Circular Economy Innovation at Tetra Pak through use of PLM System

- An Approach using Product Lifecycle Management (PLM) and Governance Model to Integrate Business Strategies, Technology and Product Innovation to Support Circular Economy Principles

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Currently, an increased importance is emerging regarding data management in organizations. (Desai et al., 2022) Sharing and managing product data, information and knowledge are key aspects of Product Lifecycle Management (PLM). (Terzi et al., 2010) *To have a successful circular economy (CE) implementation there exists barriers companies need to overcome, such as a major systematic change. (Cantú et al., 2021) Implementing CE into PLM will both require the different phases of the product lifecycle to be modified (Villamil Velasquez et al., 2020) and an increased emphasize at research institutions regarding opportunities with technological solutions is a requirement moving forward.*

Generally, PLM can be defined as a product centric, lifecycle- oriented, business model, supported by ICT, where product data is shared among actors, processes, and organizations throughout the different lifecycle phases of a product. This concept enables to achieve desired performances and sustainability for the product and related services. (Terzi et al., 2010; Stark 2022-a, p. 1) The three life cycle phases can be defined as Beginning-of-Life (BOL), Middle-of-Life (MOL) and End-of-Life (EOL). (Terzi et al., 2010)

Growing concerns regarding sustainability issues, and the emergence of the circular economy paradigm, in combination with new technological changes, press a need to redefine the PLM approach. Going from a mass production paradigm to a new more on demand, customer-driven and knowledge-based production paradigm. (de Oliveira & Soares, 2017)

The newly enforced and mandatory sustainability reporting regulation, Corporate Sustainability Reporting Directive (CSRD), requires improved corporate transparency with its precise and detailed standards. Also, requirements to provide relevant information regarding sustainable business activities. (Birkmann et al., 2024) The more detailed reporting will contribute to ending greenwashing, strengthen the EU's social market economy, and build the foundation for the sustainability reporting on a global level. (European Parliament, 2022)

The purpose of the study is to explore the current state of the PLM system at Tetra Pak regarding how it can be adapted to better support the circular economy principles, regarding their product segment, a general filling machine. Both by applying it to a real case study and analyzing the theoretical background on the topic.

The research strategy of the thesis is both an explorative case study research with data collected through qualitative interviews and a literature review on the theoretical background on the topic. This resulted in a current state analysis of the case company, a benchmarking approach with other companies to broaden the perspective of the context of the thesis and leading to a roadmap approach.

Important parts from the theoretical background of this thesis will be mentioned in the next coming sections. *The concept of closed loop PLM* can be described as an ecosystem which enables all stakeholders to a product to have access and control over product information in any product lifecycle phase. (von Stietencron et al., 2017; Kiritsis, 2011) The outcome of closing the information loops will have positive consequences when shifting from a BOL and MOL focused system to embed the EOL areas. This approach will open the opportunity for all the actors playing a role across the product lifecycle to track, manage, control the product information at any phase of the lifecycle. (Terzi et al., 2010; Jun et al., 2007) Furthermore, the challenges remain regarding reaching a closed loop PLM. Where barriers such as the information flow being disrupted when products are sold to the customers (Terzi et al., 2010), less frequent use of Product Data Management (PDM) in the EOL phase (Kiritsis, 2011), and the absence of a proper information management approach in the EOL phase results in an inefficient EOL process as well as overlooking the value the information sources can provide other processes in the PLM phases. (Hribernik et al., 2011)

Often, the *CE implementation* has been considered as a straightforward process, which provides the emerging economies best practices to implement. Despite that, to have a successful CE implementation in organizations it requires a major systemic change. PLM is seen as one enabler to achieve an CE implementation through a bottom-up approach. There exits both barriers and enablers to have a successful CE implementation in small and medium-sized enterprises (SMEs). (Cantú et al., 2021)

Scope 3 emissions cover all the indirect emissions from sources of an organizations value chain, which includes the upstream and downstream activities, which is one of the mandatory requirements in the newly enforced EU directive, CSRD. (Schmidt & Farbstein, 2024; PWC, n.d.-a) In addition, lots of companies are experiencing challenges with mapping and understanding the size of the scope 3 emissions, because the emissions are occurring outside of companies own direct control and business. (PWC, n.d.-a)

Research describes various opportunities for integrating the circular economy with the PLM system. There are different approaches that use digitalization and technical solutions to integrate PLM with circular economy. There is still low emphasize at research institutions regarding the absence of a standard for technological solutions and how they can operate in the PLM system, causing barriers to share information among the stakeholders.

Organizational Change Management (OCM) is an important aspect regarding PLM initiatives in organizations, due to their work provides change proposals in organizations. Furthermore, if OCM is in absence, a lot of PLM initiatives fail because the expected changes do not happen. (Stark 2022-b, p. 421) *The dual operating system* is an agile strategy working as a second operating system contributing to an easier operating process in the organization and acceleration of the strategic change. (Kotter, 2012) This strategy can be seen as an enabler and an approach for implementing change efforts in organizations.

The results of the study were a benchmarking approach among the three interviewed companies in the study, a current state analysis of Tetra Pak's current situation, and a roadmap proposing a unique strategic navigation on how Tetra Pak can move forward on the topic in the context of the purpose of the study and its problem statement. The roadmap is based on both the theoretical background of the study and the empirical findings. It is structured with five steps, including: 1. Set up a clear strategic plan moving forward, 2. Implement the foundation of the PLM system in the organization, 3. Implement additional technology to close the loop in EOL, 4. Experiencing closed loop PLM system, and 5. Checkpoints: evaluate stepwise. The four dimensions on each step is: 1. The target, 2. The technological approach, 3. The change work approach, and 4. The stakeholders involved. The proposed roadmap can be found in Figure 1.

To conclude, the analysis presents a uniquely proposed strategic navigation for the case company, Tetra Pak, aiming to propose how the company can adapt the PLM system to better support the circular economy principles of product reuse, remanufacturing, and recycling to drive sustainable innovation work, which is presented in a roadmap framework. Important aspects to take into consideration can be the technological approach, the change work approach and the stakeholders involved. The major goal is to reach a closed loop PLM system, which have the benefits to solve the existing information gap. With a constant information flow of real-time data reaching involved stakeholders, it will have the possibility to give correct feedback to the designers in the beginning phase of the product lifecycle, enabling a sustainable product innovation process.

Challenges remains regarding identified areas, such as technological, businesswise, CE implementation, change work, and the low emphasize at research institutions.

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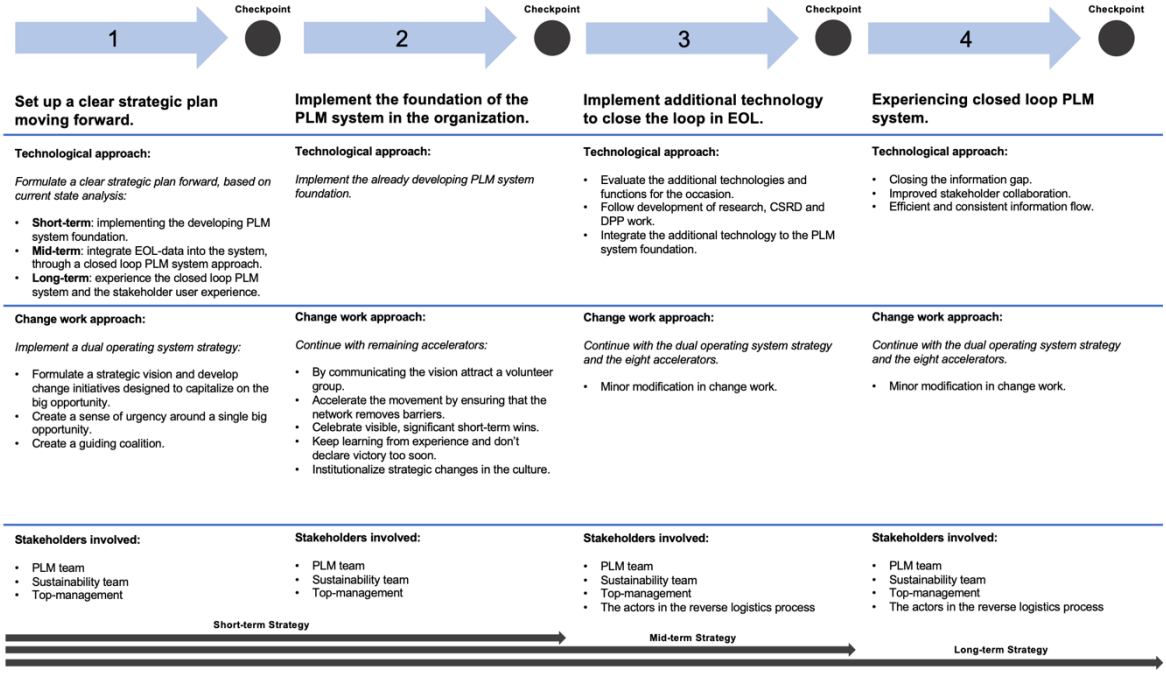

Figure 1: Proposed strategic navigation, the roadmap, moving forward regarding how Tetra Pak's PLM system can be adapted to better support the circular economy principles.

References

Birkmann, M. et al., 2024. CSRD - Burdening Regulation or Opportunity for CSR Communication? A Qualitative Study on the Influence of the Corporate Sustainability Reporting Directive on Large German Companies. *Sound or Silence? Current Developments in Organizational Communication*, 91174, pp. 10-41. [Online]
Available at: https://www.ssoar.info/ssoar/handle/document/91392. [Accessed 20 March 2024].

Cantú, A., Aguiñaga, E. & Scheel, C., 2021. Learning from Failure and Success: The Challenges for Circular Economy Implementation in SMEs in an Emerging Economy. *Sustainability (Switzerland),* 13(3), p. 1529.
doi: 10.3390/su13031529.

de Oliveira, S. F. & Soares, A. L., 2017. *A PLM Vision for Circular Economy.* Cham, Springer International Publishing (IFIP Advances in Information and Communication Technology. 506).
doi: 10.1007/978-3-319-65151-4_52.

Desai, V., Fountaine, T. & Rowshankish, K., 2022. A Better Way to Put Your Data to Work Package it the way you would a product. Harvard Business Review, 100(7-8), pp. 100-107. [Online]
Available at: https://ludwig.lub.lu.se/login?url=https://search.ebscohost.com/login.aspx?direct=true&AuthType=ip,uid&db=edswss&AN=000829466400022&site=e ds-live&scope=site
[Accessed 01 November 2023].

European Parliament, 2022. *Sustainable economy: Parliament adopts new reporting rules for multinationals.* [Online]
Available at: https://www.europarl.europa.eu/news/en/press- room/20221107IPR49611/sustainable-economy-parliament-adopts-new-reporting-rules-for-multinationals
[Accessed 20 March 2024].

Hribernik, K. A., Stietencron, M. v., Hans, C. & Thoben, K.-D., 2011. *Intelligent Products to Support Closed-Loop Reverse Logistics.* Berlin, Heidelberg, Springer Berlin Heidelberg, pp. 486-491.
doi: 10.1007/978-3-642-19692-8_84.

Jun, H.-B., Kiritsis, D. & Xirouchakis, P., 2007. Research issues on closed- loop PLM. *Computers in Industry.* Edited by 01/01/2007, 58(8-9), pp. 855- 868.
doi: 10.1016/j.compind.2007.04.001.

Kiritsis, D., 2011. Closed-loop PLM for intelligent products in the era of the Internet of things. *Computer-Aided Design.* Edited by 01/01/2011, 43(5), pp. 479-501.
doi: 10.1016/j.cad.2010.03.002.

Kotter, J. P., 2012. Accelerate! [business strategy]. *Harvard Business Review,* Edited by 01/01/2013, 90(11), p. 44. [Online]
Available at: https://ludwig.lub.lu.se/login?url=https://search.ebscohost.com/login.aspx?direct=true&AuthType=ip,uid&db=inh&AN=13593085&site=eds- live&scope=site
[Accessed 6 May 2024].

PWC, n.d.-a. *Vad är Scope 3?.* [Online]
Available at: https://www.pwc.se/sv/esg/scope-3-emissions.html
[Accessed 2 April 2024].

Schmidt, A. & Farbstein, E., 2024. *Corporate Sustainability Reporting Directive (CSRD), explained.* [Online]
Available at: https://normative.io/insight/csrd-explained/
[Accessed 25 March 2024].

Stark, J., 2022-a. Product Lifecycle Management (PLM). In: R. Roy, ed. *Product Lifecycle Management (Volume 1)*

: 21st Century Paradigm for Product Realisation. Cham: Springer International Publishing (Decision Engineering), pp. 1-32.
doi: 10.1007/978-3-030-98578-3_1.

Stark, J., 2022-b. PLM and Organisational Change Management. In: R. Roy, ed. *Product Lifecycle Management (Volume 1) : 21st Century Paradigm for Product Realisation.* Cham: Springer International Publishing (Decision Engineering), pp. 421-452.
doi: 10.1007/978-3-030-98578-3_13.

Terzi, S., Garetti, M., Bouras, A. & Kiritsis, D., 2010. Product lifecycle management - From its history to its new role. *International Journal of Product Lifecycle Management,* 4(4), pp. 360-389.
doi: 10.1504/IJPLM.2010.036489.

von Stietencron, M. et al., 2017. *Applying Closed-Loop Product Lifecycle Management to Enable Fact Based Design of Boats.* Cham: Springer International Publishing (IFIP Advances in Information and Communication Technology. 517).
doi: 10.1007/978-3-319-72905-3_46.