

Reinvigorating Soft OR for Practitioners: Report to HORAF

1. Introduction: This initiative was stimulated by a discussion at the November 2020 online meeting of HORAF, on the theme “Modelling with Uncertain Data”. Several members stressed the increased importance of Soft OR during the time of Covid but thought there was little recent case study evidence available. GORS/DSTL and some external consultancies are known to use some, or parts of some, Soft OR approaches but such work is rarely published. Academic research into Problem Structuring Methods (PSMs) was thought to have declined, in part because the ‘gurus’ who developed the main PSMs have retired (see section 2).

1.1. Soft OR: We agreed (more or less) that the following approaches should be included: Clearly *PSMs (Soft Systems Methodology (SSM); Strategic Options Development and Analysis (SODA) and Strategyfinder (an online Group Support System, based on SODA); Strategic Choice Approach (SCA))* plus *Systems Thinking (ST), Viable System Model (VSM)* and possibly *System Dynamics (SD), Scenario Analysis and Sensitivity Analysis – though in the event the latter three were not followed up.* Brief definitions of these main approaches are given in Annex A2 (with grateful thanks to Giles Hindle).

[Giles Hindle has also suggested that, for completeness, we should also include: *General Facilitation Skills*, Dyson et al’s *Strategy Framework*, *Group Model Building* (based on SD) and *Multi Criteria Decision Analysis (MCDA)*].

1.2 Aims: We agreed the following aims: 1. Understand the current Soft OR landscape 2. Publicise education and training opportunities, 3. Find recent successful case studies for promotional purposes 4. Create awareness of existing Soft OR community groups and 5. Advise HORAF members on how they can get (more) involved.

Note that this version has been expanded beyond the original aims in order to provide a comprehensive guide to those in the OR, Analytics and Data Science communities who wish to get involved, or more involved, in applying Soft OR approaches.

2. Information Collected

2.1 Practitioners: (via HORAF members at meetings). External consultants and GORS/DSTL have increased their use of Soft OR during Covid partly because of a lack of reliable historic data. External consultants are using *Cognitive Mapping, Rich Pictures, System Dynamics models, Viable System Model, Scenario Planning, Bayesian Forecasting, What-If-in-Excel and Strategic Planning*. The number of Soft OR ‘Champions’ in government is growing and they are beginning to request work. DSTL provides Soft OR expertise to government projects. The government Systems Thinking Interest Group (STIG) has over 250 members, not all from OR, and the ST network on LinkedIn is also large and active. Soft OR approaches are often used in combination with traditional hard OR and labelled ‘multi-methodology’.

Geoff Royston, ex manager of a large OR Group in the Department of Health (DoH) for many years, helped to introduce SD into the DoH. His group regularly used

Influence Diagrams, Uncertainty Analysis, Scenario Planning and Mapping. He said that these simple approaches help to bring stakeholders together and lead to a better understanding of other's roles.

Martin Parr, DSTL is joint chair of the highly successful PSM SIG (see below)

2.2 Academics We decided to approach those known by us to be currently active, rather than those who originally developed the main PSMs (Peter Checkland and Brian Wilson, *SSM* (1); Colin Eden and Fran Ackermann, *SODA and Strategyfinder* (2); John Friend and Allen Hickling, *SCA* (3)); plus Jonathan Rosenhead, who promoted *Robustness Analysis* and edited the best-selling book on Soft OR “*Rational Analysis for a Problematic World*” (4, 5).

Alberto Franco, Loughborough, is keen on the use of *Cognitive Mapping, SODA and Strategyfinder* and has published case studies in academic journals (e.g.13).

Robert Dyson, Frances O'Brien et al, Warwick, have had a major paper on Soft OR published in Operations Research in 2021, “Soft OR and Practice: The Contribution of the Founders of OR” (12), seemingly breaking INFORMS’ resistance to Soft OR. They have also made significant contributions regarding the use of OR methods within strategy making projects (26). Gomes et al, 2021, reviewed advances in PSMs over the last 10 years (11).

Mike Yearworth, Exeter; has used STEEP, a PSM like approach on two major projects (16.17) and is now a major force in the field (e.g. 7, 18). He is trialling *Strategyfinder*, which he thinks is a significant development. He has just been appointed as joint editor of EJOR (replacing Robert Dyson) and will also be supportive of Soft OR/PSM/Systems Thinking submissions.

[Leroy White, Exeter, also publishes in Soft OR.]

Kathy Kotiadis, Kent and Antuela Tako, Loughborough, teach SSM, SODA, Causal and Cognitive Mapping and carry out joint research. They have supplied three recent case studies (Annex A3).

John Mingers, Kent, published the most highly cited paper on Soft OR, in 2004 (13, also 14) but is no longer active in the field.

Giles Hindle, Hull University, studied with Peter Checkland and has an active Action Research programme with over 50 projects using PSMs (especially SSM). He publishes Soft OR research and also developed a Business Analytics Methodology (with Richard Vidgen) which shows how Soft OR can front-end analytics strategies (27, 28). He has supplied two case studies (Annex 3), links to Soft OR videos on YouTube (19, 20, 21, 22) and the Soft OR definitions in Annex 2. He and Mark Westcombe, Attivation, ex-Lancaster University, are ORS trainers on Soft OR (see section 4 and Annex A4).

[Chris Smith and Duncan Shaw, both University of Manchester, publish Soft OR research.]

[Frances O'Brien, University of Warwick, publishes around OR and strategy and in particular scenario analysis (29).]

Martin Parr, DSTL and visiting Professor at Kent University and Christina Phillips, Liverpool John Moores University, are co-chairs of the ORS PSM Special Interest group (section 3.11).

In summary, there has been a rise in Soft OR research and publications in the last few years in the UK; INFORMS resistance to Soft OR is weakening; EJOR welcomes Soft OR papers, JORS less so recently but the new editors appear to be more sympathetic. The popularity of the various PSMs over the last 10 and last 50 years has been published in two recent papers (11, 12). SSM is the most popular PSM over both periods. UK researchers still publish the most applications of Soft OR in academic journals.

3. Soft OR Communities

3.1 ORS Special Interest Groups (SIGs)

3.11 Problem Structuring Methods (Co-Chairs Martin Parr, DSTL and Kent University, Christina Phillips, Liverpool John Moores University). This SIG was reinvigorated by the current co-chairs a couple of years ago and at the time of writing had 1266 members, of whom 55% are ORS members. Well attended online meetings are held (80-120 registrations, now virtual with some international speakers and participants). An early survey of members' interests and usage of Soft OR approaches elicited 35 responses, evenly split between academics and practitioners, mostly in mid- and late- career, unsurprising as maturity and experience are critical for addressing 'messy' problems. SSM, SODA and VSM were the most used PSMs but much independent use of the tools within PSMs such as *Rich Pictures*, *Cognitive Mapping* and *Causal Loops (Mapping)*, chosen according to the context were also reported. The co-chairs both stressed the value of using Soft OR approaches e.g. *Rich Pictures*, in pre-project planning, which adds just a few per cent to the cost of a project. (The SIG is to offer training courses in Soft OR in 2022 – Gavin Blackett, ORS)

3.12 Public Policy SIG promotes the Strategic Choice Approach (2) but believes most support and use is now via planners in the public sector. Their meeting in December 2020 celebrated (joint founder) John Friend's 90th birthday and raised a plea for someone from the OR community to champion this approach.

3.13 Behavioural OR SIG. (Geoff Royston promoted this during his Presidency) This SIG organises meetings and streams at ORS conferences but not many practitioners are involved so far. Geoff sent us a copy of a chapter he has written (Past, Present and Futures of Behavioural OR) in a recent Book (6) He would like to see Behavioural OR as a standard component in OR training.

3.2 Systems Thinking (Niki Jobson, 25 years in DSTL and a recent ORS member). Nikki is involved in the GORS- led Systems Thinking in Government (STIG) network of ST, now with over 200 members, many non-OR. She is a Non-Executive Director of SCiO (Systems and Complexity in Organisations) which is the professional body for Systems Thinking Practitioners (STPs). They have developed a competency framework which forms the basis of professional accreditation for STPs, which is referenced in the Systems Thinking Level 7 apprenticeship (both in Annex A4).

There is a commonality of approaches between Soft OR and Systems Thinking, eg SSM. Multiple streams have taken place at recent ORS conferences, in effect ST conferences, organised by Giles Hindle, Gerald Midgley and Niki Jobson (and others).

Nikki is seeking to set up a STEM (Science, Technology, Engineering, Maths) Futures Hub, with partners from across government and industry, that enables the partner organisations to establish a targeted talent and development pipeline for addressing skills gaps and future-proofing capability. DSTL is leading this. ST is also strong and active on LinkedIn.

3.3 OR and Design (Also promoted by Geoff Royston during his Presidency) The Design Society now has good links with ORS, particularly in the health area, mostly with academics involved, and has set up a Special Interest Group on Health Systems (24). The work of the Engineering Design Centre at the University of Cambridge has some OR links, particularly in health, e.g. design of outpatient departments. Some joint activities are ongoing.

4. Soft OR Training Courses

4.1 ORS The OR Society has traditionally offered training courses in Soft OR. The 2021 programme includes: *Introduction to PSMs; SSM; and Cognitive Mapping*, given by Giles Hindle and Mark Westcombe, who also use these approaches, plus *SODA, SD* and *Rich Pictures*, in their consultancy work. Giles Hindle provided two impressive case studies which illustrate the effective use of *SSM* (Annex A3). He also has videos on YouTube explaining the use of several PSMs and Soft OR tools (20, 21, 22, 23). **Mark Westcombe stresses that complex craft skills are needed to apply Soft OR effectively.**

4.2 Systems Thinking Some training is provided at Cranfield and the Open University and there is also the level 7 apprenticeship (Annex A4). DSTL runs its own 3 day internal course and GO Science is developing a ST toolkit. Training in VSM is offered by SCiO (see section 3.2), which also runs regular mini-conferences and development days to help practitioners develop their knowledge and skills.

4.3 Master's courses in OR include Soft OR but are now a minor source of recruits into OR/Analytics.

4.4 Level 7 Apprenticeships have now been approved for OR; Data Science; and Systems Thinking and all include some Soft OR. However, our understanding is that the first students will not be enrolled until autumn 2021 so will not graduate until at least 2022. (Annex A4 gives links to each, showing the skills covered.)

4.5 The INFORMS CAP (Certified Analytics Professional) This qualification has been running for several years and contains some Soft OR.

5. Case studies

We have been offered ten (fairly) recent case studies, with enough detail to enable use in external promotion. (This excludes GORS, see Annex A1). Further details are given in Annex A3.

The approaches used are: *SSM*, 4; *PSMs* (general), 3; *SCA*, *VSM*, *ST*, all 1; plus individual tools such as *Mapping*, *Influence Diagrams*, *Issue Based Analysis*. However we recognise the difficulty of gaining approval from the clients of Soft OR projects, for confidentiality and sometimes political reasons.

6. Review of Information Collected

We have confirmed a resurgence of interest in *PSMs*, in practice and academia, particularly *SSM* and *SODA/strategyfinder*. The other main PSM, *SCA*, is being supported by the ORS Public Policy SIG but lacks a ‘champion’ from the OR community. Most use now seems to be by planners in the public sector.

Giles Hindle adds: PSMs are being used mainly in the following ways: to help at the start of a project – allowing stakeholder data to be collected and structured or projects to be planned; to help groups to make decisions and action plans within facilitated workshops; and to act as an epistemology within applied research projects to structure and code qualitative data.

Systems Thinking is analogous to PSMs and shares some approaches eg *SSM*. It has expanded rapidly in recent years, particularly in government, where the *ST* network has over 250 members, many non-OR. Multiple *ST* streams have been held at recent ORS conferences

There is much use of tools from within *PSMs* (and similar), such as *causal mapping*, *influence diagrams* and *rich pictures*. They also serve to bring stakeholders together in helping to resolve complex issues.

The outcome of a Soft OR project can lead to the subsequent application of a traditional OR method e.g. simulation (known as multi-methodology) but usually only by practitioners. In the main, academics in the field work solely within Soft OR.

Soft OR training courses organised by ORS (mainly PSMs) continue to be viable but mainly attract the public sector; and training for Systems Thinking practitioners is growing. Level 7 Apprenticeships have been approved for Systems Thinking, OR, and Data Science [Annex A4].

We have identified a handful of successful, relatively recent Soft OR case studies, which can be used for promotional purposes. The recent surge of interest in Soft OR in academia is supported by sympathetic publication outlets, such as EJOR and JORS. Also there could now be more potential in INFORMS journals. Academics are always interested in collaborating with practitioners but prefer to be involved at the beginning of a project.

7. Recommendations

As a result of this study we believe there is potential for the increased use by practitioners of Soft OR approaches, including PSMs, Systems Thinking and individual tools, particularly in the private sector. We therefore recommend:

- A workshop to raise awareness of the potential of Soft OR among HORAF members

- Further training for suitable staff members – via existing ORS courses and/or customised ones from current providers
- Promoting the use of Soft OR in pre-project planning
- Joining relevant ORS and other groups to keep abreast of Soft OR usage and further developments
- Considering research collaboration with appropriate academic partners

JR, JH, EM. 16/12/21

ANNEXES

A1. Summary of Discussion of Report at HORAF Meeting, 13th May 2021

A2. Definitions of PSMs and Related Tools

A3. Supplied Case Studies

A4. Available Training courses

A5. Some Key References

A1. Summary of Discussion at HORAF Meeting, 13th May

The results of the survey were presented by John Ranyard, Secretary, HORAF and Emma Murray, IBM at the HORAF meeting on 13th May, chaired by Duncan Russell, Ocado.

“Report on Reinvigorating Soft OR for Practitioners – JR said that this initiative had originated at the November meeting and subsequently he and John Hopes had set out to collect relevant information with support from EM, who had prepared the slides. John Hopes, who would have given this presentation, had dropped out for personal reasons but had written an editorial in IOR (April) promoting Soft OR. EM had also written an article in the same issue, reviewing the November discussion and her personal experiences of applying Soft OR. She thanked members for allowing their comments to be included. The presentation slides will be placed on Basecamp and a more detailed written report is being prepared, (i.e. this report).

In summary, JR said they had observed an increased interest in Soft OR (including PSMs, Systems Thinking and individual tools such as Rich Pictures) by both practitioners and academics, with potential for increased use. Recommendations include: an awareness workshop for members; hands-on training for suitable staff members; promoting the use of Soft OR in pre-project planning (added later); keeping up to date by joining relevant groups, (such as the ORS PSM Special Interest Group); and considering collaboration with academic partners.

TO'C explained why GORS had been unable to provide Soft OR case studies - mainly because of the difficulty in getting approval from clients but also because projects are not labelled as such. Soft tools are now regarded as belonging to the overall OR/Analytics toolkit and use of hard + soft (multi-methodology) is now commonplace. However he would be happy to endorse the importance of using Soft OR in helping to solve complex issues. GB pointed out that the new editors of JORS are more sympathetic to Soft OR; that the PSM SIG will be offering Soft OR training courses next year; and the online AGM (29th June, 3pm) includes a presentation by Prof Robert Dyson and Frances O'Brien, Warwick University on

"Soft OR and Practice: The Contribution of the Founders of OR." JM said he had obtained great value by reading relevant books, such as "Rational Analysis for a Problematic World", edited by J. Rosenhead. He has been using Soft OR e.g. Rich Pictures, for a long time, as he finds it good for scoping projects and making change happen. (JR – videos on demonstrating Rich Pictures are available on YouTube). NH added that scoping via Soft OR can help identify the critical assumptions which need to be handled with care. SH said that Giles Hindle (one of the ORS trainers) had given a helpful customised course at Sellafield. They find that Soft OR helps to scope hard projects but soft projects need to be chosen carefully. LM said that they use Soft OR a lot on their environmental projects: Systems Thinking can help to overcome 'silo' issues and they have documentation on some projects. TO'C felt that lockdown has largely scuppered facilitation approaches. (JR added later, Colin Eden has developed an online group support system, Strategy Finder, based on SODA, which shows great promise. It is being trialled by Prof Mike Yearworth at Exeter and presented at the EURO conference in July).

AR mentioned NATO's Human Environment Analysis Reasoning Tool (HEART), which is now available on the internet (and Basecamp), which is an overview of available Soft-ish OR approaches and is widely used in DSTL.

DR thanked JR and EM for the presentation and said that the Steering Group would further review the findings.

SG

A2. PSMs and Related Tools Definitions (with grateful thanks to Giles Hindle)

Soft Systems Methodology (SSM)

Strategic Options Development and Analysis (SODA)/strategyfinder

Strategic Choice Approach (SCA)

Systems Thinking (ST)

Viable Systems Model (VSM)

Causal Mapping, Cognitive Mapping – also Oval Mapping, Hexagons, Idea Clustering

Rich Picturing

Soft Systems Methodology (SSM) Developed at Lancaster University, SSM is most associated with the work of Peter Checkland and Brian Wilson. It started out life as a Systems Engineering method, but quickly evolved into a multi-purpose approach for addressing any kind of organisational problem. Its basic tenet is that the world is overwhelmingly complex and dynamic and so we should adopt a participative and experiential-learning mind-set to improve the situations we face. It uses the tool **Rich Picturing** (see below for more detail) to help groups explore situations and identify key issues. It also uses a modelling language based upon the concept of a **Purposeful Activity System** (PAS). PAS modelling allows groups to explore the fundamental nature and possible future state of organisational referents like business units, services, processes and even change projects. SSM can be used individually and in groups in all types of project and can be combined with other tools, including quantitative ones. (JR adds “SSM is the most popular PSM over the last 10 and 50 years.”)

Strategic Options Development and Analysis (SODA) has been developed by Colin Eden and Fran Ackermann at the University of Strathclyde in Scotland. It supports a group or individual to represent a problematic situation and explore strategic options and overall goals. The technique of **causal mapping** underpins the approach, which is a formally constructed network of statements (constructs) linked together by arrows indicating causality. The model changes as the views of the group develop through learning and exploration. Causal mapping helps groups learn about and discover important features of situations, and increases the probability of creative ideas and successful implementation. **SODA** is based upon theories from both cognitive psychology and social negotiation; it takes seriously the ‘content’ of the situation and the ‘process’ of supporting groups to reach workable agreements. **Causal mapping** can be completed using **Decision Explorer** software or through ‘**oval mapping**’ (see below) using post-its. SODA enables perspectives to be expressed publicly so participants feel the process is procedurally just; thus encouraging both emotional and cognitive commitment to outcomes. An up-to-date overview can be found in Reynolds and Holwell (2010).

[Note added by JR: Eden and Ackerman have just developed *strategyfinder*, an online Group Support System based on SODA, which is being trialled by Mike Yearworth, Exeter University and presented by him at the EURO conference in July, 2021
<http://hdl.handle.net/10871/126431>]

Strategic Choice Approach (SCA) The Strategic Choice Approach (SCA) enables a group of decision makers to deal with the interconnected set of decision problems they are facing. It was developed by John Friend and Allen Hickling and is based to a large part upon observation of experienced managers facing complex decisions. It helps decision makers focus their attention, balance present and future commitments and deal with three types of uncertainty – uncertainty about the working environment, uncertainty about values and objectives, and uncertainty about related decision fields (i.e. do we need a broader view?). It

has four based modes – shaping, designing, comparing and choosing. Shaping identifies ‘decision areas’ (any area of choice) and a ‘problem focus’ (those 3 or 4 decision areas we will focus on). The designing mode identifies options for each decision area and then ‘feasible decision schemes’ (sets of options which are compatible with each other). Comparing enables us to evaluate the feasible decision schemes on agreed ‘comparison areas’ as best we can. During the comparing mode a significant amount of uncertainty is often identified. During the choosing mode this uncertainty is examined and a set of decisions which can be taken now and a set of decisions which can be taken later are identified and agreed.

Systems Thinking (ST) is often regarded as originating in biology as a reaction to problems with reductionism within science. Reductionism means taking objects to pieces to understand how they work. Biologists argued biological phenomena literally disappear when plants and organisms are taken to pieces and their systemic properties can't be studied. The world should be viewed as hierarchical and interconnected. ST became highly influential in organisational theory and sociology; for example, ‘culture’ might be an example of a systemic property of an organisation or a society. From an OR perspective, ST tools have been used to conceptualise organisational referents like business units or processes and also to model the behaviour of complex systems. Famous approaches include the **Viable System Model** (Beer) and **Soft Systems Methodology** (Checkland) for conceptualisation and design of organisational referents, and **System Dynamics** (Forrester) for systems modelling and simulation. OR academics have also explored critical perspectives relating to ST including topics such as multi-methodology and boundary judgements (Jackson)

The **Viable System Model (VSM)** was developed by Stafford Beer, who was interested in what made systems successful – in particular, what structure and capabilities they must have in order to be successful. He wanted to develop a scientific model which was applicable to all types of systems. For him, success meant viability over time - i.e. the ability to adapt and survive in a changing environment. The VSM was the result of this research programme. He purports viable systems possess five key sub-systems which are (i) a set of primary activities, (ii) and (iii) functions of communication and control (of the primary activities), (iv) intelligence (knowing what's happening in the environment) and (v) policy making (setting direction and strategy). What makes VSM particularly interesting is that Beer argues the structure should be recursive - i.e. the primary activities should themselves also be viable systems. He argues this is an effective strategy for managing the complexity faced by an organisation. Subsystems which have some degree of autonomy are better able to manage the complexity they face – and this supports the viability of the overall system. The VSM can be used to design new organisational systems or diagnose structural or functional weaknesses in existing organisations.

Causal Mapping (CM), Cognitive Mapping (CM) The version of Causal Mapping found in OR relates to the technique underpinning Eden and Ackermann's **SODA**. It is based upon George Kelly's personal construct theory from cognitive psychology. A map is a formally constructed network of statements (constructs) linked together by arrows indicating causality. An example of a causal relationship might be ‘improve engagement with students’ leads to ‘reduced drop-out rates at university’. A map can be constructed individually (a **cognitive map**) or in groups using software (**Decision Explorer**) or post-its (**Oval Mapping, Hexagons, Idea Clustering**). The map represents a graphical representation of a situation and enables strategic options and goals to be carefully surfaced and explored. A map can be constructed relatively quickly to aid facilitation in a workshop or in a more detailed and analytical manner to fully explore chains of argument, dilemmas and key issues. Mapping

helps groups learn about the situation they face and arrive at negotiated agreement about how to resolve issues and move forward.

Rich Picturing is tool from **Soft Systems Methodology**. It's a cartoon-like representation of a situation drawn individually or by groups of up to four people. Google "rich pictures" for examples. The pictures can be drawn individually on a piece of paper, but for groups you'll need a large whiteboard or a similar surface. Drawing software can be used effectively, especially online by sharing a screen. The objective when picturing is normally to step back from the situation and try to represent it holistically; noting all the key features and issues. However, if time is tight, an interviewer might choose to explore possible future actions too. There is no set format for a rich picture and individuals tend to find a style that suits them – some with more picturing, some with more text. Picturing can be undertaken in a detailed, analytic manner or in a more light-hearted manner when interaction between participants and the surfacing of issues is of more importance. It promotes communication between participants and helps avoid premature assumptions about problems or the purpose of a project.

Annex A3. Supplied Case Studies

The Table below summarises the ten case studies we have received, that could be used for promoting the use of Soft OR. Further details are given after the Table.

No./Client	Project title	Approach	Author	Date
1.MoD	UK Reserve Forces Recruitment	VSM, SSM, Stock & Flow modelling	DSTL	2014
2.NZ Water Authority	Water Strategy Management	SCA	Bryan Jenkins Adelaide Uni	2018
3.Large Telecom	Strategic Workforce Planning	ST, Scenario & Sensitivity Analysis	Emma Murray, IBM	2020
4.Department of Transport	Fitness to Drive	SSM	Giles Hindle, Hull Uni	2007
5.'Turf Science'	Improving Performance	SSM	Giles Hindle, Hull Uni	2005
6.Rutland County Council	Supporting Rutland County Council to design a new 'falls and frailty' support service	PSMs, Issue based analysis, mapping	Antuela Tako, Loughboro Uni Kathy Kotiadis Kent Uni	2020-
7.National Institute of Healthcare Research, Kenya	Mapping the functioning of the baby friendly community initiative and identifying its needs within the Kenyan Health System	ST, Influence Diagrams	Elizabeth Kimani, African Population and Health Research Centre, et al	2020/21 (NIHR Funded Project)
8.Kent Resilience Forum (KRF)	Supporting KRF decision making through virtual facilitated workshops	SSM, issue based analysis, mapping	Kathy Kotiadis, Kent Uni, Antuela Tako, Loughboro Uni	2020 phase 1 2021 -> p2
9.EU	Systems Thinking for Comprehensive City Efficient Energy Planning EU FP7-ENERGY (314277)	STEEP (PSM-like), ST	M.Yearworth, et al, Bristol Uni	2014
10.EU	REPLICATE - REnaissance of PLaces with Innovative Citizenship and Technology H2020-EU.3.3.1.3. Smart Cities & Communities (691735)	STEEP (PSM-like), ST	M. Yearworth et al, Exeter Uni.	2017

Case Study Details

1.A Holistic Systems Review to Improve UK Reserve Forces Recruitment, DSTL

Background

Following the publication of the Future Reserves 2020 paper in 2011 it was concluded that the UK's reserve forces were in need of significant revitalisation and re-orientation. By 2014, the trained strength of the reserves was 13,000 short of the target of 35,000. There were problems in increasing the reserve force levels by any significant amount, despite considerable resource being directed at growing the trained strength levels. A number of initiatives were tried but these did not increase the trained strength levels greatly and by 2014 the situation was urgent as the total trained strength levels were just over 22,000.

The systems review

Dstl worked closely with other government organisations to review the reserve recruitment system holistically so that the real problems with the system were highlighted. This ensured that the system could be improved, rather than risk enhancing elements of the system while inadvertently moving problems to another part of the system. The review was conducted in the following way:

1. An enterprise level review was developed with a representation of the system being formed using the Viable Systems Model (VSM). This highlighted what was performing the governance, management, audit and coherence activities. The work also showed the links between each system and the information flows that were available to decision makers.
2. Some elements of Soft Systems Methodology (SSM) were used to consider the purpose and role of some of the key system elements.
3. Stock and flow modelling then considered how the candidate reservists move through the following steps: (1) Advertising, (2) Application, (3) Eligibility Testing, (4) Selection, (5) Training and (6) Maintaining Force Strength. Analysis determined that less than 3% of candidates that completed an application form (end of stage 2) joined the trained strength (stage 6).
4. The flow rate analysis then started to consider the marketing campaign that was focused on a small group of the population, under 35,000 people. Some simple initial tests showed that if all 35,000 completed an application form (assuming 100% of the target audience responded to the advertising campaign) and the measured loss rates were consistent for this population, the trained strength levels would only increase by around 1,000 people, which was not sufficient.
 - o Widen the target audience based on 'word of mouth' for the marketing campaign so that the campaign would appeal to a much larger population group and would ameliorate, at least some of, the high loss rate seen within the Testing, Selection and Training elements of the system.
 - o At the same time reduce the losses in the recruitment pipeline through more streamlining and monitoring of the recruitment system.
 - o Monitor and control the system using more targeted management information and use this information to make key decisions about the system e.g. how decisions such as the tattoo policy affect losses in the recruitment system.

Conclusions and Recommendations

The problems in the reserve system originated in a commitment being made to achieve an aim, without a clear evidence base supporting what needed to be done and how the changes would be delivered. The system that was intended to deliver changes was grown

from the original system, based on an assumption that the original system would be capable of growing the reserve population substantially.

The Outcome

The recommendations were made, through the military staff who were improving the reserve recruitment system, to the Secretary of State for Defence. Following the systems review significant changes were made to the reserve recruitment system. Within six months of the enterprise level review completing, the trained strength figures began to increase. While there were other activities within MOD that were looking into the reserves, this systems review certainly contributed to the improvements in the system. By April 2015 a clear upward trend had been established and this continued, on a linear trajectory that, if it continued, would have been expected to deliver close to the original target figure of 35,000, even with the substantial outflow figures from the reserves.

[Note: a similar study was reported in JORS: Lowe D, Martingale L and Yearworth M (2017) Guiding interventions in a multi-organisational context: combining the Viable System Model and Hierarchical Process Modelling as a Problem Structuring Method. JORS 67, 1481-1495]

2. Problem Structuring for Decision Making in Complex Systems: The Application of Strategic Choice Analysis (SCA) to Water Management in Canterbury, Dr Bryan Jenkins, University of Adelaide

Summary: Managing water resources in the Canterbury region, which contains 58% of NZ's allocated water, 70% irrigated land. 65% of hydro storage and 70% of groundwater is a significant national issue. The focus of this study was to assess the potential long term demand for water and the capacity of the region to meet this, given a range of conditions. An initial analysis showed that annual demand could be met but would require storage at the few available sites, causing negative environment impacts and major community conflicts. The Strategic Choice Approach (SCA) was adopted to structure the issues and enable stakeholder engagement. The shaping, designing, comparing and choosing modes in SCA proved to be extremely helpful and relevant. The outcome was a series of shared commitments which would improve water availability whilst minimising environmental impacts. The collaborative approach enabled by SCA was valued for addressing conflicting perspectives, leading to a shift in positions and new options from stakeholder engagement. The water problems were not 'solved' by the use of SCA but a 'structure' for addressing future problems was established.

(Summarised by John Ranyard from a presentation by the author to the Centre for System Studies seminar series, Hull University, 13 February 2018. Available from: jranyard@cix.co.uk)

3. Strategic Workforce Planning for a Large Telecoms Company, Emma Murray, IBM

This Strategic Workforce Planning (SWP) project examined the organisation's workforce in the context of the overarching business strategy, and assessed what actions should be taken to ensure the organisation has the right mix of resources and skills to support the business vision. It is a high-level planning technique designed to help organisations make decisions about the shape of their workforce over a three to five year time horizon. Specifically, it looks at what levers such as recruitment, automation, cross-skilling can be applied to reshape the workforce in preparation for the business changes ahead. It relies heavily on Soft OR techniques, including systems thinking, scenario analysis & sensitivity modelling.

4. Fitness to Drive Study for the Department of Transport, Giles Hindle, Hull University

This Soft Systems Methodology (SSM) case study supported innovation of a large public sector service, the Department for Transport's arrangements to deliver Medical Standards on fitness to drive. The Medical Standards determine whether a patient with a medical condition such as diabetes or dementia are able to retain their driving licence. A series of workshops was run with a range of stakeholders including hospital consultants, GPs, occupational therapists, nurses, social workers, patients, Department for Transport staff and others. The purpose of the workshops was to identify issues with the current system (mapping) and generate structured ideas for how the system might be improved in the future (modelling). Further details available from the author, Giles Hindle: Giles.Hindle@hull.ac.uk

5. Improving Performance for ‘Turf Science’ using Soft Systems Methodology, Giles Hindle, Hull University

In this case study SSM was used within a consulting project to facilitate innovation within the company. The project was run over a two-month period and included three half-day workshops. The workshops were delivered in a large meeting room with whiteboard and flipcharts.

Turf Science Ltd is a UK based company which produces specialist turf fertilizer for golf courses and football clubs around the world. The name of the company has been changed for the purposes of this document. The company employs 30 people and has a turnover of £5 million. Core activities of the company include securing and maintaining accounts with turf managers, soil testing to determine fertilizer requirements, designing bespoke fertilizer solutions, and delivering fertilizer orders around the world. Turf Science was facing growth problems due to the performance of their junior sales staff. They perceived this to be a problem with recruiting the right people. As it turned out, it was the sales system itself which needed innovating.

Further details in reference 14.

6. Supporting Rutland County Council to design a new ‘falls and frailty’ support service, Antuela Tako, Loughborough University, Kathy Kotiadis Kent University

We have been working with Rutland County Council (RCC) for almost 2 year on the design of a new service aimed at reducing the high number of falls and hip fractures in Rutland. They needed to proactively identify and engage with patients in the community at a high risk of falling, targeting nearly 13,000 over-55s in the county. Using the SIMTEGR8 research and participatory methodology, we have used *issue based analysis* in workshops with key healthcare professionals. This led to the co-production of a concept service and delivery model named Your Community Health Project.

In December 2020 RCC’s two Principal Occupational Therapists (OTs), responsible for leading the design of the service, stated: “Dr. AntuelaTako has brought objectivity, clear direction of travel, due process, inspiration and academic gravitas to our project..... without her involvement we would not have the level of engagement, interest and collaboration of our partners in this project work”. The project report was presented to the RCC Cabinet in December 2020. The OTs added: “The concept has been well received, and we have commitment across RCC and the Primary Care Network (PCN) to take this project forward....across all communities in Rutland.” The project is ongoing and the council are currently planning to run the service as a pilot in a sample village.

7. Mapping the functioning of the baby friendly community initiative and identifying its needs within the Kenyan Health System

(Project team: Dr. Elizabeth Kimani, African Population and Health Research Center, Kenya; Prof. Paula Griffiths, Loughborough University, UK; Calistus Wilunda, Dr PH, APHRC, Kenya;

Antonina Mutoro, PhD, APHRC, Kenya; Milkah Wanjohi, MSc, APHRC, Kenya; Gyuchan Jun, PhD, Antuela Tako, PhD (author), Patrick Waterson, PhD, Loughborough University, UK)

This current project aims to support the implementation of the baby-friendly community initiative (BFCI) in Kenya. The Kenyan government has adopted the BFCI to promote and support optimal maternal and child nutrition at the community level. The BFCI applies the principles of the baby-friendly hospital initiative by extending follow-up and care of mothers and children to the community. The BFCI is being implemented in some communities amidst some challenges and is in the process of being scaled up nationally.

In this project, we use Systems Thinking (ST) tools to analyse the BFCI system, whereby we map out and analyse the key factors that influence the functioning of the BFCI system in Kenya with the view to identifying the system implementation needs. Stakeholders from different levels (national and community) and parts of the BFCI system provided input in our analysis which aimed to develop a holistic view of the system.

The methodology used includes three phases: 1) preliminary high-level analysis, 2) in-depth *systems mapping* analysis, and 3) high-level identification of opportunities for further development of the BFCI. Maps of the core parts of the BFCI system identified in the 2nd phase of the research were presented at national and local level stakeholder dissemination meetings. Participants were then able to prioritise areas for future research.

Stakeholder involvement (at different stages and levels of our analysis) and the use of systems mapping has enabled us to reach a common understanding of the core elements that make up the BFCI system and to identify key factors that influence its functioning. Factors and areas for further research were prioritised to strengthen the BFCI and enable its scale-up and implementation within the Kenyan health system. The top priority area for further research was BFCI financing, which stakeholders in our project dissemination meetings revealed has the potential to be addressed through improved integration of the BFCI into the community health strategy, and funding through the County Governments in the devolved health care system in Kenya. Our study will next focus on producing *systems dynamic simulation* models including cost effectiveness. These models will aim to help policymakers and users to understand the effects changing key parameters in the model, to support decision making.
<https://aphrc.org/publication/mapping-the-functioning-of-the-baby-friendly-community-initiative-and-identifying-its-needs-within-the-kenyan-health-system>.

8. Supporting the Kent Resilience Forum's decision making through virtual facilitated workshops, Kathy Kotiadis, Kent University, Antuela Tako, Loughborough University

This study aimed to establish the priorities for Kent Resilience Forum (KRF) in the short term in light of preparations for the imminent potential concurrent challenges a Covid-19 second wave and “a no deal” Brexit, as well as other likely major incidences such as flooding. The approach was to engage with the different levels of command in virtual problem structuring workshops starting with the Gold (Executive) command level for Kent Resilience forum. In total three workshops were undertaken within a period of 3 months. The first workshop has enabled KRF to establish and agree the key issues that needed to be addressed. The Gold level membership of Kent Resilience (workshop participants) contributed detailed issues and then linked these to associated challenges. In addition, the Gold membership agreed that their top priority related to shared resourcing with subsequent workshops establishing and detailing these operational needs.

9. Systems Thinking for Comprehensive City Efficient Energy Planning for the EU, M. Yearworth, Bristol University e al

Objective: The partners of the project are 3 cities with similar characteristics, experience and policies in specific sustainable use and production of energy and very ambitious carbon and

energy reduction targets, aligned with Europe's targets. In each city, initiatives to reduce energy inefficiency are already in place; however each of them has been aimed at a specific sector objective, while overlooking the impact that may be causing on other sectors. This is why all the stakeholders and city systems are considered so important when undertaking measures aimed at improving sustainability to make this an integral part of their urban planning in order to achieve best results in less time and with less cost.

For this reason, these cities have decided to join together to improve efficiency along all the key aspects of their energy value chain, by applying smart city concepts in an integrated manner while learning from each other's expertise and viewpoint in applying sustainable practices. The partners are experts on Energy (FSS, San Sebastian, Tecnalia and Acciona), ICT (Bristol, Bristol Uni and ARUP) and Mobility (Florence, SPES and ATAF).

To get the proposed objectives, the STEEP project will create a process model based on *Systems Thinking* for district energy master planning, which will be applied to 3 city districts to better understand the systems impacting upon energy use and interventions which can be taken to meet the ambitious energy and carbon targets. These models will be enriched and validated through open innovation methodologies applied with the stakeholders. The learning obtained from the process model for district energy master planning, then, will be applied at the definition of specific action plan (time line, the costs and pay-back periods) at city level. With the knowledge gathered in this process, a replicable open source methodology will be developed plus Key Performance Indicators for developing and screening integrated Smart City Plans. More information:

<https://cordis.europa.eu/project/id/314277>

10. REPLICATE - REnaissance of PLaces with Innovative Citizenship and Technology (Smart Cities & Communities), M. Yearworth, Exeter University, et al

Summary of the context and overall objectives of the project

The main objective of the REPLICATE project is the development and validation in three lighthouse cities (San Sebastián - Spain, Florence – Italy and Bristol – UK) of a comprehensive and sustainable City Business Model to enhance the transition process to a smart city in the areas of the energy efficiency, sustainable mobility and ICT/Infrastructure. This will accelerate the deployment of innovative technologies, organizational and economic solutions to significantly increase resource and energy efficiency improve, the sustainability of urban transport and drastically reduce greenhouse gas emissions in urban areas. The REPLICATE project aims to increase the quality of life for citizens across Europe by demonstrating the impact of innovative technologies used to co-create smart city services with citizens, and prove the optimal process for replicating successes within and across cities.

The Business Models that are being tested through large scale demonstrators at the three cities are approached with an integrated planning through a co-productive vision, involving citizens and cities' stakeholders, providing integrated viable solutions to existing challenges in urban areas and to procure sustainable services. Sustainability of the solutions is fostered in three areas: economic and environmental and finally, fostering transparency in the public management.

In addition, the Model features the replicability of the solutions and their scale up in the entire city and in follower cities, particularly in Essen – Germany, Laussane - Switzerland and Nilüfer-Turkey, that are involved in the project and therefore, have access to know-how and results achieved on the project so they can apply the developed model. At the moment, there are 2 observer cities, Guanzhou (China) and Bogota (Colombia). Further information:

<https://cordis.europa.eu/project/id/691735>

A4. Available Training courses

ORS - for the latest information go to: <https://www.theorsociety.com/training/online-training/>

In 2022 the PSM SIG will be offering training in Soft OR.

Systems Thinking - Cranfield, Hull and the Open Universities offer courses. The **SCiO** (*Systems and Complexity in Organisations*), has developed a competency framework which forms the basis of professional accreditation for STPs.

<https://www.scio.org.uk/page/scio-competency-framework-professional-qualification>

Viable System Model (VSM) Training on VSM is offered by SCiO

<https://www.scio.org.uk/events/professional-development>

Level 7 Apprenticeships – follow these links for more information, including Soft OR content:

OR <https://www.instituteforapprenticeships.org/apprenticeship-standards/operational-research-specialist-v1-0>

Data Science [https://www.instituteforapprenticeships.org/apprenticeship-standards/data-scientist-\(integrated-degree\)-v1-0](https://www.instituteforapprenticeships.org/apprenticeship-standards/data-scientist-(integrated-degree)-v1-0)

Systems Thinking <https://www.instituteforapprenticeships.org/apprenticeship-standards/systems-thinking-practitioner-v1-0>

A5. Some Key References

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Presentation Links

YouTube Videos (suggested by Giles Hindle):

Soft System Methodology

21. Soft Systems Methodology in 10 minutes! <https://youtu.be/JpjsLtqU4lw>

Rich Pictures

22. Rich Pictures in 5 minutes! <https://youtu.be/Gb6eDQ9dRVc>

Systems Thinking

23. Systems Thinking in Practice <https://youtu.be/N5RPTIRR9eY>

Strategic Choice

24. Introduction to the Strategic Choice Approach (1 of 6) <https://youtu.be/EWtUZYZj15g>

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<https://healthsystems.designsociety.org>

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