted by a single, exploratory case study as part of a two years Avans’ managed project, in which Dutch companies (especially SMEs) from the entire textile chain work together with Indian companies to design and record the process of a regenerative, circular system in which cotton is reused multiple times before it finally returns safely to the biosphere.

Objectives of the most ideal chain are formulated as:

- The final product (landscape fabric) in the last step of the chain should be safely returned to the soil. This means this product must be guaranteed to be 100% cotton, that is biodegradable or biocompatible. If there are any blends in these products, it must be ensured that these can safely return to the biosphere as well.
- Products should be designed in a way these could be reused multiple times, extending their life cycles, with as little waste as possible, aiming for 0.

Data was collected through qualitative research by conducting semi-structured open end interviews with a total of six stakeholders from as many companies: 3 manufacturing companies, 1 farmer company, 2 sorters/recyclers. Besides, data was collected through several workshops in which all companies were attending. This research was conducted during the first year of the project to answer following question:

What challenges do value chains (that pursue regenerative and circular practices) face when they aim to make the transformation to a transparent chain in order to effectively trace products and their components and how can digitalization support this transformation?

Data was analyzed by content analysis through codes that were defined before and during the recording of the research findings. These findings have been categorized according to the steps of the Management Information Cycle by Choo (2002). For each step the challenges, that need to be met, were determined in order to achieve transparency, based on the operational definitions of transparency by Schnackenberg and Tomlinson (2016). The operationalization of transparency as well as the Management Information Cycle are elaborated in following sections.

Transparency as a construct

Schnackenberg and Tomlinson (2016) define transparency as: 'the perceived quality of intentionally shared information from a sender.' They propose a framework by suggesting that transparency is comprised of three primary dimensions: **disclosure, clarity, and accuracy**. They define perceived **disclosure** as the extent to which information is released rather than hidden.

Williams (2008) states that disclosure refers to the perception that relevant information is made available to the receiver. The concept of disclosure include perceived information **availability, observability, and visibility** (Schnackenberg and Tomlinson, 2016).

Perceived **clarity** can be described as the extent to which information is understandable rather than obfuscated (Schnackenberg and Tomlinson, 2016). Related terms subsumed within the concept of clarity include perceived **understandability, lucidity, and simplicity**.

Perceived **accuracy** is defined as the extent to which information is reflective of reality rather than exaggerated or biased with terms as perceived information **correctness and reliability** (Schnackenberg and Tomlinson, 2016).

Schnackenberg et al. (2021) found that transparency can be modeled as an aggregate of its dimensions, as indicated by high factor correlations and evidence of convergent validity between them. The correlations were .69 between disclosure and clarity, .70 between disclosure and accuracy, and .78 between clarity and accuracy. These relatively high correlations suggest to aggregate items across the dimensions into a single transparency scale. This justifies operationalizing these dimensions into definitions for conducting research, see figure 2 below.

Figure 2 Transparency: from concept to operational definitions according to Schnackenberg and Tomlinson (2016)

Concept	Dimensions	Operational definitions
1. Transparency (the perceived quality of intentionally shared information from a sender)	**1.1 Perceived disclosure** (the extent to which information is released rather than hidden)	1.1.1 Perceived information **availability**
		1.1.2 perceived information **observability**
		1.1.3 perceived information **visibility**
	1.2 Perceived clarity (the extent to which information is understandable rather than obfuscated)	1.2.1 Perceived **shared** information **understandability**
		1.2.2. Perceived information **lucidity**
		1.2.3 Perceived information **simplicity**
	1.3 Perceived accuracy (the extent to which information is reflective of reality rather than exaggerated or biased)	1.3.1 Perceived information **correctness**
		1.3.2 Perceived information **reliability**

The Management Information Cycle

Choo (2002) developed the Management Information Cycle in which the process is drawn from information needs to information use which should eventually lead to adaptive behavior. This model forms the basis for the qualitative research as literature shows that organizing an optimized and synergetic data/information flow through the chain is the primary step towards transparency in order to effectively trace products and their components. Figure 3 visualizes the Management Information Cycle.

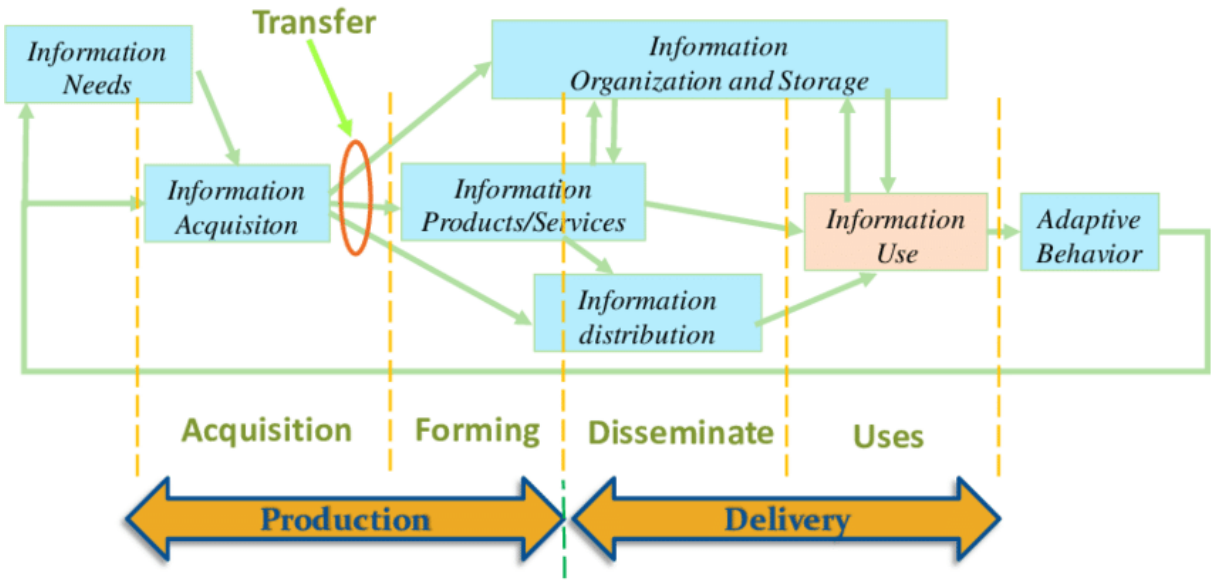

Figure 3 Management Information Cycle (Choo 2002)

According to Choo (2002) **Information Use** (see figure 3) is a dynamic, interactive social process of inquiry that may result in the making of meaning or the making of decisions. Considering the definition of transparency from Schnackenberg and Tomlinson (2016) (the perceived quality of intentionally shared information from a sender), information quality is actually perceived during the 'information use' phase. Therefore, information perceived by the value chain's stakeholders needs to be meaningful in order to make decisions towards circular, regenerative practices contributing to **adaptive behavior** of the value chain partners.

The identification of **Information Needs** requires to be sufficiently rich and complete in representing and elaborating users' true needs. Information needs consist of several inseparable parts, like:

- What information is needed?
- Why is the information needed?
- How will the information be used?
- How will this help you?
- In what form do you need to know it?

The phase of **Information Acquisition** is about the selection and use of information sources and the extraction of data that has to be planned for, and continuously monitored and evaluated. The organization accumulates a huge amount of information about its internal operations and resources. This phase IT solutions can be used to aid the acquisition of internal data out of the selected sources. Here it is essential to investigate

the integrity of the source, in other words whether its data is reliable, complete and correct without losing sight of its confidentiality.

In the **Information organization and storage phase** information that is acquired or created has to be organized and restored systematically in order to facilitate sharing and retrieval after which **Information product and services** are created. This phase is about the content and form as users require. To stay well-informed and build up its knowledge base, the intelligent organization needs to feed on a balanced diet of high quality information supplied through a varied menu of information products and services.
To be relevant and consequential, information products and services should therefore be designed to address not only the subject matter of the problem but also the specific contingencies that affect the resolution of each problem or each class of problems.

Before the information is to be used and interpreted the **Information Distribution** takes place. The delivery of information needs to be done through vehicles and in formats that dovetail well with the work habits and preferences of the users. To encourage users to be active participants, easy ways to comment on, evaluate, and re-direct the information they have received needs to be available. Information distribution and sharing is a necessary precondition of perception and interpretation. Distribution is in the first instance about the dissemination of routing according to 'the right information to the right person, in the right time, place and format.'

4 Results

Information needs (see figure 3)

Findings show that information needs became more clear as time progressed. Respondents indicated that this was reinforced by the fact that they became more and more aware of project's objectives. Due to the unfolding character of the project, partners gained increasingly better understanding of their roles in the chain as well as their added values.

After analyzing the collected data the information needs were categorized as follows:

1. **Information on product constituents (for regenerative purposes)**
   Partners clearly have a need of information on chemicals and constituents that were added to the product/fabric during processes upstream. Common add-ons in the textile industry are dyes and coatings but also ink prints. Besides, it is important to know in what kind of industry/sector the received products were used to assess the risks of contamination such as oil lake. Ideally, also the way products are treated with e.g. fabric softener, is important to know. This information needs to be available per batch in a way that each batch can be treated differently. In short, information should justify regenerative practices in a way that products and components that pass through the chain are not harmful to the biosphere. Besides, corrective actions can be made during the process and initiatives can be launched to design (more responsible) compositions in future.

2. **Information on design for disassembly and reuse (for restorative purposes)**
   Respondents stress that in order to effectively reuse products (like recycling or

remanufacturing) and preventing waste it is important to design products in a way dismantling or disassembly is made possible and reuse can be conducted. Especially sorters/recyclers in this particular textile chain need to know in advance what components need to be disassembled and how this should be done. Think of zippers, snaps, buttons, elastic velcro and even yarn. Additionally, respondents point out that partners upstream need to know if and how their design is compliant with processes downstream (e.g. supplied materials must have the right sizes for the machines used further down the chain, to prevent waste). Alignment between partners is therefore crucial.

3. **Information on product quality**
   Assessing product quality is important for lots of reasons. In the context of regenerative and circular practices, high product quality is relevant to increasing the amount of recycles and herewith extending the lifecycle of the product. This will reduce waste and will delay the return of products to the biosphere. Partners in this particular textile chain indicate to have several requirements when it comes to the quality of the supplied fabrics/products to ultimately meet the quality of their final product. Information they need to know is for example fiber length, tear-strength, color fastness and cotton weight. But also information about the type of process upstream (e.g. the washing process, amount of times washed and circumstances).

4. **Information for effective logistics**
   Information on traceability in transparent chains is important for several reasons. First, partners of course have a wider product portfolio than the products in this specific textile chain only. They need to effectively trace from which suppliers and from which batches the received fabrics/products originate in order to process these according to agreements made.
   Second, products are distributed to several industries and sometimes to the consumer market. These products must be returned, into the chain to be collected, sorted and recycled. So, one needs to know where these products have been distributed to and once returned what the origin is. This really is a challenge because products tend to stay for years in companies or at consumers before getting returned.
   Third, if defects are found in materials or products (e.g. harmful constituents), it needs to be possible to determine in which process this occurred and in which batch, so that it possibly leads to recalls and/or corrective actions. Information as supplier, type of process, batch number, production date, distribution date, destination are crucial to overcome challenges above.

Acquisition, forming and dissemination of information (see figure 3)

Once information needs are defined, information sources need to be selected to retrieve the required data. Transforming this data into information needs to be prepared to send it to the appropriate users. Results show that:

1. for most companies, data is highly fragmented across a multitude of systems;

2. there are substantial differences when it comes to the maturity level of these organizations in terms of digital competences and capabilities;

Data that currently is retrieved are test reports (for quality purposes), certificates (e.g. to justify that products and added chemicals are compliant) and details out of several systems such as SharePoint, and ERP. Currently, transforming data into information is often done in Excel files, while certificates and reports keep the original shape. In most cases, this information is sent to downstream partners through e-mail. The information in the e-mails, in turn, have to be stored in company's internal systems. Just a few partners have organized information management reasonably well and are already exchanging information in an automated way with their suppliers and customers. This might work at company level but chain-wide this way of working is highly error-prone and might inexorably lead to incorrect, unreliable and unclear information. Respondents have a clear need to aggregate and store unambiguous, timely, and reliable information in a standardized manner. In order to prevent (perceived) inaccuracy of this information it is crucial to have integer sources in which data is complete, correct and reliable.
The respondents, however, argue for small steps while implementing a synergetic information flow. At this moment partners are investigating the added value of a Product Circularity Data Sheet (PCDS). This sheet, that travels, with the product though the chain is seen as a master document that indicates: if and to what extent there are product constituents, if and to what extent the product is recycled and the way the product is designed. This document justifies responsible product composition, -design and -processing and aims to encourage companies to request detailed information from their partners.

Information use and Adaptive behavior (see figure 3)

Effective Information promotes the making of meaning or the making of decisions. Purposeful information use (as well as information provision) calls for the incorporation of functions such as chemists and product developers in these kind of trajectories to make judgments about product compositions and -designs. Also quality- and procurement functions are important to have compliant products that ultimately will increase the amount of recycles and extend the lifecycle of the products. The incorporation of logistics people, finally, is important to ensure traceability and efficient flow of goods without the least possible waste. Awareness, engagement and alignment among these stakeholders is crucial.

Respondents indicate that perceived accuracy is a highly relevant dimension of transparency when it comes to regenerative purposes. In fact, incorrect or unreliable information about added constituents and/or toxic substances could lead to harmful materials disappearing into the soil. Without shortchanging the other dimensions, perceived clarity and perceived disclosure. After all, design information that is unclear and interpreted differently by stakeholders will lead to inefficient or even harmful sort-en recycling processes. Think of removal of zippers or yarn made of synthetic fibers and in what way this is done in order to avoid a disrupted process or yarn that will be recycled along with the cotton. When it comes to returning products from consumers or companies, partners foresee a great challenge in obtaining information (perceived

disclosure). Because how do you get information from products that have left the chain for years and how do you make sure products getting returned into the chain?

Respondents endorse the importance of effective information use, collaboration and alignment in a transparent chain so effective decisions can be made leading to required adaptive behavior: continuously redesigning the products and processes in the chain towards regenerative, circular practices.

5 Conclusion

What challenges do value chains (that pursue regenerative and circular practices) face when they aim to make the transformation to a transparent chain in order to effectively trace products and their components and how can digitalization support this transformation?

Review of recent literature shows that it is primarily not about IT solutions when value chains pursuit regenerative and circular practices and aim to make the (digital) transformation to a transparent chain, but initially about the way the data in the chain is managed, exchanged and transformed to meaningful information. For example, Centobelli et al. (2021) assert that digital technologies have increased the amount and accuracy of data collection, yet little progress has been made in data integration and utilizing this to operationalize circular supply chains. Prior aligning the information needs in the chain, circular and regenerative purposes need to be clear to all participating organizations and their stakeholders. This counts as well for their roles and their added values in the chain. While determining information needs, partners need to focus on: information that justifies safe products/materials without any harmful constituents to the biosphere (regenerative practices), information on disassembly and reuse of products (restorative practices), information on product quality and information for logistics purposes. The latter creates a significant challenge. When products are distributed to several industries and sometimes to the consumer market, these products must be returned into the chain to be collected, sorted and recycled. So, one needs to know where these products have been distributed to and once returned what the origin is. However, collecting products for reuse is a challenge, they tend to stay for years in companies or at consumers before getting returned.

Once information needs are defined, information sources need to be selected to retrieve the required data. Transforming this data into information needs to be prepared to send to the appropriate users. However, results show that for most companies data is highly fragmented across a multitude of systems and there are substantial differences when it comes to the maturity level of these organizations in terms of digital competences and capabilities. This is why Adisorn et al. (2021) recommend a single point of information that could bring together all existing information with high security standards and provide them according to different access rights to specific stakeholder groups. Whether this should be a datahub in a Blockchain environment in combination with RFID technology has to be investigated. Matter is to first get companies on par when it comes to digital maturity. Here it is essential to investigate the integrity of the sources, in other words whether its data is reliable, complete and correct without losing sight of its confidentiality (Schnackenberg and Tomlinson, 2016).

Effective use of information promotes the making of meaning or the making of decisions. Considering the definition of transparency from Schnackenberg and Tomlinson (2016) (the perceived quality of intentionally shared information from a sender), information quality is actually perceived during the 'information use' phase. They propose a framework by suggesting that transparency is comprised of three primary dimensions: disclosure, clarity, and accuracy. Respondents indicate the relevance of these dimensions. For example, information that is difficult to access or unreliable information about added constituents and/or toxic substances can lead to harmful materials disappearing into the soil. Additionally, Moyo et al. (2016) have shown that information with high disclosure promotes greater awareness, consensus, and ownership of the information being conveyed. These aspects are important when it comes to (the respondent's call) for alignment of functions such as chemists, product developers and quality-, procurement- and logistics experts. According to Choo (2002) effective Information use is, after all, a dynamic, interactive social process of inquiry that may result in the making of meaning or the making of decisions.

Overcoming challenges mentioned above will provide the basis for effective information use, collaboration and alignment in a transparent chain so effective decisions can be made leading to required adaptive behavior: continuously redesigning the products and processes towards regenerative, circular practices. Ultimately, IT solutions can ensure transparency and traceability through a single point of information that could bring together all existing information with high security standards and provide them according to different access rights to specific stakeholder groups.

Acknowledgement

The research is made possible with the SIA grant: RAAK.MKB13.020. We would like to take this opportunity to thank the consortium for participating in our research. We also thank the graduate students involved in this project for their contribution to data collection and reporting.

References

Adisorn T., Tholen, L. Götz, T. (2021). Towards a Digital Product Passport Fit for Contributing to a Circular Economy. *Energies 2021, 14*, 2289. https://doi.org/10.3390/en14082289

Centobelli P., Cerchione R., Del Vecchio P., Oropallo E., Secundo G. (2021). Blockchain technology for bridging trust, traceability and transparency in circular supply chain. *Information & Management*. https://doi.org/10.1016/j.im.2021.103508

Choo (2002). *Information Management for the Intelligent Organization: The Art of Scanning the Environment* (3rd ed.). Medford, NJ: Information Today, Inc.

Ellsworth-Krebs K., Rampen C., Rogers E., Dudley L., Wishart L. (2021). Circular economy infrastructure: Why we need track and trace for reusable packaging. *Sustainable Production and Consumption*. 2021, 29, 249-258. https://doi.org/10.1016/j.spc.2021.10.007

European Commission (2019). *The European Green Deal*. COM(2019) 640 Final; European Commission: Brussels, Belgium, 2019. https://ec.europa.eu/

European Commission (2020). *Circular Economy Action Plan. For a Cleaner and More Competitive Europe*. European Commission: Brussels, Belgium, 2020. https://ec.europa.eu/

Farooque M., Zhang A., Thürer M., Qu T., Huisingh D. (2019). Circular supply chain management: A definition and structured literature review. *Journal of Cleaner Production 228* (2019). https://doi.org/10.1016/j.jclepro.2019.04.303

Fullerton, J. (2015). Regenerative Capitalism: How universal principles and patterns shape a new economy. *The Journal of Urban, Rural and Environmental Resilience* , 15 May 2015. https://futurestewards.com

IPBES, 2019. *Summary for Policymakers of the Global Assessment Report on Biodiversity and Ecosystem Services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.* IPBES Secretariat. https://ipbes.net/

Moyo C., Kaasbøll J., Nielsen P., (2016) The information transparency effects of introducing league tables in the health system in Malawi. *The Electronic Journal of Information Systems in Developing Countries 75(1):* 1–16. https://doi.org/10.1002/j.1681-4835.2016.tb00544.x

NASA, 2021. Available at: https://climate.nasa.gov/vital-signs/carbon-dioxide

Schnackenberg A.K., Tomlinson E.C. (2016). Organizational transparency: A new perspective on managing trust in organization-stakeholder relationships. *Journal of Management 42(7):* 1784–1810. https://doi.org/10.1177/0149206314525202

Schnackenberg A.K., Tomlinson E., Coen C. (2021). The dimensional structure of transparency: A construct validation of transparency as disclosure, clarity, and accuracy in organizations. *Human Relations volume 74.* https://doi.org/10.1177/0018726720933317

Stoel van der J. (2021). *What is a suitable traceability system to be deployed on large scale in the textile supply chain?* MVO Nederland, Amsterdam Fashion Institute. https://www.mvonederland.nl/

Williams C.C. (2008). Toward a taxonomy of corporate reporting strategies. *Journal of Business Communication 45(3)*: 232–264. https://doi.org/10.1177/0021943608317520

World Economic Forum (2020), World Economic Forum, 2020. *Global Risk Report 2020*, 15th Edition Insights report available at: http://www3.weforum.org/docs/WEF_Global_Risk_Report_2020.pdf.

Zhang D., Huang X., Wen Y., Trivedi P., Joghee S. (2021). Sustainable Circular Business Model for Transparency and Uncertainty Reduction in Supply Chain Management. *Journal of Theoretical and Applied Electronic Commerce Research*, 16, 959-975. https://doi.org/10.3390/jtaer16040054