

## **Applying Soft Systems Methodology for Better Regulation**

Ian M Mitchell  
Operational Research Unit  
Analytical Decision Support  
Strategy, Analysis & Better Regulation

3 Beyer Road  
Amesbury  
Wiltshire  
SP4 7XG

[IanMitch1@gmail.com](mailto:IanMitch1@gmail.com)

*Ian Mitchell has worked in Operational Research (OR) since 1988. Commissioned into the Territorial Army in 1984 he encountered OR as part of a Business Studies degree during 1986. For the Centre for Operational Research and Defence Analysis (CORDA) he produced historical data compilations then studied land operations.*

*For two years as an independent OR consultant Ian supported clients in the UK Department of Social Security and the European Space Agency then joined the Defence Research Agency at Fort Halstead in 1994. He managed the Battle Group War Game, and led infantry studies, moving to Porton Down in 1998 to manage force protection studies until 2000 when he was seconded as an OR specialist in Whitehall. From 2004 he supported capability management across domains including naval systems. Joining the OR Unit at the Department for Business Innovation and Skills in 2010.*

*Ian served on the Council of the UK OR Society from 1994 to 2000 and 2002 onwards, being Vice-President from 2003 to 2005 and Treasurer as of 2007. Ian has served as a Town and District Councillor. He became Secretary to the Cornwallis Group in 2006.*

### **ABSTRACT**

The paper describes a 2011 study by the Operational Research Unit within the Economic Strategy and Better Regulation Group at the Department of Business Innovation and Skills, using Peter Checkland's Soft Systems Methodology (SSM) to support the Better Regulation Executive.

The result was a better understanding of the processes and gaps in the creation of regulation and its place as one means in the broader policy context. The paper covers the technical use of SSM, the techniques adopted for this project and how social aspects of the work allowed OR to assist the management of change.

## INTRODUCTION

In 2011 the Operational Research Unit (ORU) within the Economic Strategy and Better Regulation Group at the Department of Business Innovation and Skills (BIS), used Peter Checkland's Soft System Methodology (SSM) to support the Better Regulation Executive (BRE). The result was a better understanding of the processes and gaps in the creation of regulation and its place as one means in the broader policy context.

The paper covers the technical use of SSM, the techniques adopted for this project and how social aspects of the work allowed OR to assist the management of change. Peter Checkland's SSM has a long track record. In this case SSM proved useful in developing a basis for discussion of policies extending beyond organisational and national boundaries. The approach clarified crucial questions of scope and provided means to identify the actors within and across national and international boundaries.

From the experience this paper proposes that SSM is a useful analytical tool to develop understanding of the causes and effects leading to the emergence and impact of new conflict drivers. It suggests that SSM provides a fast means to explore complex societal relationships.

The paper considers the place of SSM within Operational Research, technical use of SSM, practical techniques adopted and notes how social aspects of the work allowed OR to assist the management of change. It concludes on the value of OR through the provision of insights and knowledge, rather than answers. The resulting basis for discussion improves how clients and their stakeholders work together.

## THE OPERATIONAL RESEARCH METHOD

I first encountered the OR Method as part of the University of Buckingham's business modelling course. The OR Method has seven steps, although these are interlinked rather than being a single linear sequence. Harrison gives the seven steps as:

- Understand the problem
- Determine the key variables
- Formulate the variables
- Solve the formula
- Interpret the solution
- Validate the findings
- Implement action

The OR Method gives a context for the use of analytical techniques to provide a basis for decision. Although shown in a ladder like list they feed into one another. The seven may be seen as a set of criteria for the level of understanding of a situation obtained.

Understand the Problem is the first step of this OR Method. Some form of structure is essential for this. Peter Checkland's Soft Systems Methodology (SSM) acts as a means for elicitation of domain knowledge. For BRE it informed consideration of structural changes and develop a new view of a situation as a system of transformation, but one derived from many perspectives.

### **AN INSTANCE OF "ROCKET SCIENCE"**

In 1993 as an independent OR Consultant I used SSM to structure work to identify the economic benefits accruing from European telecommunication satellites.

*"Soft Systems Methodology in action"* by Checkland and Scholes was extremely useful then and again in 2011. For both studies the book provided a structure to understand a situation with multiple components and indistinct boundaries.

The 1993 work for the European Space Agency studied the economic benefits arising from telecommunication satellites. SSM enabled the development of a view of the many components of a system for television broadcasting that emerged as the main user of the satellites. With the problem understood in these terms the crucial place of the television broadcasters became apparent in the system of value chains. This cued the data gathering activities essential to complete the project for ESA including a European Interview Program. This covered ten sources across four countries in six working days.

### **ANOTHER URGENT REQUIREMENT**

Many of the ORU's tasks are undertaken at short notice but this tasking was particularly fast. Late on the evening of Sunday 5 February 2011 an urgent message arrived by e-mail requesting support for the redesign of the Better Regulation Executive (BRE). A Director General perceived that there was a need to map the process of regulation to understand the potential cause and effects of different parts of the system as it affected different actors recognising that were "lots" of these.

The Director General suggested soft systems analysis would inform assessment of where BRE was, where it wanted to get to and how that might be done. By Tuesday before dawn I was travelling to BRE's options workshop.

This tasking brings out the importance of contact and support within the leadership of both supplier and client for OR. The Director General provided the impetus for this work within her Group. She wrote to the Head of Profession for OR who facilitated the support and a senior manager within the BRE who acted as the sponsor for that support. This gave access to the participants and gave the task sufficient priority to secure the necessary inputs.

## APPLYING SSM

I was welcomed to the BRE Deputy Directors' weekly meeting held on each Thursday, during this study. At the first of these, four days after the Director General's request, I explained what I understood my task to be and introduced SSM's terms.

To communicate with BRE's Deputy Directors I relied on Power Point slides, usually as black and white paper print outs, rather than projected slideshows. The notes view allowed pictures to be created on the slide and text to be combined below this.

With the first set of slides I summarised my understanding of the problem facing the Better Regulation Executive as how to apply a lower amount of Resource to achieve its aim, in these terms:

- What options are there?
- Which is better (or less worse)?

I introduced SSM as a means to define a problem as "A system that transforms inputs into outputs." I suggested that if we could define the purpose of BRE as "Do X by Y in order to achieve Z" then we would have a means to judge the relative merits of the options for changes to the organisation.

This slide was probably the most important of the project.

6

**BIS** | Department for Business  
Innovation & Skills

---

### SSM uses terms to prompt a view

- CATWOE
  - Customers – Victims or beneficiaries of T
  - Actors – Those who would do T
  - Transformation – Conversion of inputs to outputs
  - Weltanschauung – World view making T meaningful
  - Owners – those who could stop T
  - Environment – Elements outside system taken as given
- Answers give Root definitions and Rich Pictures

Figure 1: SSM Terms defined

The importance of the slide lay in defining the common language that we would use. It gave the terms to prompt a view that would feature in all conversations, summarised by the acronym: CATWOE. This is centred on the "T" that stands for Transformation Process: an input becomes an output, transformed from one state to another:

- Customers – Victims or beneficiaries of T
- Actors – Those who would do T
- Transformation – Conversion of inputs to outputs
- Weltanschauung – World view making T meaningful
- Owners – those who could stop T
- Environment – Elements outside system taken as given

Answers to these six questions give components from which Root definitions and Rich Pictures of the system may be constructed. The slide acted as an Aide Memoire for the initial discussions in a process of enquiry. I used it to structure my views as these developed.

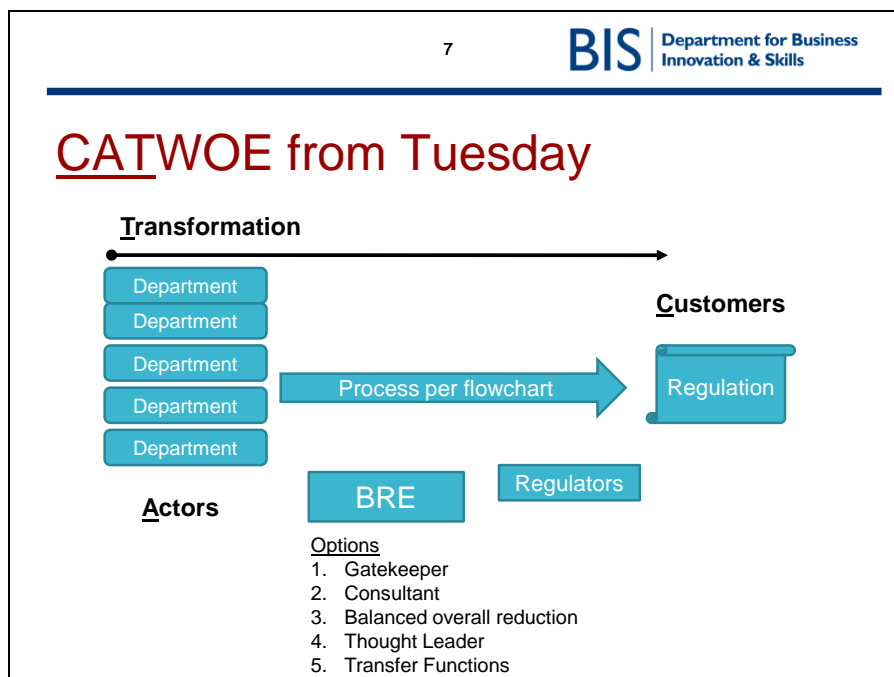


Figure 2: First partial view of the system of regulation

This slide, also from 10 February 2011, shows the Customers, Actors and a Transformation process, the C,A and T from CATWOE. I based this view on a flowchart of the regulation process obtained by a literature search. The flow of activity moves from left to right and the participating organisations are shown as rectangles. This style was used in many of the subsequent diagrams, which introduced greater detail and complexity.

This view was further informed by the discussions held at Tuesday’s workshop. With the prospect of a material reduction in its size BRE had a range of five options for its future role. These appear at the bottom of the slide. Gatekeeper, Consultant ,Balanced overall reduction, Thought Leader and the transfer of its functions elsewhere.

From what I had learned the transformation process produced regulations as an output from initiatives launched by the various Government Departments. I assumed that

these regulations were produced for the Regulators. Even with this basic view there were gaps and other possibilities for interpretation. These prompted discussions.

There appeared to be to be some implied Customers, Actors and a Transformation process, the C, A and T of CATWOE, but not a clear Weltanschauung, a “world view” or clearly identifiable Owners or Environment. The implicit boundary was that regulation was an activity wholly within the public sector, one part of government feeding another.

## SETTING BOUNDARIES

I used the next slide to show how rich pictures could illustrate ideas for discussion. The issue of C, Customers, was important so the following view proposed a broader interpretation of these as being the members of Society and the Economy. This also implies a different W Weltanschauung or Worldview.

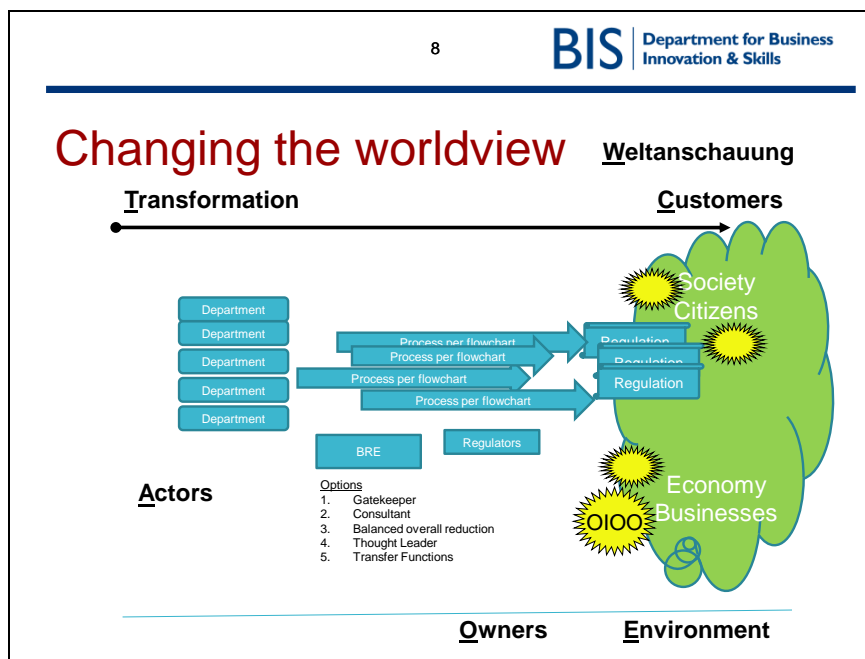


Figure 3: A broader Weltanschauung


If a new Weltanschauung or worldview is used, such as “Regulation is a means to enable better outcomes in economy and society” then this changes the boundaries to the process to be considered. Different Actors become apparent whilst the Citizens and Businesses beyond government are the Customers in SSM terms. The form and relative value of the contribution of each of the five options for BRE also changes. BRE was definitely an Actor, in whatever Weltanschauung was selected.

This view shows that there will be many different regulations going through the process. It also prompted discussion of the other policy levers available to achieve an effect

The concept of One In, One Out (OIOO), shown in the star, was essential to understanding who the Customers of regulation were. OIOO is an approach introduced as of 2010 to reduce the burden of regulation. Under OIOO no new regulation can be introduced without an equivalent burden of regulation being removed. This gave a clear implication that the boundary of the process lay with that burden. From the definition of OIOO it seemed that the span of the transformation T has to reach to Citizens and Businesses. They bear the burden so are the victims and beneficiaries of regulation. If they are the Customers then the Transformation process reaches beyond government.

This diagram was my view at the time. The first phase of my work was to elicit and reflect the views of BRE so the diagram acted as a strawman for them to comment on amend, expand, edit or quite possibly discard in favour of something else. As I said to the meeting of Deputy Directors:

*“ More important are your views, especially on the terms so far undiscussed; Environment – what do we have to take as given and Owners – who can stop the system.*

9


---

## Next steps

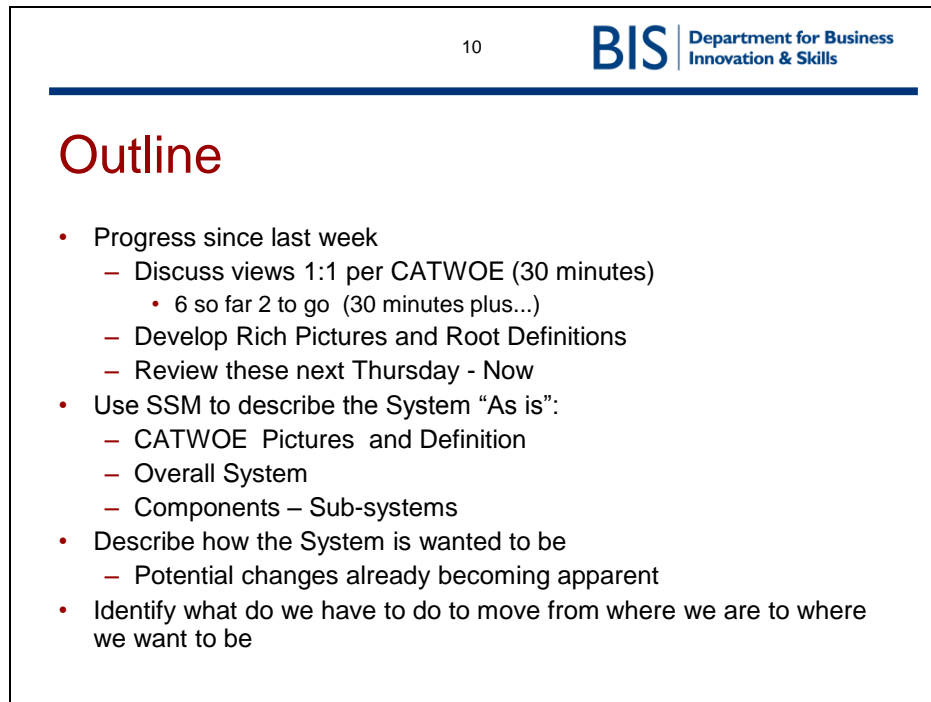
- Complete the picture and description
  - “To do X by Y in order to achieve Z”
    - Identify Efficacy, Effectiveness and Efficiency
      - Which option generates greater value in the broader system?
      - What other options are there?
- Means
  - Discuss views 1:1 per CATWOE (30 minutes)
  - Develop Rich Pictures and Root Definitions
  - Review these next Thursday

Figure 4: Practical application of SSM

At the end of my brief on the first Thursday I proposed these next steps. Completing the picture of the system and the description using the CATWOE terms was the main aim. I suggested that 30 minute discussions took place over the next week. Some participants took considerably longer but everyone could find at least 30-minutes in their schedules, and this was sufficient to elicit points seen as important.

As a result the data gathering was largely complete within 10 working days of the first request.

After this the half term holidays intervened as did the drive on restructuring in BIS- The selection process went into high gear in March, with every member of BIS applying for their own job and many then considering other roles within the Department. This was a stressful time with much labour intensive activity.



10

**BIS** | Department for Business  
Innovation & Skills

---

## Outline

- Progress since last week
  - Discuss views 1:1 per CATWOE (30 minutes)
    - 6 so far 2 to go (30 minutes plus...)
  - Develop Rich Pictures and Root Definitions
  - Review these next Thursday - Now
- Use SSM to describe the System “As is”:
  - CATWOE Pictures and Definition
  - Overall System
  - Components – Sub-systems
- Describe how the System is wanted to be
  - Potential changes already becoming apparent
- Identify what do we have to do to move from where we are to where we want to be

Figure 5: Maintaining momentum with SSM

This outline was used the following Thursday on 17 February, giving a progress report and a reminder of what the SSM work was doing.

The top level system view had evolved so that a feedback loop from Society-Economy to prompt ideas linked to the start of the process of policy development.



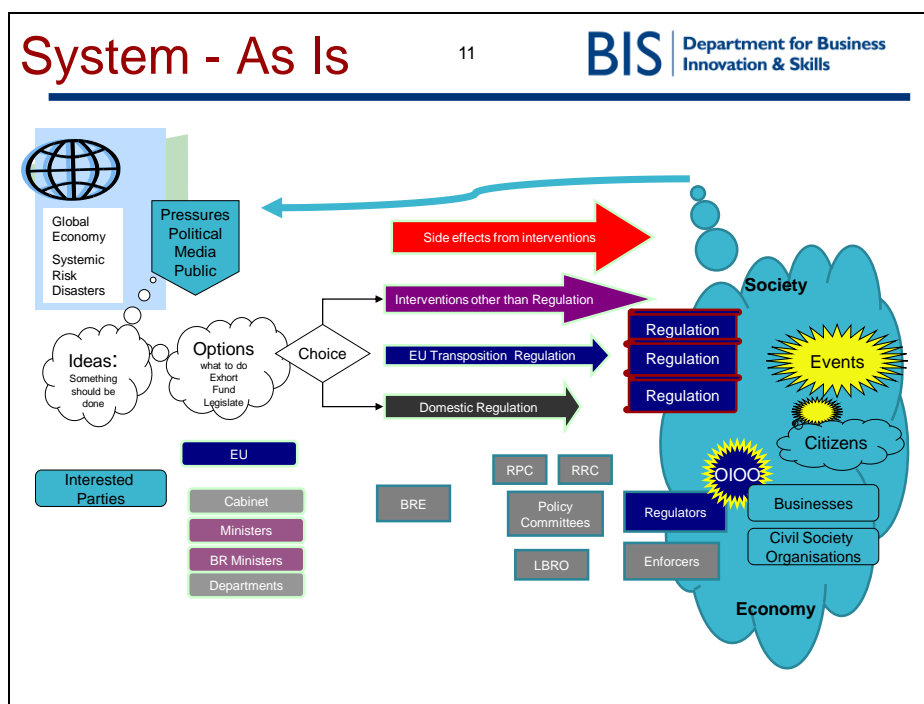


Figure 6: High level system view of regulation

Although there were additions to this diagram its basic form remained consistent from this point onwards. It acted as a reference for other views.

### OTHER PERSPECTIVES

Each of eight participants discussed the high level view and then their areas of interest. I made notes and fed back these and amended slides to them individually for comment. This elicited a range of responses including one participant adding new items to my view of her area. The information in each heading of CATWOE evolved with the discussions:

-C Customers – The broad view of the transformation suggests that Citizens, Civil Sector Organisations [such as charities or not-for-profit bodies] and Businesses are the beneficiaries and victims.

-A Actors These are- BRE, the Regulatory Policy Committee (RPC) the Regulation Reduction Committee (RRC, a ministerial body) the Policy Committees, Regulators, and the Local Better Regulation Office (LBRO),

--T The transformation :

Ideas for improving sequences of events experienced by Customers

=>

Customers experience improved sequences of events

The Policy system in which BRE is an Actor is a Transformation of ideas for interventions some of which are regulations in order to lead to improved sequences of events in the society-economy for the citizens and businesses that exist within it.

-W The Weltanschauung is that Policy can improve Society by several means, one of which is the stock of regulations in effect.

- “Regulation is a means to enable better outcomes in economy and society.”

Owners – Those who can stop the T system: At this point it was not clear whether this should be BRE, Ministers or someone else.

Environment – what the system has to take as given: such as the stock of regulation as at February 2011.

This was well received and formed the basis to link other views and terminologies. A strength of SSM is the ability to knit together different views of parts of the system. These may use other metaphors or symbols. Bringing in the views of the participants was helpful, especially when combined directly with SSM terms.

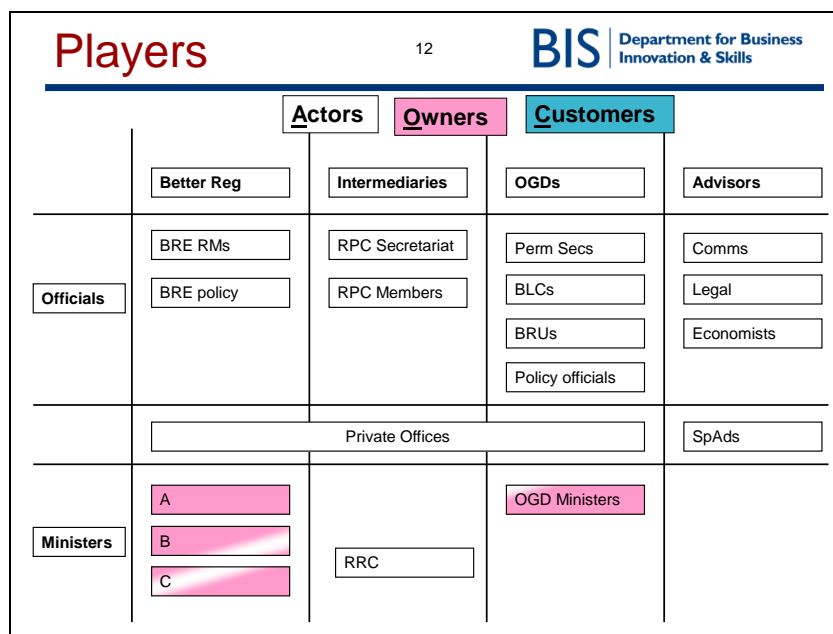


Figure 7: Combining views: Players as identified by a BRE expert in SSM Terms

This was a diagram created by one of the Deputy Directors in BRE. It gives a view of the players, the people driving the creation of regulation. Officials are Civil Servants and Ministers are the elected members leading the Government. A, B and C were Ministers identified by name in the original. The Regulation Reduction Committee (RRC) was a ministerial body looking across Government. Other Government Departments (OGD) also have Ministers.

Private Offices and Special Advisors (SpAds) were the interfaces from the Ministers to the Civil Servants including BRE, policy leads, the Regulatory Policy Committee (RPC) secretariat and the committee members.

The Permanent Secretaries (Perm Secs) are the Senior Civil Servants in each Government Department. Each Department also contains its own Board Level Champion (BLC) and Better Regulation Units (BRU) apart from the Civil Servants leading individual policies. Some Departments have direct interest in better regulation so their Ministers are Better Regulation Ministers (BRMs)

Classifying these players with a colour code as Actors, Owners and Customers, the A, O and C from CATWOE, was instructive. If, as the OIOO discussion raised, the system is a means to effect policy changes to citizens, civil society organisations and businesses then there are no Customers here in Government.

It was apparent that the Owners of the broader system, those who can stop it, may also be Actors within it. The Ministers are Owners in this sense, although they can also be Actors. Diagrams combining SSM terms with local knowledge were complemented by diagrams using local knowledge.

The next view was a diagram of how Departments created legislation, as illustrated below.

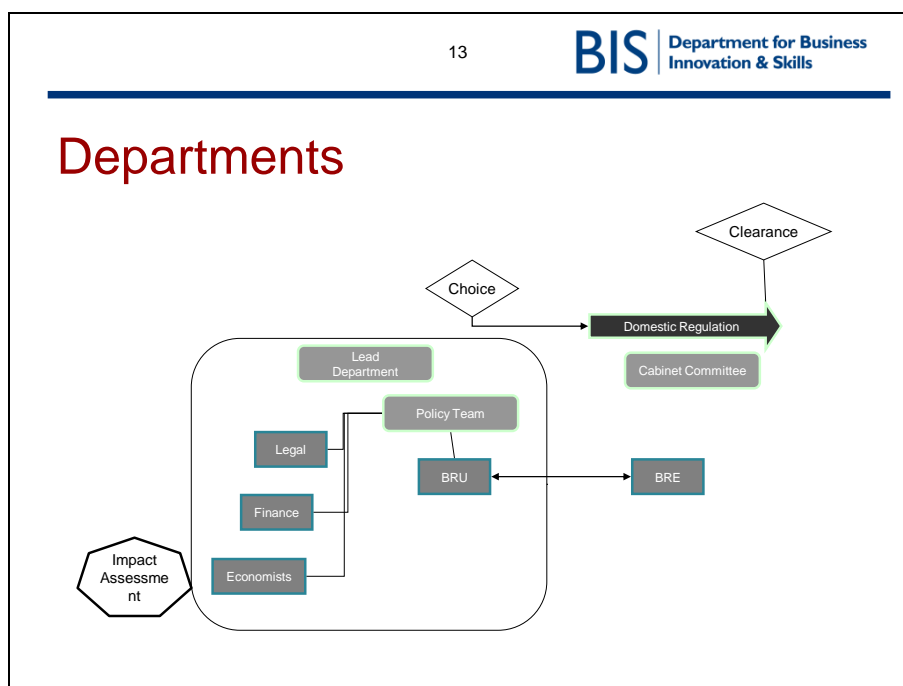


Figure 8: Department activities

Within a Department Policy Teams work in conjunction with Better Regulation Units (BRUs) to design regulation, using finance and legal advice from their own Departments. Impact Assessments come from Economists, who work within the lead department. The high level diagram's black arrow of Domestic Regulation gives the context for this lower level view.

Another BRE Deputy Director explained the contents of the black arrow as shown below.

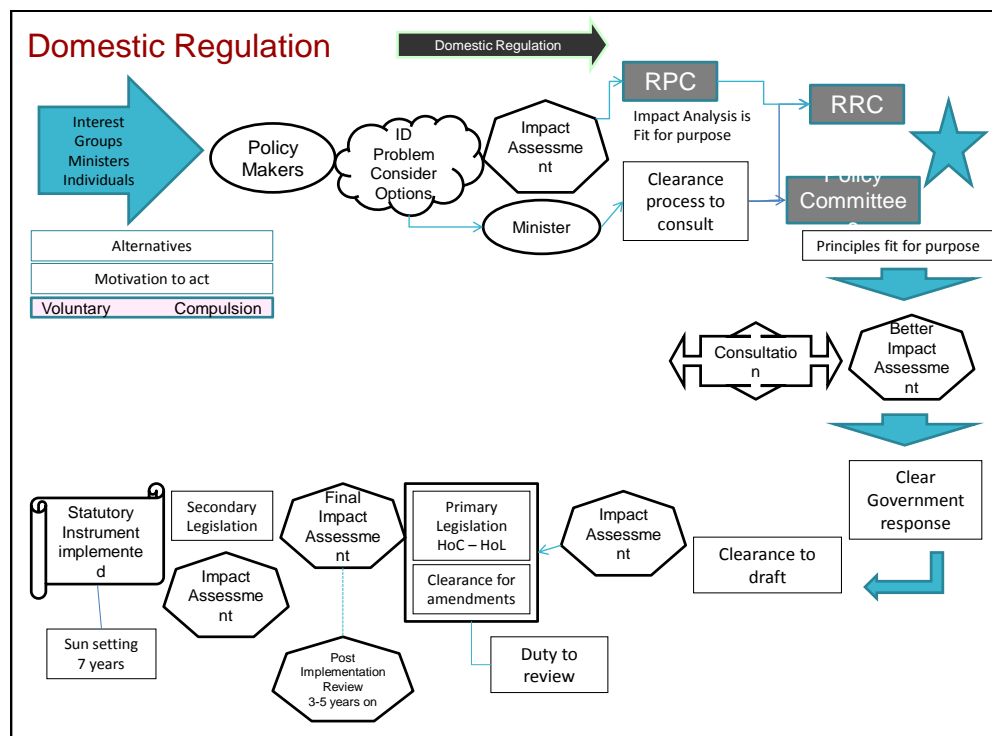


Figure 9: Domestic Regulation in detail

This diagram reproduced the hand drawn original as a PowerPoint slide. It shows the process of policy development via domestic regulation. The whole process is represented by a single symbol, the black arrow, on the high level view.

The diagram gives a perspective on how domestic regulation comes into existence. Interest groups, Ministers and/or individuals influence and/or direct policy makers to address a problem that they are concerned about. They may have some solutions in mind, with varying motivation from internal voluntary to compulsion.

The Policy Makers consider the problem and options. If regulation emerges as the preferred option an Impact Assessment is conducted whilst the owning minister initiates the clearance process to consult.

The Regulatory Policy Committee (RPC) approval of the Impact Assessment as fit for purpose assures the Regulatory Reduction Committee (RRC) that the principles of the regulation are fit for purpose. This is a key decision point, represented by the star. It is often the time at which the proposed regulation becomes visible across government through consultation.

Consultation and a more detailed impact assessment then take place. The Government clears the response to this prior to clearance to draft. The draft has an Impact Assessment.

Primary Legislation passes through the Houses of Commons and Lords, with any number of iterations for amendments, which have their own clearance process. The result is subject to a final Impact Assessment as is Secondary legislation. The resulting Statutory Instrument is implemented with a sun setting requirement after 7 years. There is therefore a long gap between the initial choice of regulation as a policy lever and its implementation.

This demonstrates how local views are brought together through a common high level map. The next BRE expert consulted considered the transposition of European directives into British regulation, which is shown in the Blue Arrow in the top level diagram. Again this is the local expert's view linked to the higher level system through incorporation of the symbol for the higher level view.

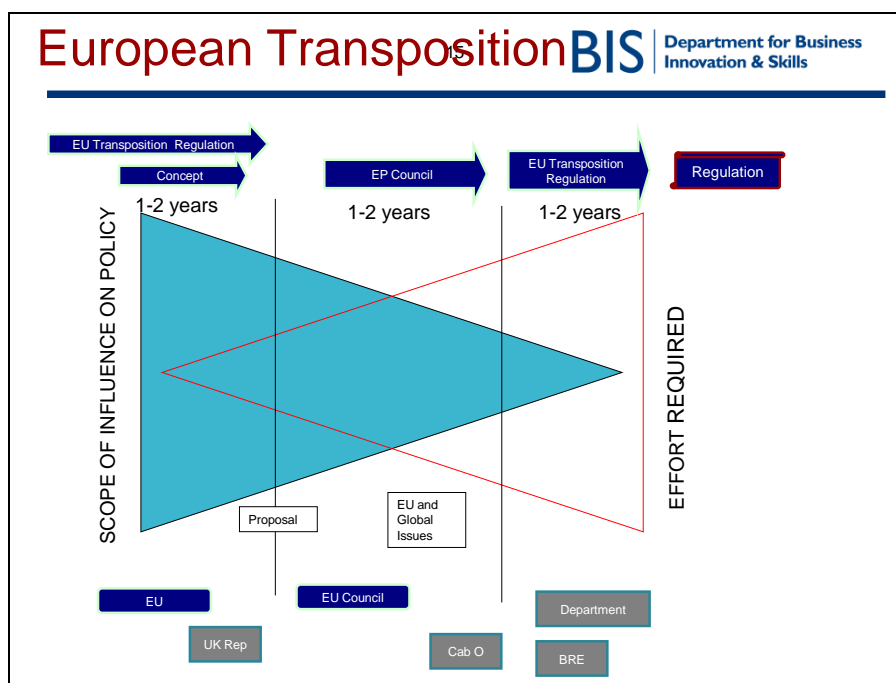


Figure 10: Local view of European Transposition process

The lower level representation uses a different scheme from the Domestic Regulation chain. The two triangles represent the degree of influence and the amount of BIS effort required.

Regulation requiring transposition into UK Regulation from Europe has been formulated with limited participation by the UK. It becomes visible through the Cabinet Office list of EU and Global Issues (EGIS) by which time there is far less scope for the UK to influence the policy. The effort required lies mainly in the transition which is carried out by Departments in conjunction with BRE. There was very little intelligence on what EU policies was being conceived limiting the scope for

the UK to shape these. By the time the proposal is formulated the decision point for means other than regulation has passed.

There seemed to be benefit in developing a longer ranged intelligence picture of potential European sourced policies likely to lead to regulation or overall.

Where diagrams did not already exist then I used a similar set of symbols and layout to that of the top level diagram.

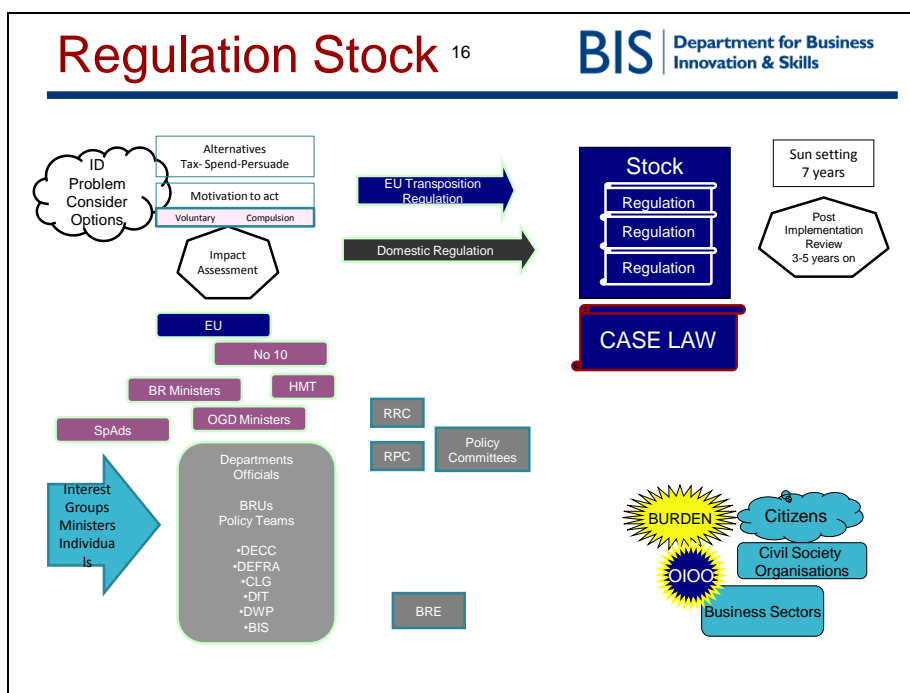


Figure 11: Production of regulation stock

This slide considers more details that emerged from discussion of the organisations creating the stock of regulation. It uses the same symbology as the top level view, but with greater detail on the interactions within Government. It also adopts the symbols used in the Domestic Regulation diagram, such as the polygon for Impact Assessment.

Departments work in parallel, and sometimes in silos, generating regulation and other policy levers of spending or persuasion. There are about 20 Departments and circa 100 Ministers. The major departments are Department of Energy and Climate Change (DECC), Department for Environment, Food and Rural Affairs (DEFRA), Community and Local Government (CLG), Department for Transport (DfT) and Department for Work and Pensions (DWP) and BIS. Tax is under direct control of Her Majesty's Treasury (HMT).

Incentives to initiate regulation are detached by time from the costs in bringing the regulation into being and applying it. The worldview is that through policy one can make an intervention to change the way that the whole system behaves and so can change the system.

The personalities of Ministers and the interests of their Policy Teams offer a range of combinations leading to different choices of policy or “pokes”. There is a desire to actively intervene, to “poke” a situation and to be seen to poke it. This also assumes that predictable consequences follow any intervention and often that these consequences are simple and linear. Reality may be otherwise.

The implied need is for a means to assess the combined effects of multiple interventions – “the sum of all pokes” – in order to adjust any new intervention. There is no single cross-cutting view of the amounts of regulation or the “Balance of Policies” planned or in effect.

The Queens Speech summarises Primary legislation which is then timetabled by the Cabinet Office as the legislative programme. Secondary legislation, comprising Statutory Instruments, follows this.

Post Implementation Review may be a means to provide a dis-incentive to bad regulation but takes place some years after a regulation was set in motion so is unlikely to directly impact on the policy makers involved, who are likely to have moved on from their posts.

Different departments cover separate parts of the law according to their interests: BIS covers Company, Consumer and Employment Law, such as the Health and Safety Act of 1974.

The full stock of regulation in force had not been comprehensively logged at the time of the study. Some parts of it such as those regulations owned by BIS and its predecessors have been listed. Estimates that half of the current stock came from European sources may be correct.

Symbols compatible with those from the higher level diagram show the additional lower level components that were described. An example was how case law based on judgements forms an additional source of requirements to the Acts.

The next step was where the local experts took the approach sufficiently to add their own views to the maps. The following comes from the bottom right of the top level system and represents the views of the expert.

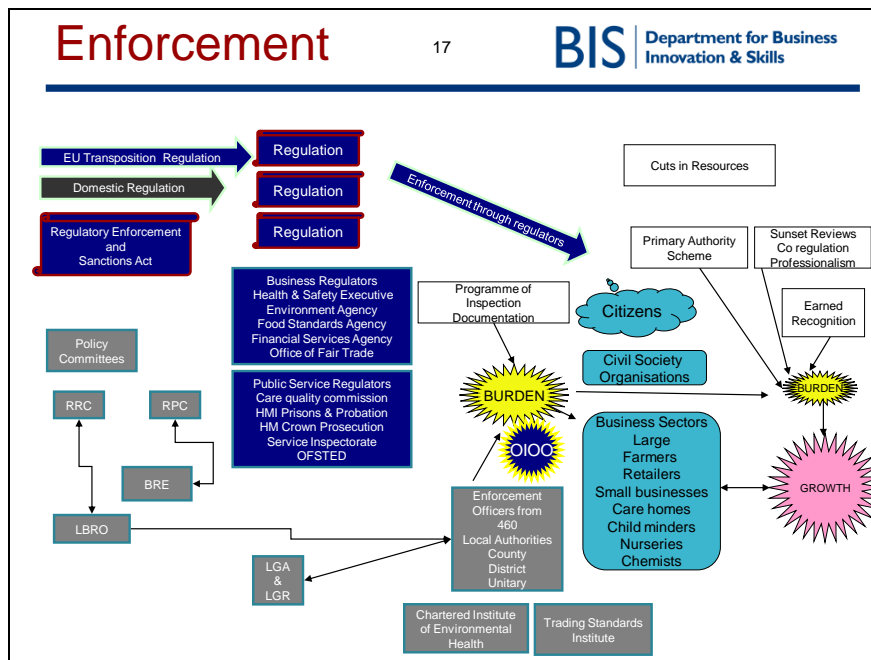


Figure 12: Enforcement

Enforcement is “The use of a sanction to get an outcome”

The diagram shows the high level blue and black arrows feeding the stock of regulation. Regulation stock resulting from the Domestic Regulation and EU Transposition processes is enforced via Regulators, Public Sector and Local Enforcers principally via contact with businesses. Small Businesses find greater utility from this than the larger businesses which have their own internal controls.

Enforcement Officers from Local Authorities are developed through professional institutes. The Local Better Regulation Organisation (LBRO) was the main link to the Local Authorities from BRE. The Local Government Association (LGA) represented views from the Local Authorities.

The burden of enforcement, which OIOO seeks to reduce, is principally felt by Businesses. The work of enforcement relies on the Programme of Inspection and documentation. Schemes such as Earned Recognition and Primary Authority reduce the amount of effort required.

### SYNTHESIS VIA SSM

Synthesising the answers that emerged from the 1:1 meetings appear here.



18

**BIS** | Department for Business  
Innovation & Skills

---

## CATWOE Elements

- Customers – Citizens and Businesses
- Actors – Central and Local Government, Enforcement organisations
- Transformation – Improvement of Society-Economy
- Weltanschauung – Policy can improve Society and Economy
- Owners – Ministers
- Environment – Machinery of Government, Policy levers, World Events

Figure 13: SSM CATWOE Terms emerging definitions

19

**BIS** | Department for Business  
Innovation & Skills

---

## Root Definition

- BRE enables UK Government policy makers and deliverers across Government and Partner Organisations to create and enforce the right stock of the right regulations *in order to* improve the state of the Society and Economy of Britain.

Figure 14: Root Definition

To complete the terms of my brief the next phase of the work was how the System might change

20

**BIS** | Department for Business  
Innovation & Skills

---

## Changing the System

- Fri 04/03/2011 11:04- *I hope that, in the coming weeks we can start to use Ian's work as a basis for discussion of various aspects of the regulatory system and how it's going to need to change.*
- 8 March - Three Boards Workshop
  - What is good about the System as is?
  - What is bad about the System as is?
  - What are your brightest ideas for a better System?
  - Issues and Solutions

Figure 15: Making use of the SSM findings

To bring the individual inquiries together and elicit ideas for the way ahead, I ran a “Three Boards” workshop. This uses three poster sheets for good and bad aspects and bright ideas via post-its written by the participants to collect and then cluster ideas. The bad board identifies issues. These issues prompt solutions to be collected on the third “good ideas” board.

Putting issues against Solutions in a table allowed coverage to be seen and whether any solutions cover multiple issues. The outputs of this work fed into the action plan that BRE then implemented.

This workshop took the “System As Is” diagram, enlarged to poster-size, as a foundation for discussion.

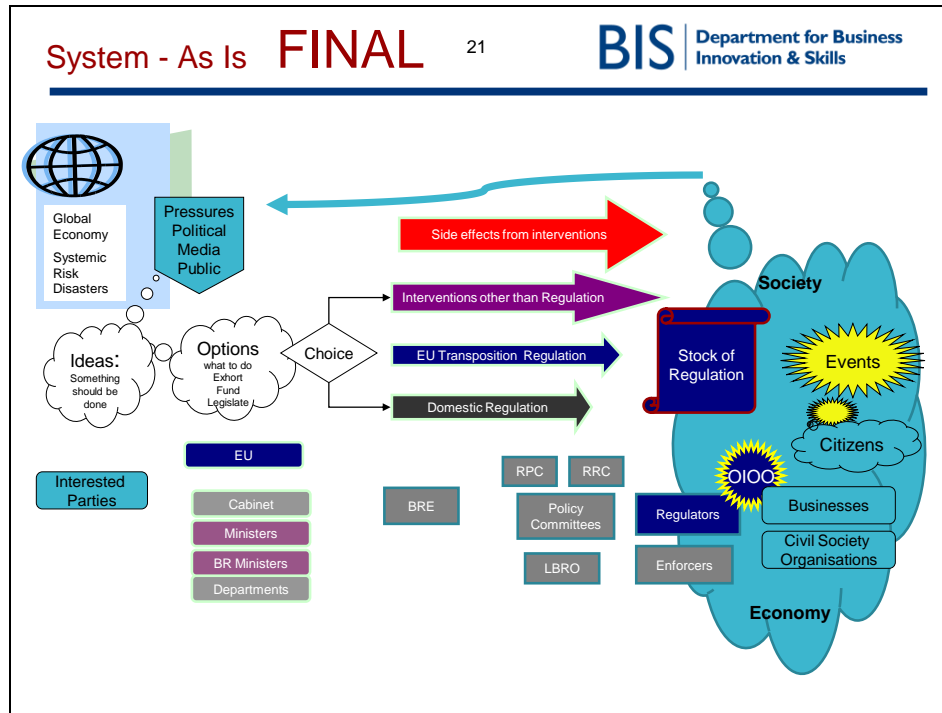


Figure 16: System View

As a result of the workshop I created a map of how the system might be changed.

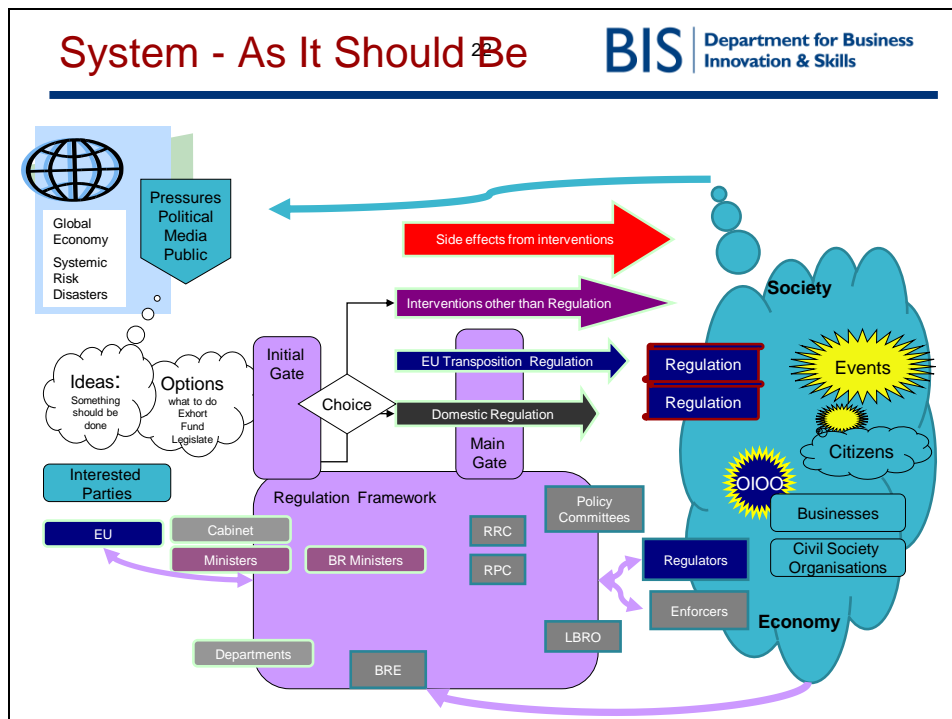


Figure 17: Changing the System

The System as it should be suggests a way ahead. This envisages BRE leading the development of a framework for the Policy Teams within departments allowing a collated view of their regulation stock and flow. A cross government intelligence function brings together the current component member organisations. There is potential for studying the predicted impact of these changes to the regulations on the Society-Economy as well as the burden of administering them.

In this view BRE would be the framework provider and facilitator of the descriptive, predictive and prescriptive processes. This changes the focus of effort from carrying regulations into stock to concentrating on the early stages of option formulation and selection. A longer range view and earlier influence on European policy selection is implied.

Through a consistent and comprehensive assessment of the impacts of all regulation a decision can be better reached on what regulations should be brought into existence. This also extends the use of Impact Assessment so that experience from the events that occur in the Society feed back so that the Framework becomes better informed on what works in real life. This informs subsequent decisions at the Initial and Main Gates where regulation is chosen then confirmed as the means to proceed

### **SSM – LESSONS INDICATED**

The successful use of SSM has both technical and social aspects.

Technically SSM provides insights rather than “answers”. These are for the Analyst and for Decision Makers. The process develops a common language. During the Three Boards workshop it was apparent that the top level system view had become accepted as a summary with various views of the lower level sub-areas linked to it. It acted as a means to share understanding of the problem.

Socially the work demonstrated the benefit of benevolent patronage as an enabler of OR. The interest from both Director General and senior staff gave an impetus which was productive. The close liaison with BRE accelerated the process. Arrival of a new Director, Selection and Restructuring of the Department complicated the process and distracted from the study but the findings were put to good use as BRE restructured.

OR can enable change by illumination of the individuals’ models, which might be seen as perceptions. In the inaugural issue of OR Quarterly published in 1950 Professor Patrick Blackett wrote that OR’s successes often arise from the “discovery of problems which had not hitherto been recognised as significant.” SSM is a practical means to make the discoveries by combining different perspectives within an overall view of a transformative system.

## REFERENCES

P Blackett, page 5 Operational Research Quarterly Issue 1 Volume 1 March 1950

P Checkland & Scholes Soft Systems Methodology in action" J Wiley 1990

P Harrison pages 36- 41 Operational Research Core Business Studies Mitchell Beazley 1983