Institution: University of Sunderland

Unit of Assessment: 12 Engineering

Title of case study: Wholescale modernisation of a major manufacturer's asset maintenance management system

Period when the underpinning research was undertaken: 2015-2020

Details of staff conducting the underpinning research from the submitting unit:

Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
David Baglee	Professor and Head of School of Engineering	2012-present
Salla Martonnen-Arola	Research Fellow	2017-19

Period when the claimed impact occurred: 2019-December 2020

Is this case study continued from a case study submitted in 2014? N

1. Summary of the impact (indicative maximum 100 words)

Research by Martonnen-Arola and Baglee at Sunderland was fundamental in supporting a case for wholescale modernisation of a major Tier 1 automotive supplier's asset maintenance management systems. It underpinned the company's £50,000 investment in a Computerised Maintenance Management System (CMMS) during a period of major political and economic uncertainty. The CMMS will operate across the site's entire plant and machinery asset base, which has a net book value of £3.25 million.

2. Underpinning research (indicative maximum 500 words)

The underpinning research is a body of work produced by David Baglee and Salla Martonnen-Arola, in collaboration with colleagues at Lappeenranta University of Technology, VTT Technical Research Centre of Finland, and Luleå University of Technology.

A preliminary study of various Internet of Things technologies and applications in industrial asset management **[R1]** revealed the research potential of specific technological applications in asset management, based on a study of previous literature and a group of industrial professionals and academic experts. [Note the work was undertaken several years prior to publication].

A further study of inter-organisational asset management through managerial models **[R2]** concluded that one of the biggest challenges of inter-organisational collaboration in asset management is how to effectively share data and information which is highly diffuse and fragmented.

The project then addressed the vast amount of data available in the daily maintenance operations of manufacturing industry, and discussed new data mining solutions to support especially condition-based maintenance **[R3]**, emphasizing the difficulty of extracting valuable knowledge from the raw data, which constituted the main research problem of the LeaD4Value project (see below).

The research also focused on the data required in different asset management decision-making situations during a fleet life cycle **[R4]**. Although this research studied asset fleets, it concluded that novel methods are needed to ensure that the correct data is collected, processed and exploited in various decision-making situations.

A final strand of research emphasized that existing asset management standards (ISO 55000) are mostly seen to benefit large organisations and that small and medium sized enterprises (SMEs) might struggle with adopting the complex methods **[R5]**.

After discussing the published research papers with industry, it became apparent that a new industry-driven project was needed to support manufacturing SMEs with the collection and analyses of production data. Lean Data Management for Maintenance Value (LeaD4Value), funded by a Marie Curie Individual Fellowship awarded to Martonnen-Arola, studied how the business value of industrial maintenance data can be maximised through adopting lean principles, using case studies to demonstrate how data use can be optimised in maintenance decision-making by adopting lean management principles. These case studies were based on rigorous analyses of partner companies' existing practices and maintenance data, and identified value-destroying challenges and their impact on asset maintenance management. This impact case study is based on one such analysis, where Martonnen-Arola and Baglee identified four key value-destroying challenges: unnecessary data transfer, unnecessary data processing, incorrect data and analyses, and waiting for data and decision-making **[R6]**.

3. References to the research (indicative maximum of six references)

R1 Sini-Kaisu Kinnunen, Antti Ylä-Kujala, Salla Marttonen-Arola, Timo Kärri, and David Baglee (2018) Internet of Things in asset management: insights from industrial professionals and academia. *International Journal of Service Science, Management, Engineering, and Technology,* 9 (2), pp. 104-119. **Quality indicators**: Peer-reviewed article. Q2-ranked journal

R2 Antti Ylä-Kujala, Salla Marttonen, Timo Kärri, Tiina Sinkkonen, and David Baglee (2016) Inter-organisational asset management: linking an operational and a strategic view. *International Journal of Process Management and Benchmarking,* 6 (3), pp. 366-385. **Quality indicators**: Peer-reviewed article. 9 citations.

R3 David Baglee, Salla Marttonen, Diego Galar (2015) The need for Big Data collection and analyses to support the development of an advanced maintenance. *The 11th International Conference on Data Mining* (DMIN'15), July 27-30, Las Vegas, Nevada, USA, pp. 3-9. **Quality indicators**: Peer-reviewed conference presentation. 17 citations.

R4 Sini-Kaisu Kinnunen, Salla Marttonen-Arola, Antti Ylä-Kujala, Timo Kärri, Toni Ahonen, Pasi Valkokari, David Baglee (2016) Decision making situations define data requirements in fleet asset management. *Proceedings of the 10th World Congress in Engineering Asset Management* (WCEAM 2015), Lecture Notes in Mechanical Engineering (2195-4356), Springer, pp. 357-364, ISBN 978-3-319-27062-3. **Quality indicators**: Peer-reviewed conference paper, subsequently selected for peer-reviewed proceedings. 16 citations.

R5 David Baglee, Ibifuro Ihemegbulem, Salla Marttonen-Arola (2016) Identifying organizational requirements for the implementation of ISO 55000 in small to medium sized enterprises (SMEs). *Euromaintenance 2016,* Athens, Greece. **Quality indicator**: Peer-reviewed conference paper.

R6 Marttonen-Arola, Salla, Baglee, David, Yla-Kujala, Antti, Sinkkonen, Tiina and Kärri, Timo (2020) Modelling the wasted value of data in maintenance investments. *Journal of Quality in Maintenance Engineering*, 26 (3). **Quality indicators**: Peer-reviewed article. Q2-ranked journal.

Funding

EU Horizon 2020 Marie Curie Individual Fellowship. 'Lean data management for maintenance value' (LeaD4Value) PI: Martonnen-Arola. 2017-19. €195,454.

4. Details of the impact (indicative maximum 750 words)

Faurecia is a tier-1 supplier to Nissan Manufacturing UK, the producer of a third of all cars in the UK, and had a turnover of £43m in 2019 [**S1**]. The company's Washington site was a partner in the LeaD4Value project. It manages asset maintenance using a manual system using paper forms, information from which are subsequently input into spreadsheets. Martonnen-Arola and Baglee carried out rigorous analyses of Faurecia's maintenance

management data and processes. The four key value-destroying challenges identified by the research **[R6]** increase both the likelihood and duration of unplanned downtime. This is of major concern to the site since its main customer, Nissan Manufacturing UK, operates a continuous manufacturing process. In the event of downtime, buffer stock is used to maintain supply to the customer. However, when this runs out Faurecia is charged a penalty of £10,000 per minute **[S2]**.

Martonnen-Arola and Baglee's research gave the site's senior management staff a comprehensive insight into the shortcomings affecting production, downtime and data-based decision making, and their financial impact. Moreover, their analyses allowed senior management staff to understand, for the first time, the expected costs and benefits of addressing these shortcomings by modernising their maintenance management processes. Martonnen-Arola and Baglee's findings underpinned their recommendation that the site invest in wholesale modernisation of its maintenance management system. The site's Manufacturing Engineering Manager says: "*Faurecia accepted this recommendation and in 2019 used the analyses to support a £50,000 investment in a Computerised Maintenance Management System that will integrate into SAP. That the investment was made despite current economic and political uncertainty speaks to the importance of Dr Martonnen's and Prof. Baglee's work, and the value that Faurecia places in this new system*" **[S3]**. Likewise, the significance of the investment is reflected in the fact that implementation will necessitate planned downtime, thus risking considerable penalties by their main customer. The system will manage maintenance of the entire plant and machinery assets, which have a current net book value of £3.25 million **[S1]**.

In undertaking this wholescale modernisation programme, the site will see an increase in production of around 1,100 hours per year through reduced breakdowns. Reducing breaktimes de-risks the site's asset maintenance strategy, since it consequently reduces its exposure to the significant financial penalties it can incur during unplanned downtime. The Manager says, "*When the system is implemented in late 2020/early 2021, we expect to see cost- and time-savings, enhanced proactive decision-making, improved data reliability, and proactive spare part management*." The new system will "*create easily accessible data to allow the technicians to review previous faults during the fault-finding process, and allow the maintenance planner easy access to the same data while reviewing the suitability of the current preventative maintenance schedules*" **[S3]**.

5. Sources to corroborate the impact (indicative maximum of 10 references)

S1 SAI Automotive Washington Limited (trading as Faurecia) annual report and financial statements for year end 31/12/2019
S2 Marttonen-Arola, Salla and Baglee, David (2019) *Adoption of information-based innovations in industrial maintenance.* In: The XXX ISPIM Innovation Conference, 16-19 June 2019, Florence, Italy.
S3 Written testimonial from Manufacturing Engineering Manager, Faurecia.