

Impact case study (REF3)

Institution: Teesside University		
Unit of Assessment: 12		
Title of case study: Developing digital technologies and processes to support the management of assets in heavy engineering and construction projects		
Period when the underpinning research was undertaken: 2011-2020		
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:
Nashwan Dawood	Associate Dean (R&I)	Nov 1991 to Present
Huda Dawood	Senior Lecturer in Engineering	Sep 2014 to Present
Joao Patacas	Research Associate	Nov 2016 to Present
Mohamad Kassem	Enterprise Fellow	Feb 2011 to Sep 2016
Vladimir Vukovic	Research Lecturer	Aug 2014 to Present
Period when the claimed impact occurred: 1 st August 2013 to 2020		
Is this case study continued from a case study submitted in 2014? N		

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

Research on digital processes and asset engineering information sharing undertaken at Teesside University's Centre for Sustainable Engineering has led to the development of novel digital technologies and processes for the management of information flows throughout the entire life cycle of complex and heavy engineering and construction assets. Supported by two Knowledge Transfer Partnerships funded by Innovate UK, this research has increased the market potential and turnover of two companies working with the smart energy sector. For Datum360, research has contributed to a growth in turnover from 2018 to 2019 of 23% to GBP2,124,000, with international sales growing from close to zero to more than 35% of revenue. For Unasys, the research has expanded their client base and business portfolio and led to them securing funding from the Oil & Gas Technology Centre in Aberdeen for a project worth GBP650,000.

2. Underpinning research (indicative maximum 500 words)

There are many challenges in managing the large amounts of data that are generated and used throughout engineering and construction projects. Given limited knowledge about the requirements, processes, and the value of digital handover of information to the facility management phase, our research has focussed on data management in the built environment in the design and construction phases.

Between 2011 and 2013, research was undertaken to provide empirical evidence of the value of, and outlined the key requirements for, handing over digital information to the operational phase of assets [3.1, 3.2]. A structured framework for information management in Facilities Management and Maintenance (FMM) using web-based Common Data Environments (CDE) and open standards was developed to provide stakeholders in engineering and construction projects with the ability to manage their facilities using Asset Information Models. The models were developed on the basis of the delivery of information models from distributed data sources, the validation of the information models against asset owners' requirements, and the use of the information models in facilities management (e.g. operation and maintenance of assets) [3.3, 3.4].

The lack of a simple, flexible, and scalable class library poses challenges for information integration in engineering contexts where analogues of Building Information Management (BIM) standards are not available. The majority of engineering operations are using file-based data management approaches. This introduces problems in the synchronisation of individual instances of the class libraries, leading to conflicts that cost time and resources and trigger errors. Between 2011 and 2014, the team developed a web-based Common Data Environment,

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using a software as a service (SaaS) approach, enabling users to manage class library data from any internet capable device in any location, ensuring all users are working on synchronised data. The semi-structured database that was developed for the backend of the CDE represents a significant technical contribution, the application of which out-performs existing technologies, especially where engineering data volumes are high [3.5].

The late life and decommissioning stages of oil and gas and other industrial facilities present specific information management challenges. In particular, the availability of 3D and other visual models, which could support maintenance tasks and decision-making (i.e. if, when, and how to decommission) is typically limited. Between 2016 and 2018, research was undertaken to address these challenges through work on the integration of various sources of structured and unstructured asset information for oil and gas and other energy facilities – including the Owner/Operator’s documents, GIS data, as well as a variety of reality capture and visualisation methods to capture the interior and exterior of industrial facilities. This was successfully demonstrated through the development of a prototype web-based CDE using data from oil & gas clients as well as publicly available data, and provided a contribution to optimise the late life and decommissioning of assets within the oil and gas industry [3.6].

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

[3.1] Kassem M, Kelly G, Serginson M, Lockley S, Dawood N. 2015. BIM in facilities management applications: a case study of a large university complex. Built Environment Project and Asset Management. 5:3, 261-277. <https://doi.org/10.1108/BEPAM-02-2014-0011>

[3.2] Patacas J, Dawood N, Vukovic V, Kassem M. 2015. BIM for facilities management: evaluating BIM standards in asset register creation and service life. Journal of Information Technology in Construction (ITCon). 20, 313-331. Available at: <http://www.itcon.org/2015/20>.

[3.3] Patacas, J, Dawood N, Kassem M. 2020. BIM for facilities management: A framework and a common data environment using open standards. Automation in Construction. 120, 103366. <https://doi.org/10.1016/j.autcon.2020.103366>.

[3.4] Patacas J, Dawood N, Greenwood D, Kassem M. 2016. Supporting building owners and facility managers in the validation and visualisation of asset information models (AIM) through open standards and open technologies. Journal of Information Technology in Construction (ITCon). 21, 434–455. Available at: <http://www.itcon.org/2016/27>. Cited 13 times (Web of Science). Selected for REF2021.

[3.5] Rasys E, Dawood N, Scott D, Kassem M. 2014. Dynamic web3d visualisation of oil & gas facility assets. Proceedings of the 14th International Conference on Construction Applications of Virtual Reality (CONVR). Sharjah, United Arab Emirates. Available at: <https://research.tees.ac.uk/files/6439351/559489.pdf>.

This research was underpinned by funding from Innovate UK. grid.423443.6. Knowledge Transfer Partnership. 2011. KTP008668. GBP88,896. Partners: Teesside University (Dawood N) and Datum 360.

[3.6] Patacas J, Dawood H, Dawood N. 2017. Reality Capture and Visualisation of 3D Oil & Gas Facility Data for Operations and Decommissioning. Lean and Computing in Construction Congress (LC3). Volume I & Proceedings of the Joint Conference on Computing in Construction (JC3). Heraklion, Greece. 201-208. <http://itc.scix.net/paper/lc3-2017-285>.

This research was underpinned by funding from Innovate UK. grid.423443.6. Knowledge Transfer Partnership. KTP010316. GBP82,013. Partners: Teesside University (Dawood N) and Unasys.

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

Research at the Centre for Sustainable Engineering has enhanced the business portfolios and market potential of two smart energy companies, Datum360 and Unasys.

Datum 360 is an SME whose core business is the provision of consultancy services and the design and delivery of software solutions to manage engineering information to support operations and facility engineering. In partnership with Teesside University, Datum360 identified

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in 2010 the need to develop a new class library SaaS system. A class library is used to provide the configuration baseline of what information/specifications (data, documents & models describing the equipment) are needed to support the safe, profitable operation of a large engineered facility. It enables the generation of live project metrics when processing large volumes of project/asset lifecycle data against the class library requirements. As such the class library acts as a manager of the templates required for complex information. Supported by a Knowledge Transfer Partnership (KTP) between Teesside University and Datum360, collaborative research was undertaken to develop a competitive, flexible, reliable and robust Class Library system, CLS360, which was then embedded within Datum360's software portfolio [5.1]. The KTP Partner's Final Report states that the CLS360 system has 'provided Datum360 with a vehicle to deliver a game changing, configurable, secure, high performance, and virtualised (cloud based) platform for collaborating on engineering information. The commercial opportunity was to drive down costs and optimise the use of this information over the full asset lifecycle for global clients, by providing reliable tools and qualified feedback to the project collaborators. The KTP has delivered a Software as a Service (SaaS) offering. Datum360 consultants can now service more clients, more efficiently' [5.1]. The KTP ended in 2014.

Since 2014, Datum360 have expanded their client base, the research-informed system enabling Datum360 to secure new clients in Europe, Australia and North America (BHP, BP, Maersk Oil/Total, South32, Neptune Cygnus and ICL, Boulby) [5.2]. For the CEO of Datum360: 'the CLS360 system is now a core component of the Datum360 Connected Data platform and has enabled us to target a broader range of project opportunities including a developing focus on BIM and Digital Twins as we move forward' [5.2]. The system allows their clients to be agile with their asset information requirements and apply significant governance processes to the capture and management of that data [5.2]. The system has led to "solid growth" for Datum360. In 2019, the company had growth in turnover from 2018 of 23% to GBP2,124,000 and an increase in gross profit since 2018 of 43% to GBP1,364,000 [5.2]. In addition, the work with Teesside University has supported Datum360 growth. As stated by the CEO: 'the global Datum360 team has grown by more than 500%, international sales have grown from close to zero to be more than 35% of revenue. To cater for this growth, the team has moved offices, in collaboration with the university, from the Phoenix Building at Teesside University to the thriving Fusion Hive offices in Stockton-on-Tees' [5.2].

Unasys were established in 2000. Their business function is to reduce risk, cost and uncertainty by managing the transfer of care, custody and control of facilities throughout their lifecycle. They have recognised demand for digital (in particular visualisation) tools that enable their consultants and clients to access various sources of asset data to assist in managing commissioning and decommissioning procedures of oil and gas North Sea oil platform assets and other industrial assets. In Nov 2016, a collaborative project was undertaken with Unasys, supported by an Innovate UK KTP [5.3]. Research on digital technologies and processes for managing assets in the oil and gas sector was used to develop and implement a Capital Facilities Information Hand Over Specification (CFIHOS) compliant 3D GIS-based environment tool to manage large data sets of offshore oil, gas and renewable assets and facilities in the North Sea. The development of a visualisation interface by Teesside researchers was integrated with the company's Engineering Project Management software tool in 2017 and enabled the integration of facility 360 photo data and 3D GIS data with structured and unstructured asset data sources. According to the KTP Partners Final Report: the KTP has enhanced our capability to provide a 3D visualisation of offshore assets and utilise these models within our own decommissioning compliance software. The software provides an enhanced ability for our clients to make decisions relating to reusing, repurposing or recycling of aging assets' [5.3].

Since implementation in April 2018, the tool has enabled Unasys to target a broader range of opportunities that require the use of 3D Visualisation of complex data sets [5.4]. For the Managing Director of Unasys: 'the research has led directly to a number of new clients and further funding streams not only in Oil and Gas Sector but in Carbon Capture and Storage, Hydrogen, Offshore Wind and Energy from Waste. Those new and potential clients include EDF, TAQA, Orsted, Tufts University Boston, National Decommissioning Centre Aberdeen, Aberdeen University, ODE, Independent Oil and Gas, Ramboll and Volund. They see the value proposition in reduced cost, risk and uncertainty through better and effective transfer of care custody and

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control of facilities throughout their life cycle' [5.4]. The research has also led to Unasys reshaping their business portfolio. In 2016, they obtained funding from the Oil & Gas Technology Centre in Aberdeen for the project The Digital North Sea worth GBP650,000 [5.4]. The project aims to develop a digital 3D representation of an offshore asset, all associated infrastructure and the seabed bathymetry [5.5]. The five tools could save the industry around GBP70,000,000 over the next 20 years [5.4]. Unasys have also gone on to develop a whole life cycle information flow (WLCIF) framework for assets identification and management based on research undertaken with Teesside University. A prototype has been developed by Unasys and is now being tested in the field. The final version will be produced based on modification and testing of the final system in conjunction with industry partners [5.4]. The potential industry value is based on a five-asset deployment of the tool per year. Over the next 20 years, this could save the industry around GBP14,000,000 (per tool) [5.4].

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

[5.1] Knowledge Transfer Partnership Final Report (pdf). Datum360. KTP008668. Project completed on 02 January 2014.

[5.2] Signed Letter (pdf). Testimonial from the Managing Director of Datum360. Received on 16 March 2020.

[5.3] Knowledge Transfer Partnership Final Report (pdf). Unasys. KTP010316. Project completed on 06 November 2018.

[5.4] Email (pdf). Testimonial from Managing Director of Unasys Ltd. Received on 11 March 2021.

[5.5] Brochure (pdf and link). Unasys. (no date). The Digital North Sea. Available at: <https://www.unasys.com/digital-north-sea>