Impact case study (REF3)

Institution: Aston University

Unit of Assessment: 17 Business and Management Studies

Title of case study: Using systems thinking and serious games to improve operations management practice in organisations

Period when the underpinning research was undertaken: 2003-2020

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:
Prof Ben Clegg	Reader → Prof. Operations Mgt	2003 onward
Dr Richard Orme	PhD/Researcher → Teaching Fellow	2011 onward
Krishna Balthu	Research Associate →Teaching Fellow	2011-13,2018 onward
Dr Panos Petridis	Lecturer → Snr. Lecturer Gamification	2014 onward
Prof John Edwards	Prof. → Emeritus Prof. Knowledge & IS	1978 onward
Dr Dan Andrews	Research Fellow	2015 onward
Matt Davies	Teaching Fellow → Snr. TF Accounting	1993-99,2008 onward

Period when the claimed impact occurred: 2014-2020

Is this case study continued from a case study submitted in 2014? No

1. Summary of the impact

Aston University has developed systems thinking, specifically soft systems thinking, into a new approach known as the Process Orientated Holonic (PrOH) Modelling Methodology to model, debate, implement and gamify changes to strategic and operational processes in service and manufacturing organisations. Our research has created impact by (i) increasing *awareness* of systems thinking and gamification by management (ii) implementing *use* of soft systems thinking and gamification to give demonstrable organisational improvements, and (iii) ensuring a lasting *legacy* of systems thinking and gamification practice, as managers' use of these approaches becomes more effective after completing research projects with Aston University (see Sec.4).

2. Underpinning research

Aston University's critical thinking into operations, strategy and management of change has for decades focused on systems thinking, and more latterly on serious games and gamification; and provides context for much of the work done in the Operations and Information Management (OIM) Department. Since the late 1970s systems thinking, simulation, gamification and change management have historically been used by managers but typically limited to standard non-holistic approaches.

Aston University's OIM has demonstrated that standard soft systems methodologies (SSM) are too vague for effective organisational process improvement and standard hard systems methodologies (HSMs) are inappropriate for facilitating strategic and operations change management projects. The former are too ill-defined and the latter are too mechanistic. PrOH Modelling sits between hard and soft systems thinking by defining a set of rules and guidelines that enable holarchies (**R1, R2** and **R3**) to be validated and verified. PrOH Modelling, through applied research, has driven change management initiatives (see Sec.4) and gamification developments for performance enhancement and greater employee engagement.

The initial and original scientific research findings relating specifically to the PrOH Modelling Methodology and the composition of holarchies in organisations were developed by Aston's OIM. The PrOH Modelling Methodology is an extension of SSM but differs from it as PrOH Modelling has radically new and different rules and guidelines used to build sets of process models into holarchies (where each part – a holon – is both a whole process and part of another whole process) rather than into hierarchies (where each part is part of a whole with explicit inheritances from the whole). In brief this is because PrOH modelling

builds *holarchies* of models composed using rules of *abstraction and enrichment*, rather than using HSM rules which build organisational models as *hierarchies* using rules of *aggregation and reductionism* (**R1, R2,** and **R3**) or pure SSM that has no explicit rules or guidelines to build sets of *process* models. Thus PrOH Modelling can produce holarchies which allows re-contextualization of elements in holons at different levels of the holarchy to exhibit emergent and hidden properties.

In layman's terms this means that sets of systems models can be built using PrOH Modelling to represent a human activity (e.g. a business process) without having to resort to mechanistic similes. In addition systems thinking presentational techniques (e.g. story boarding - combining words and pictures effectively - and the use of scene setting) have been perfected in PrOH Modelling to make it appealing and accessible to non-expert practising managers. This is significant because PrOH Modelling assumes that systems composed of people, culture and awkwardly codified processes cannot be optimised in ways suited to mechanical systems, but must be improved through consensus building and, more lately, the development of novel serious games that embody systems thinking - making improvement approaches more accessible to practising managers.

Further original underpinning applied research continues contribution to systems practice in law firms (**R4**), automotive supply chains (**R5**) and gamification of disruption management in passenger rail services (**R6**); these contributions are published in academic journals papers in the systems science field and funded by various competitive research grants (**see G1** to **G10**).

3. References to the research

Journal Papers [Google Scholar citations October 2020]

R1 Clegg BT, 'Business Process Orientated Holonic (PrOH) Modelling'. *Business Process Management Journal*. Vol12, No4, 2006, p410-432. Gives rules of holarchy building. [16]. https://doi.org/10.1108/14637150610678050

R2 Clegg BT, 'Building a Holarchy using Business Process Orientated Holonic (PrOH) Modelling'. *IEEE Systems, Man and Cybernetics: Part A*. Vol.37, No.1, Jan 2007, p23-40. Gives detailed rules of holarchy with a manufacturing example. [33] 10.1109/TSMCA.2006.886343

R3 Clegg BT, Shaw D 'Using Process-Orientated Holonic (PrOH) Modelling to Increase Understanding of Information Systems'. *Information Systems Journal*. Vol18, 2008, 447-477. Gives detailed rules of holarchy building with an information systems example. [32] https://doi.org/10.1111/j.1365-2575.2008.00308.x

R4 Clegg B.T., Balthu, K., Morris, G. 'Changing professional service archetypes in a law firm by using Process Orientated Holonic (PrOH) modelling'. *Knowledge Management Research and Practice*. Vol.18, Iss.1, pp.38-52. Gives application to changing a law firm. [2] https://doi.org/10.1080/14778238.2019.1571387 .

R5 Kalaitzi, D. Matopoulos, A., Clegg, B, 'Managing resource dependencies in electric vehicle supply chains: a multi-tier case study'. *Supply Chain Management: an International Journal*. Vol.24, Iss.2, pp.256-270. 2019. https://doi.org/10.1108/SCM-03-2018-0116. Application to redesigning supply chains. [9]

R6 Clegg, B., Orme, R., Owen, C., Albores, P., 'Analysis of a Train-operating Company's Customer Service System during Disruptions: Conceptual Requirements for Gamifying Frontline Staff Development'. *Journal of Rail Transport Planning and Management*. Vol.8, Iss. 1, 2018, pp.56-77. https://doi.org/10.1016/j.jrtpm.2017.12.002. Application to game design for increasing employee engagement. [6]

Grants (selected: directly relevant to the underpinning scientific research and development)

G1 ESRC Productivity Insights Network. £45k. 'Exploring the productivity narrative in manufacturing organisations'. Led by Strathclyde with Aston, York and Bristol Universities, ES/R007810/1. Sept '19 – July '19.

G2 Rail Safety and Standards Board (RSSB, DfT) and Chiltern Railways - 'A feasibility study into how a synthetic digital environment can help people with less visible

impairments use rail more easily: a systems approach'. £195k. Clegg PI (CIs: Orme and Petridis). RSSB/2698. Sept '18 – Aug '18.

G3 Innovate UK. Niche Vehicle Network. 'Drivetrain Integration, Supply Chain Upscaling and Streamlining'. Clegg, CI (A. Matopoulos as PI). Advanced Propulsion Centre (APC, OLEV) With companies **Microcab** and **MCT-Reman**. £69k, for Aston University. Total Grant £167k. SMESC16-151. Oct '16 –July '17.

G4 RSSB and Chiltern Railways. Train Operator Company '15 competition. 'A systems thinking approach to improving passengers' information during disruptions (PIDD): a gamification pilot study'. Run as a development project with Chiltern Railways (Contract 51000597). Clegg PI (with P Albores, C Owen, P. Petridis). £165k value to Aston. £235k total. RSSB funded (DfT). 2015-2016.

G5 Chiltern Railways 'Minimising the impact of disruptive incidents for passengers through improved information sharing'. Contract research. £72k. BT Clegg PI (with C. Owen, P. Albores, L. Rackliff). Chiltern funded PO-032675. Apr '14 – Jun '15.

G.6 ESRC Case Award with SigmaPro. 'A systems Approach to integrating lean thinking and six-sigma'. £73k (plus £46k in-kind training in 6-Sigma). Clegg. Jan 2011 - Dec 2013. Part of capacity ESRC capacity building cluster award RES-187-24-0005.

G7 Knowledge Transfer Partnership (AWM & ERDF funded) with Higgs & Sons. 'To implement an innovative cultural change programme that will impact on sector performance by better understanding client needs, re-examining pricing strategy and challenging operational processes'. Used PrOH Modelling for change. Clegg. £122k. Aug 2011 - July 2013. KTP008633.

G8 EPSRC with Eyesparks. 'Transforming the adoption of product-service systems through innovations in applied gaming technology'. £409k to Aston. EP/K014080/2. 2013-2018.

G9 EPSRC with Orbit. 'An Intelligent Digital Household Network to Transform Low Carbon Lifestyles'. £669k. Led by Coventry University (with Aston, £20k). EP/K002716/1. Jan '13 - Dec '18.

G10 Erasmus[+], EU Programme. 'Financial Education for Future Entrepreneurs (FEFE)'. €276k, with **ELearning Studios** (UK), BEST (Austria), CARDET (Cyprus), Hi Iberia (Spain), University of Barcelona (Spain). £55k to Aston. Oct'16 - Sept'18. 2016-1-UK01-KA202-024585.

The above peer-reviewed publications and grant awards total approximately £1.2 million (as Aston PI) and another £1.1m (as Aston co-investigators) demonstrating the originality and significance of this research.

4. Details of the impact

Cases in this section (as published and funded in Sec.3 and corroborated by Sec.5) demonstrate PrOH Modelling and gamification awareness, use and impact.

Microcab – systems thinking to support supplier development: A ten-month £167k UK Government grant used PrOH modelling with Microcab and its suppliers to: (i) redesign new electric motor and gearbox changes for higher production volumes, (ii) strengthen supplier relationships with new suppliers, (iii) develop new commercial relationships with a large German Tier 1 company, (iv) win other projects (e.g. Ecobulk – a €12m Horizon 2020 project on the Circular Economy) and, (v) prepare for key exhibitions (e.g. CENEX-UK's Low Carbon Vehicle show 2018 and 2019). Owner and CEO said, "*Overall, we believe novel approaches brought by Aston to the project made a strategic difference to the company, and although difficult to quantify has enabled us to succeed with suppliers where we previously struggled. This may have saved us the equivalent of £100k per year in time and costs, (totalling nearly £500k so far) and has been instrumental in boosting our sales and developing our end user partnerships*". (**S1 testimonial**) (**funded by G3, work** continuing using **G1** data).

Eyesparks – gamification for manufacturing servitization: Co-developed systems (i.e. game technologies, development processes and a body-of-knowledge) has accelerated the adoption of advanced manufacturing services. Three digital game 'apps' were co-developed: (i) Drilling for Success, (ii) Unlock Your Insight, and (iii) The Service

Transformation Game. Over 240 businesses and 500 people have used these apps between 2014 and 2020. The Eyesparks MD stated that, *"…we would like to endorse the innovative use of gamification and servitization by the Advanced Services Group at Aston, as they have helped Eyesparks develop more robust, streamlined and impactful development practices and outputs. Working with Aston University has helped our business to grow"*. (**S2 testimonial**) (**funded by G8**).

SigmaPro, - systems thinking for service provision improvement: SigmaPro is a small successful quality management consultancy; it used the ideas of PrOH modelling to (i) build a survey on cause and effect of different quality management techniques. Further ESRC CASE award support developed a unique model using PrOH modelling and systems dynamics; this led to building a unique hybrid soft-hard **'cost-of-quality'** model that can assess the quality maturity of an organisation, predict its cost of quality, diagnose areas of deficiency and direct consultants to more accurately prescribe remedial actions. Used successfully with clients from 2013 up until 2020 it has helped SigmaPro create a unique selling point. The Operations Director stated, "*There is no doubt that SigmaPro's new approaches, based on the PrOH Modelling Methodology, has helped sell our services and given us sustainable competitive advantage from 2008 through to 2020."* He further added, *"an estimated contribution to the economy as a whole can be given as £3.6m*" (**S3 testimonial**) (**funded by G6**).

Chiltern Railways Company Ltd., (Arriva) – systems and games for improvement: Chiltern Railways operates mainline passenger services between London and Birmingham. PrOH modelling and serious games use by Chiltern has (i) reduced the impact of disruptive incidents for passengers through improved information sharing – applied PrOH modelling research with executive team and tactical managers changed disruption management practice. (ii) Improved passengers' information during disruption – a board game used by the training department improved systemic thinking and data use by frontline staff; and, (iii) increased accessibility of rail transport for people with less visible impairments – by creating a virtual reality game application called Station Partner (see Google Play). The Commercial Director stated that, *"…we strongly endorse the insightful application of systems theory, and innovative use of gamification by the OIM Department at Aston, as they have helped Chiltern address some complex challenges in our business*" (S**4 (a) and (b) innovation awards, S5 testimonial, and S6 article**) (**funded by G2, G4 and G5**).

E-Learning Studios – game application to support non-financial operations managers: The Count FEFE (Financial Education for Future Entrepreneurs) 'app' gamifies the learning process of management accounting for non-financial managers. Developed with ELS, a Coventry based serious games company; Count FEFE has been downloaded nearly 10,000 times from 2018-2020, and used by intuitions around the world (e.g. Pearson/Edexcel, Manchester Business School and the University of Johannesburg) who give strong instructor and end-user testimony to its effectiveness. For ELS the lasting impacts of working with Aston Business School has been follow-on funding success, improved (i) software development process (ii) client engagement, (iii) game design, and (iv) learner analytics. The Managing Director of E-Learning Studios stated that, "*…the expert input of Aston Business School's gamification experts in the FEFE project has had significant positive impact on the development of E-Learning Studios capabilities and resources in the field of games and gamification*" (**S7 testimonial**) (**funded by G10**).

Orbit Group Ltd. – games to reduce carbon use: Aston developed new gamification that have been used by householders to improve low-carbon-use lifestyle. Gaming technology advocated by Orbit and used by their clients (e.g. e.on) has delivered in-home displays to combine live energy consumption data with game playing techniques to reduce energy consumption. Orbit's Head of Portfolio Investment estimates that "*during the project 42% of the users have changed their ventilation behaviour, 36% changed their daily habits ... through greater understanding and visualization of how behaviours were impacting upon energy usage, and it could be seen that over time this could help customers to reduce their energy bills"*. (**S8 testimonial**) (**funded by G9**).

Higgs & Sons Solicitors – systems thinking for strategic change: Higgs & Sons used PrOH modelling for a strategic change project (2011-2013) to five legal services. Financial impacts during the project were estimated to be [text removed for publication] and similar for each year following the project up to 2020. In 2019 profits were [text removed for publication] than before the project. A Partner in the company stated, "*PrOH Modelling enabled … buy-in to developing solutions and catalyse implementation. Without the use of PrOH modelling, it is very unlikely that these changes would have happened…*". For (i) Road Traffic Accidents: "*conversion rates were* [text removed for publication]" (ii) Dispute Resolution: "*As a result of this work performed with this team those individuals have become champions on issues like pricing and profitability…*". (iii) Commercial Property Services *"…our lawyers work more efficiently …*". (iv) Corporate Services: moved from a "[text removed for publication]". (v) Private Client: "*a significant project to document, scan and manage all of the information in the will bank has been reinvigorated …*" This work was classed as "*outstanding*" by Innovate UK, shortlisted for KTP of the year in 2014 (from 800), received the prestigious Innovation Award 2014 from Suffolk University Law School, Boston (USA), and shortlisted for 'Innovative Law Firm of the Year 2016' by the International Legal Technology Association. In summary, Higgs*, "…believes that the PrOH modelling systems thinking developed at Aston University has created valuable long-lasting impact in our professional services environment*". (**S9 testimonial, S10 article**) (**funded by G7**).

5. Sources to corroborate the impact

S1 Letter of corroboration – Microcab Industries Ltd., Coventry.

S2 Letter of corroboration – Eyesparks Ltd., Belfast.

S3 Letter of corroboration – SigmaPro Ltd., Warwick.

S4 (a) Award Winner 2019 - Innovative teaching award, European Operations Management Association (EurOMA) **(b) Highly commended Award 2017 -** Innovative teaching award EurOMA. (certificates provided).

S5 Letter of corroboration – Chiltern Railways Company Ltd., Arriva Group, London.

S6 Dark, J., 'Delivering Arriva's Ambition'. Interview with Chris Burchell, MD of Arriva Trains UK. *Passenger Transport*. Iss.105, pp.34-37. 27th March 2015. 3rd party article citing research projects with Chiltern Railways (part of Arriva Trains UK).

S7 Letter of corroboration – E-Learning Studios, Coventry.

S8 Letter of corroboration – Orbit Group Ltd., Coventry.

S9 Letter of corroboration – Higgs & Sons Solicitors, Brierley Hill.

S10 Lentell, D. (2015) 'Times are ever changing, even for Lawyers: Higgs & Sons Embrace Change with Aston Business School'. *Developing Leaders Quarterly*. Iss19, p64-69. IEDP. 3rd party written on work by an independent author.