D1.1 CRM efficient PaaS demonstrator 1 – Washing machine

Modern business practice in general emphasizes the social dimension equally as the environmental one [1]. The social sustainability interplays with much needed transitions to a circular economy (CE) according to the European Commission's vision for a clean planet. A few scientific publications overviewed the social sustainability for manufacturing; for instance, [1] showed relevant national-level indicators as well as stakeholders and indicators for manufacturers. For the enterprise level, relevant indicators are further developed; e.g., [2]. However, research on the social sustainability is underdeveloped compared to that on environmental sustainability for manufacturing and in the context of a CE [3, 4]. Therefore, Deliverable 1.1 of the Scandere project is presented in this document: it is a PaaS demonstrator building upon a CE model that the project developed in terms of the social sustainability [5]. The PaaS has been deployed in Belgian using washing machines and other appliances.

The PaaS demonstrated

The example offering demonstrated is a PaaS for home appliances such as washing machines provided by collaboration between a Scandere partner, BSH (Bosch and Siemens home appliance), and a social enterprise in Belgium called SAAMO West-Vlaanderen (SAAMO, hereafter). This variant of the PaaS model has been implemented in Belgium since 2018, under the name Papillon, targeting families living in poverty who cannot afford to buy energy-efficient household appliances [6]. SAAMO's mission is to help socially vulnerable people. The three actors with flows of products/services and money involved in the case PaaS offering are visualized in Figure 2.

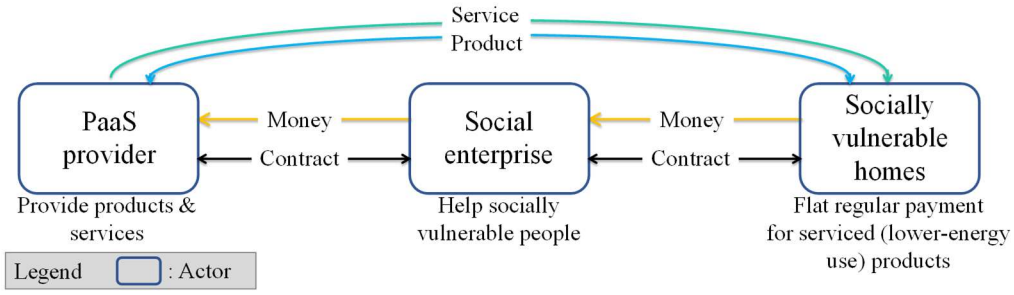

Figure 1. Three actors with flows of products/services and money involved in the case PaaS offering (Source: BSH home appliance).

Social sustainability of the PaaS

The guideline for social life cycle assessment (S-LCA) provided by UNEP/SETAC was used. It is a methodology to evaluate the social impact of a product or service throughout its lifecycle. It consists of two documents: (1) guidelines for S-LCA of products and organizations [7] and (2) methodological sheets for subcategories in S-LCA [8]. In this project, the authors propose to use qualitative indicators, utilizing the following options to categorize their influence compared to traditional businesses by an original equipment manufacturer (OEM); no influence, unknown, positive, possibly positive, negative, and possibly negative. The reference is set as the traditional product one-off sales businesses as an OEM for the identical product. This proposal is motivated by the lack of data and the significantly large resources needed for decisive assessment results. The social sustainability is shown in Table 1 focusing on key aspects from all the six stakeholder categories. Among the 41 subcategories, many were assessed as no influence or unknown and none was assessed as negative or possibly positive

Table 1. Key aspects of the PaaS case from social sustainability assessment

Stakeholder category	Subcategories	Inventory Indicator	Assessment	Reasoning behind
Workers	Working hours	Number of hours effectively worked by employees and Number of holidays effectively used by employees	Possibly negative	In case providing 24*7 service to the end users in the PaaS, the hours and the holidays might be influenced negatively compared with the product sales businesses.
Local Community	Community engagement	Diversity of community stakeholder groups that engage with the organization	Positive	In the PaaS, the local social enterprise is involved contributing to the business

				viability and to bridging with local municipalities.
	Local employment	Percentage of spending on locally-based suppliers	Unknown	In the PaaS, local dealers are not needed but repair work generates local jobs.
Value chain actors	Promoting social responsibility	Integration of ethical, social, environmental, and regarding gender equality criterions in purchasing policy, distribution policy, and contract signatures	Positive	The PaaS is judged to have integrated ethical, social, and environmental aspects in the business.
Consumer	End-of-life responsibility	Do internal management systems ensure that clear information is provided to consumers on end-of life options (if applicable)?	Positive	The PaaS includes end-of life treatment and maintenance support (prolonging product lifetimes), so that end users are not only informed but also significantly supported.
Society	Poverty alleviation	The organization carries out a poverty alleviation program	Positive	The PaaS helps socially vulnerable people in energy poverty in terms of, primarily, energy bills (from using washing machines for cleaned clothes and refrigerators for fresh food) and, secondly, living comfort.
Children	Health issues for children as consumers	The organization carries out programs to promote health impact to children	Positive	The PaaS provides home appliances that contribute to physical, mental, and social well-being of children (and adults).

The PaaS deployed

In Papillon, for some appliances, the contracts run for a period of 10 years with a monthly rent of around €11 per unit: subsidies from the Flemish Minister of Energy (also Environment) contribute to reduce end-customers' payment down to €9 per month (according to SAAMO). The PaaS contract also includes delivery, installation, instruction, return of an old unit, 10 years of "full service" and collection of the unit at the end of the contract (see the subcategory of end-of-life responsibility). Figure 2 shows the washing machine used for the PaaS in Papillon. More information about Papillon is available at https://papillon.saamo.be/nl/

Figure 2. Washing machine used for the PaaS in Papillon (Source: https://papillon.saamo.be/nl/)

Acknowledgement

This document is Deliverable 1.1 of the project Scandere (Scaling up a circular economy business model by new design, leaner remanufacturing, and automated material recycling technologies), which has been granted from the ERA-MIN3 program under the grant number 101003575. SAAMO West-Vlaanderen is much appreciated for their invaluable support.

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References

1. Sutherland, J.W., J.S. Richter, M.J. Hutchins, D. Dornfeld, R. Dzombak, J. Mangold, S. Robinson, M.Z. Hauschild, A. Bonou, P. Schönsleben, and F. Friemann, *The role of manufacturing in affecting the social dimension of sustainability.* CIRP Annals - Manufacturing Technology, 2016. **65**(2): p. 689–712.
2. Hutchins, M.J., J.S. Richter, M.L. Henry, and J.W. Sutherland, *Development of indicators for the social dimension of sustainability in a U.S. business context.* Journal of Cleaner Production, 2019. **212**: p. 687-697.
3. Alvarez, C.M. and T. Ligthart, *A social panorama within the life cycle thinking and the circular economy: a literature review.* International Journal of Life Cycle Assessment, 2021. **26**(11): p. 2278-2291.
4. Bhatnagar, A., A. Härri, J. Levänen, and K. Niinimäki, *Exploring the role of social life cycle assessment in transition to circular economy: A systematic review.* Resources Conservation and Recycling, 2024. **207**.
5. Sakao, T. *Social sustainability of home appliance product-as-a-service for a circular economy*. in *2025 REMADE Circular Economy Technology Summit & Conference*. 2025. Washington D.C.
6. Dworak, C. and J. Longmuss. *Focus on Reparability*. in *3rd PLATE Conference*. 2019. Berlin.
7. UNEP, *Guidelines for Social Life Cycle Assessment of Products and Organisations*. 2020, United Nations Environment Programme (UNEP).
8. UNEP, *Methodological Sheets for Subcategories in Social Life Cycle Assessment (S-LCA)*. 2021, United Nations Environment Programme (UNEP).