

**MASTER THESIS**  
**(COUPLED WITH A WORKING STUDENT POSITION)**

**CIRCULAR ECONOMY AND THE INTERNET OF THINGS:  
DIGITAL PRODUCT PASSPORTS FOR ASSET REUSE  
IN THE B2B CONTEXT**

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| Supervisors:      | Univ.-Prof. Dr. Erik G. Hansen<br>Institute for Integrated Quality Design (IQD)<br><i>Optional (in case of Business Informatics studies):</i><br>Univ.-Prof. Dr. Stefan Koch<br>Chair of Business Informatics - Information Engineering |  INSTITUTE FOR<br>INTEGRATED<br>QUALITY DESIGN |
| Industry partner: | Electrical engineering – Environmental management –<br>Supply chain management<br>Siemens AG Österreich   |    |

The Institute for Integrated Quality Design (IQD) at the Johannes Kepler University Linz (JKU), Austria, and Siemens AG Österreich are searching for an excellent student to work on a cutting-edge research topic at the intersection of the circular economy and the internet of things in the B2B context.

## BACKGROUND

A Circular Economy (CE) proposes circular strategies including maintenance, repair, reuse, remanufacturing, upgrading and recycling (Blomsma, Kjaer, Pigosso, McAloone, & Lloyd, 2018) to overcome the current linear systems of production characterised by negative environmental externalities (Kirchherr, Reike, & Hekkert, 2017). In industrialised societies, products are often quickly replaced by newer versions despite their condition. In this sense, *reuse* is a promising strategy because it allows longer product lifetimes and higher efficiency across several users.

Reuse, and more broadly the CE, are increasingly driven by the digitalisation and the Internet of Things (IoT). The IoT represents a new technological wave reshaping the way in which products are used as well as how organisations create value. Internet platforms address information deficits (e.g., [materiom.org](http://materiom.org) provides a materials library) and bring together supply and demand in the CE to form circular markets (Berg & Wilts, 2019). They increasingly enable the reuse or sharing of existing products and assets, both in the consumer-to-consumer sphere (e.g., [ebay.com](http://ebay.com)) as well as in business-to-business (e.g., [floop2.com](http://floop2.com), [pathway21.com](http://pathway21.com)). This might contribute to the monetisation of excess capacity, more efficient resource flows and cost reductions (Konietzko, Bocken, & Hultink, 2019).

However, digitalisation not only enables a matchmaking between supply and demand, it also changes what we know about (used) products. The use of sensing or identification technologies allows firms to gather critical product data like its condition, location and performance (Porter & Heppelmann, 2014). Digitalisation also provides the required information about products and assets to enable the implementation of feedback-loops and circular strategies (EMF, 2016). This could be done by facilitating the tracking of materials stocks (Heeren & Hellweg, 2019; Myers, Fishman, Reck, & Graedel, 2019), as seen in the case of the construction industry ([bamb2020.eu](http://bamb2020.eu)).

Sometimes, data across the life-cycle is integrated in product life-cycle (management) databases and solutions (Kiritsis, 2011; Li, Tao, Cheng, & Zhao, 2015; Pagoropoulos, Pigosso, & McAloone, 2017). A notable example in the textile industry is the development of a pioneer initiative to power end-to-end business intelligence across fashion manufacturers, apparels and retailers (connect-fashion.com).

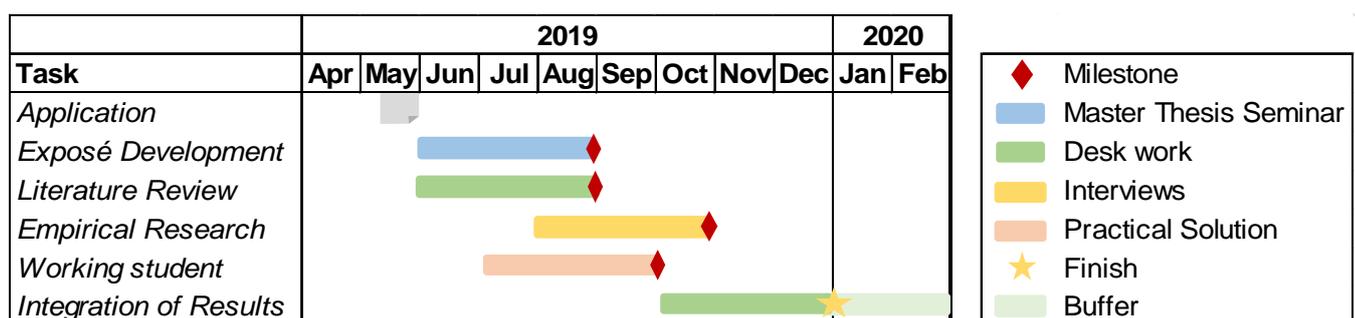
## FOCUS: DIGITAL PRODUCT PASSPORTS

While platforms for exchange of second-hand products become available and products become smarter providing more life-cycle data, significant barriers for the market exchange of used products pertain. One major challenge is the exact identification and characterisation of used products covering multiple aspects across the product life-cycle, such as their material composition, actual condition, and/or (remaining) economic value. Extant literature addresses this issue with concepts such as product biographies (Spring & Araujo, 2017), product/material passports (Luscuere & Mulhall, 2019), or circularity passports (EPEA GmbH, 2019) to signalise a catalogue with information about products, their characteristics, components and ingredients (Luscuere & Mulhall, 2019). For example, the main goal of materials passports in the building industry is to determine the residual value of the product and its components to provide insights into the economic potential for optimal use, recovery and reuse (Luscuere & Mulhall, 2019). For this thesis, the concept of “Digital Product Passport” could incorporate any relevant product or asset information like description, status, current quality, age, technical data, price, location, operating hours, and service history, among others.

## YOUR TASK

- Develop an academic understanding of the concept of “Digital Product Passport” in the context of the CE – in particularly for reusing products and assets. What are digital product passports? How are they used in digital environments? How do they enable the extension of product lifetime and an increase in efficiency? And what role do they play in the B2B context?
- Based on your conceptual understanding you will analyse the current situation, best practices and requirements of the SIEMENS “Reuse” programme through desk research, internal interviews with actors from various departments, and where necessary, interviews with external partners.
- Your overarching goal will be to develop a strategy for implementing digital product passports to manage the reuse of products and assets at SIEMENS.
- As a working student at SIEMENS, you assess current lifetime management and valuation approaches for used products and assets, you develop the business benefit of digital product passports, you analyse requirements, sources of information and develop a proposal for its implementation. This information is integrated in a report and presentation.

## SUGGESTED TIMELINE



## WORKING STUDENT POSITION AT SIEMENS

Embedded in your Master Thesis, you can work at SIEMENS in Vienna or Linz 10-25 hours a week for the duration of 3 months (this is additional time on top of the conventional thesis). You will be paid the usual hourly salary for working students. The time as working student will be dedicated to develop practical solutions for SIEMENS, whereas at the university you will use the practical experience to develop your scientific results of the thesis. Together you will gain practical and scientific experience.

## APPLICATION AND CONTACT

You are an excellent and highly motivated student? You are keen to take part in latest research in Circular Economy and the Internet of Things? You study a management-related programme (e.g., General Management; Business Informatics)? If your answer is YES, then submit your e-mail application (motivation letter, resume with picture, grades certificates and other relevant documents) as soon as possible to [andres.alcayaga@jku.at](mailto:andres.alcayaga@jku.at).

For any further questions, do not hesitate to contact us.

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## LITERATURE

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