



Complexity Research Programme



***‘Complexity Research - Approaches and Methods:
The LSE Complexity Group Integrated Methodology’***

by

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In

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Abstract

If organisations are seen as complex evolving systems (CES), then the approaches, methods and tools that we use to study them and to help them evolve need to be appropriate - for example, they need to take the characteristics of organisations as CES into account; they need to track changes over time; and they need to address both the qualitative and the quantitative aspects of the organisation under study as well as its broader environment.

The Complexity Group at the London School of Economics has been working collaboratively with organisations since 1995 to develop such a methodology and the paper will describe the different qualitative and quantitative tools and methods that make up the integrated methodology. At the same time the Group has been developing a theory of complex social systems. Both the methodology and the theory have been developed and tested in practice in a series of projects looking at real problems faced by our business partners. They include BT, BAe Systems, Citibank (New York), GlaxoSmithKline, the Humberside TEC, Legal & General, MoD, Mondragon Cooperative Corporation (Basque Country), the Modernisation Agency of the NHS, Norwich Union, Rolls-Royce Marine, Shell (International, Finance and

Shell Internet Works), the World Bank (Washington DC), AstraZeneca and several companies in the Aerospace industry.

What is a ‘Methodology’?

What we call a ‘methodology’ is a set of tools and methods using a *collaborative, action research* approach. It is *collaborative* in the sense that we work closely with our business partners. We do not just observe them and then tell them what to do. The whole approach emphasises *co-creation*. This is not easy either for researchers trained in more traditional approaches or for our business partners who often expect us to act like consultants providing them with a report and a list of recommendations. It is *action research* in the sense that we are part of the process and the research directly influences our partner. But this is not a one-way process. We also learn and are influenced in the process. Collaboration and action research are necessarily interdependent. The one cannot take place in the absence of the other.

The Problem

We start with a specific issue or practical problem, or at least with the *perception* of such a problem. In the process of analysis, triangulation, validation, etc the problem may appear in a different light, but initially we have to start with what our business partners *see* as a problem. For example, when we were studying the IT Legacy issue (i.e. to what extent information technology systems supported and continued to support changes in business strategy and direction, such as providing new products or services or by entering new markets) the dominant assumption was that the problem lay largely with the technology and the question raised was: how can we design and develop information systems that can be constantly upgraded to meet changing business demands? Twenty eight projects were funded by the British Government through the EPSRC (Engineering and Physical Science Research Council) to look at this issue that was costing industry a great deal of time, effort and money. Most of the projects started by taking a purely technical approach as they accepted the dominant assumption. The LSE project started by looking at the relationship between the information systems and the business domains, or to put it another way, at the *co-evolution* of the two domains. This included the technology, the strategy changes and the relationship between the individuals involved.

One of our key findings, in due course supported by most of the other projects, was that the problem was not just technical, but *socio-technical*. In other words, the legacy issue could not be confined to the design and development of computer software and hardware; these aspects were necessary but not sufficient to reduce the legacy problem. We found that the *relationship* between the IS professionals, the business strategists and the user community was critical. Another finding was that legacy was not a function of age. Brand new IT systems could quickly become legacy in the sense that they did not fully support the business process. However, when the right environment was created, the difficult dialogue between IS professionals and business strategists improved.

This in turn, led to greater understanding of (a) what the technology was capable of delivering and (b) where the business wanted to go and what it wanted to achieve.

This reciprocal understanding actually helped to resolve some of the technical issues and to reduce the legacy problem¹.

The initial perception of the problem both by the business partners and by other researchers was modified by the findings, and this in turn led to a change in working practices that improved the problem. If the original perception of the problem had remained intact then the problem would have persisted. Technical improvements would have made a temporary difference, but the next version of the system or the installation of a new system would have re-created the problem.

Natural Experiments

An important insight from that project was the confirmation that a combination of social, technical and cultural conditions was necessary. Together they created an enabling environment that facilitated the co-evolution of the two domains and our work since then has emphasised the *co-creation of enabling environments*. But there was another insight that was critical. The example or case that we identified was what may be called a '*natural experiment*'. A natural experiment is part of an organisation that wants to change. It is not an experiment in the scientific sense where the researcher is testing something and is able to control the experimental situation; a natural experiment cannot be controlled and there is no closure, as it is ongoing. A natural experiment is one where the organisation itself wants to experiment and to explore different *ways of working and relating*. That is, the way that people interact, communicate and work together - the 'way of relating' reflects the informal structure of the organisation and if this changes it could have significant implications on ways of working or how work is done, how procedures and processes are undertaken. To use the language of complexity, when individual agents change their patterns of interaction new structures or new properties *emerge*. This process may also affect the culture of that part of the organisation.

These insights resonate with the logic of complexity. Organisational change cannot be designed top-down and cannot be determined in advance in full detail. The constant failure of major restructuring initiatives and of merger and acquisition activity, where a highly specified organisational design is involved, indicates that the approach may be flawed. We are working on the hypothesis that a robust organisation evolves its social and organisational relationships and is capable of guiding and supporting its co-evolution with a changing environment. This kind of organisation has a relatively high degree of self-organisation and is comfortable that some procedures, processes and relationships will emerge and cannot be predetermined. It can live with this type of uncertainty and does not find it threatening. It also encourages the exploration of the space of possibilities by acknowledging that exploration means that some attempts will 'fail'. But without experimenting and running the risk of failure, a new order cannot emerge. This is not easy to put into

¹ Mitleton-Kelly E. and Papaefthimiou MC. 2000: '*Co-Evolution and an Enabling Infrastructure: A Solution to Legacy?*' in 'Systems Engineering for Business Process Change' Edited by Henderson P., Springer-Verlag, ISBN-1-85233-222-0

Mitleton-Kelly E. and Papaefthimiou MC. 2001 '*Co-Evolution of Diverse Elements Interacting within a Social Ecosystem*' in 'Systems Engineering for Business Process Change' Vol. 2, Edited by Henderson P., Springer-Verlag, Oct. 2001, ISBN 1-85233-399-5

practice, as it requires a different style of leadership and management, as well as a high degree of personal responsibility from all employees. But it has been achieved with remarkable outcomes² and is the longer-term objective of our approach - i.e. to help organisations become fitter and more sustainable by learning to co-evolve effectively with their changing environment, or to become aware of *co-evolutionary sustainability*. If the organisation does not continue to co-evolve in an aware and purposeful manner the systems, procedures, etc may become legacy in the sense that they are what has been ‘left over’. Co-evolution does not stop, it is an ongoing process, but it may become reactive and change its emphasis from co-evolution with to adaptation to a changing environment³. The distinction is between strong and weak reciprocal influence and in the way the organisation thinks about and responds to changes in its environment.

Necessary Conditions

But how can this ‘holy grail’ of organisational fitness be achieved? First of all the organisation should *want* to experiment; secondly it needs to spend some time and effort in trying to *understand in depth* where it is and what are its capabilities; thirdly it needs to know *how to set up* the natural experiment, to facilitate its success; and fourthly it needs to create an *enabling environment* that will help it achieve its goal, while understanding that the goal may itself change. The following qualitative and quantitative tools and methods provide the material and the processes on which that understanding may be built. They each provide different but complementary information about the organisation, so when all the tools and methods are used the organisation ends up with a very rich and deep understanding of itself. The findings can then be used as an informed basis to identify the conditions for building the enabling infrastructure.

To begin with, the researchers meet some of the key people involved and discuss the background to that particular ‘natural experiment’. This gives us some context and identifies the key questions, concerns or problems. We explain the research process and our business partner is then in a better position to identify potential interviewees, who will take part in Phase One of the project. This phase includes (a) a set of **semi-structured interviews**, taking the key questions and concerns into account; (b) an introduction to **complexity thinking** by using the principles of complex evolving systems; (c) use of the **other tools and methods**; (d) analysis and presentation of the initial findings from the interviews at a **Reflect-Back workshop**; (e) findings from other tools and methods, may also be incorporated in the workshop presentation; (f) working with a core group to identify the **enabling conditions**, and to co-create the enabling framework that will be implemented in Phase Two. This will facilitate the emergence of a new way of organising or even a new organisational form.

Semi-Structured Interviews

² The Humberside Training and Enterprise Council in the UK worked with these principles for over 5 years and achieved remarkable results. A paper describing this case study is forthcoming.

³ Mitleton-Kelly E. Chapter 2 ‘Ten Principles of Complexity & Enabling Infrastructures’ in ‘Complex Systems and Evolutionary Perspectives on Organisations: The Application of Complexity Theory to Organisations’ Elsevier 2003, ISBN: 0-08-043957-8

Semi-structured interviews provide a narrative analysis. They are based on only eight topics that stimulate reflection on the central problem and on related issues. They take 1.5 hours; they are recorded with the express permission of the interviewee and are conducted by two interviewers. The lead interviewer asks the set questions (not seen by the interviewee) while the second interviewer explores some broader issues. The analysis uses direct and full transcripts, as the language used by the interviewee is an important element in the narrative analysis. Some researchers use the software Atlas for the analysis while others prefer to work directly with the scripts. The first analysis identifies *common themes*, *dilemmas* and *key questions*.

The interviews are analysed by at least three researchers and each researcher will analyse interviews done by him/her as well as interviews done by the other researchers to gain as broad experience of the interview data as possible. All the researchers will then meet for one or more whole days to share their initial findings. The themes and dilemmas are clustered in related groups with their associated questions. All papers are then put aside and after a break the team reconvenes to identify some underlying assumptions. This is the hardest part of the analysis. Assumptions are not voiced. They are tacit. They are based on impression and interpretation and are the most 'subjective' elements in the analysis. But they are extremely valuable as they highlight how the organisations 'shows' itself to others.

During this process several things happen: (a) interpretation bias is reduced by checking each other's reading; (b) by offering several perspectives, the understanding of each individual researcher and of the team is deepened; (c) patterns emerge and connections are made leading to some significant insights. The process is so powerful that we can identify key themes and dilemmas with only 6 interviews. In practice however we usually conduct 12-20 interviews. Interviewees are not seen as an average sample in a population, but as fractal representatives of the whole, offering different and overlapping perspectives.

Experience of the organisation is not confined to interviews. We join our partners in conferences, workshops and other meetings. We spend time over lunch with them and we keep in touch by telephone and email. Building and nurturing of these relationships is essential. We also scan the press for articles involving our partners; we visit their websites and generally keep ourselves informed through the literature and the media.

The Reflect-Back Workshop

These initial findings are then presented at a Reflect-Back Workshop. They offer a 'mirror' to the organisation and they provide an informed starting point for the identification of the social, cultural and technical conditions (as well as the political and economic conditions, where appropriate) to create an *enabling environment* for integration after a merger or acquisition, or to achieve organisational change, or to promote the generation and creation of knowledge, etc.

In parallel with the interviews and before the Reflect-Back Workshop the following may also take place:

Complexity Thinking Workshops

Introduce complexity thinking to all those interested in exploring the theory and how to apply it in practice. Participants are introduced to ten principles of complex evolving systems within an organisational context³. Figure 1 shows the 10 principles and the main theories that have contributed to their development. If we understand the characteristics of organisations as CES, we can work with them rather than against them. This kind of understanding can help change mind-sets and bring about quite fundamental changes in ways of organising and relating. Workshop participants are encouraged to use the principles of complexity within their own organisational context and this may provide insights as well as practical benefits, when applied to day-to-day operations. This introduction will provide the theoretical framework for the findings presented at the Reflect-Back Workshop.

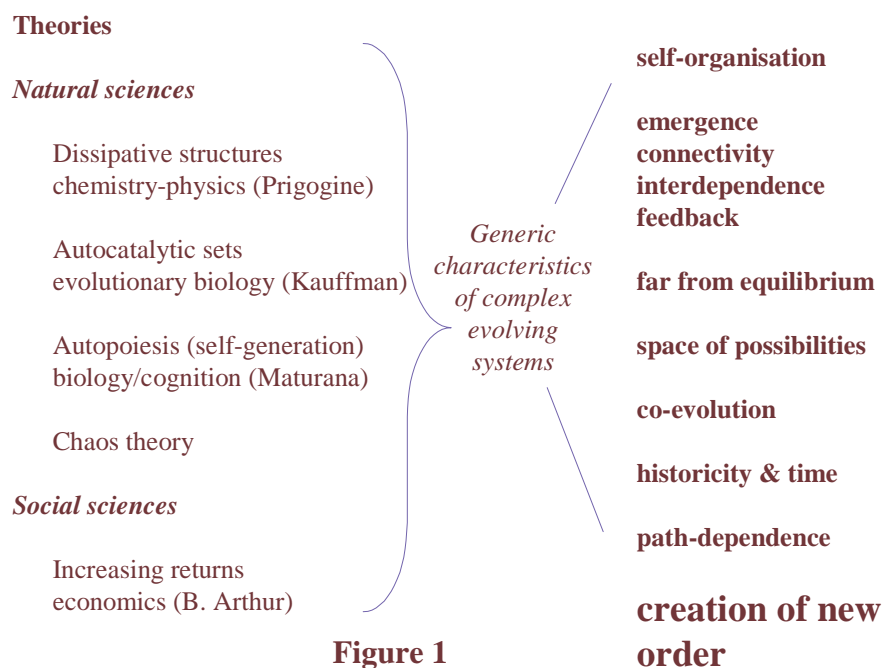


Figure 1

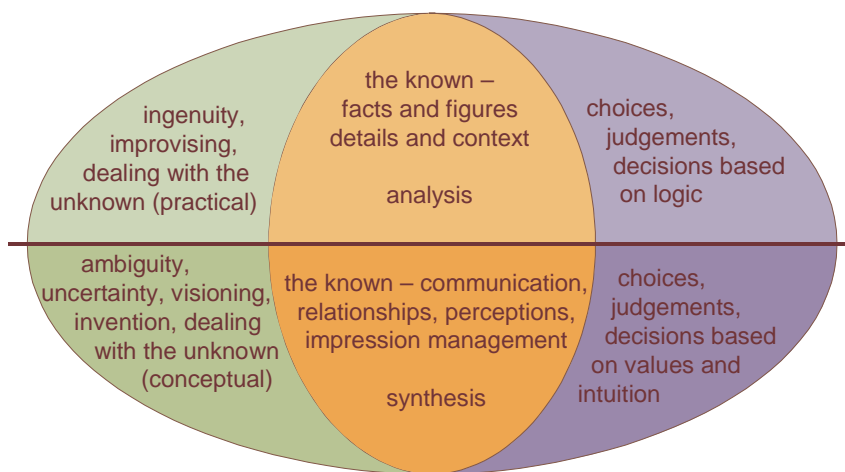
Landscape of the Mind (LoM)

We can also look at the cognitive preferences of individuals and teams, in the way that they make decisions, exchange information, create new ideas and how they implement them, etc. This is done through a tool called Landscape of the Mind (LoM) developed by **Kate Hopkinson**, which is based on an email questionnaire completed by the participants themselves. The findings help to triangulate the interview data, but individual details are never given to anyone other than the person concerned. Presentations only show findings for whole groups. In fact, findings from all tools are **non-attributable** and neither the interviewees nor the LoM respondents are identified.

³ Mitleton-Kelly E. Chapter 2 'Ten Principles of Complexity & Enabling Infrastructures' in 'Complex Systems and Evolutionary Perspectives on Organisations: The Application of Complexity Theory to Organisations' Elsevier 2003, ISBN: 0-08-043957-8

Individuals and teams use different **‘conceptual architectures’** to think when taking decisions, generating knowledge, etc. These architectures can act as potential constraints or enablers in the decision taking process, in strategic thinking, in knowledge generation, etc. The tool identifies and shows in diagrammatic form, both individual and group profiles of the ‘Landscape of the Mind’. Figure 2 shows a high level description of LoM, but there are several levels of analysis providing greater detail on specific preferences. It is not only the architecture itself which is important, it is also a question of how individuals, teams and organisations move around within an architecture – the “inner skills strategies” they use to progress, for instance, from a new idea to implementing it.

Figure 2: Landscape of the Mind (LoM)



Landscape of the Mind – varieties of inner skill

© KateHopkinson 1995

Visual Representation

During the analysis our resident artist, **Julian Burton**, will capture some of the themes, dilemmas and underlying assumptions in a picture. This has several advantages: many related aspects that are difficult to think about at the same time, can be captured in one picture; and very sensitive issues that are difficult to talk about, can be presented diagrammatically to workshop participants, before the presentation begins. Once they recognise what is being shown they may laugh and thus break the tension and open the issue(s) to discussion. One of Julian’s pictures created for one of our business partners is at figure 3.



Figure 3

In addition, Julian Burton uses art to facilitate the process called ‘Visual Dialogue’. This provides a visual perspective on important issues and challenges before, during and after meetings. The method can (a) capture the ideas, meanings, concerns and issues expressed in meetings, reflecting back emergent themes visually, as a catalyst for further discussion; (b) provide a visual overview of a current situation, expressing and conveying complex inter-related issues in context symbolically and engage a group’s attention thus enabling them to quickly grasp the main issues and focus on relevant elements; and (c) structure problems to facilitate shared sense-making, developing novel perspectives that can open up new possibilities in meetings. The difference between the two approaches is that the visual *representation* of themes etc is used as part of a presentation that will incorporate the interview analysis and LoM, while in the *Visual Dialogue* art is the only tool being used.

The interviews, narrative analysis, reflect-back workshops, LoM and visual representation are all qualitative tools and methods. The quantitative tools are agent-based-models (ABM) and simulations and a tool called NetMap, which maps email exchange. Each tool also expands the area of application - e.g. we may do 20 interviews, apply LoM to 70, ABM to 100-200 respondents and NetMap to several thousand email exchanges.

Agent-Based-Models (ABM) and Simulations

The agent-based-models and simulations, built by **Dr Ugur Bilge**, show connectivity using all media (email, face-to-face meetings, virtual conferencing, etc). The simulations help with ‘what if’ exploration. When repeated, they also show the evolution or development of connectivity. The data is collected through an email questionnaire, which is refined and tailored to each individual business partner, after the initial interviews. The tool enriches the insights and data set derived through the

interviews and shows the different and inter-related informal and formal, social and work-related networks within the organisation. They can also show how ideas spread, how new ideas may lead to innovation or be blocked from being developed.

NetMap

The models and simulations are complemented by another tool called NetMap, developed by **Prof. John Galloway**, which maps email exchange. This tool is extremely powerful and shows in graphic form email connectivity. Figure 4 shows a high level representation of such connectivity, but the tool allows zooming-in at many levels to look at the connectivity patterns. Exploring these patterns with our partners helps them to understand the formal and informal networks within the organisation as well as connections with suppliers, customers, etc. It will again show the evolution of connectivity when repeated during the life of the project. NetMap only requires access to a server and only looks at the exchange of emails not at content.

Figure 4: NetMap

**Reciprocated
relationships**



The simulations and NetMap both show connectivity patterns and identify ‘lynchpins’ or highly connected individuals or groups. If you are doing any kind of restructuring you certainly need to know about these individuals or groups. In addition they show lack of connectivity where it should be taking place. ABM and NetMap could provide a useful metric of social capital, by showing changes in connectivity as a means of tracking the exchange of information over time.

Why So Many Tools?

We use so many tools because they triangulate the data and provide robust and rigorous findings. But that is not the only reason. They each provide different but complementary information about the organisation. So when all the tools and methods are used the organisation ends up with a very rich and deep understanding of itself. The findings can then be used as an informed basis for building the enabling

infrastructure. This last part is a **co-creation** activity. We work with a core team of ‘volunteers who can make a difference’ to identify the social, cultural and technical (also political and economic) conditions that together will help the organisation create the kind of environment conducive to change and the emergence of new ways of organising (ways of working and relating). But this is not a one-off process, the new way of thinking based on complexity, the new relationships, procedures, processes, structures, etc need to become sustainable. Ideally, the organisation will help its employees to develop the capacity to continue the process of co-evolutionary sustainability.

The Three Phases

To summarise, the end of phase one is the identification of the conditions for co-creating the enabling infrastructure. The second phase involves experimenting with that infrastructure and implementation. There is a lot of learning in this phase and this is where working with ICoSS and a number of business partners, is advantageous and beneficial, because the partners will learn from each other’s experiments and will support each other during implementation, as well as getting support from the research team.

The final phase - phase three, runs in parallel with the other two phases and continues to the end of the project. It is the documentation and dissemination of the research process and the findings. This is interesting at two levels. First of all we will be looking at the research process at a meta-level. The researchers, business partners and advisors make a good natural experiment – we are exploring new ways of working and different ways of relating; and we want to capture this. The other level of course is to do with dissemination and this paper is part of that dissemination process - so that others may benefit from our work. Since the project is funded by a Research Council its ultimate aim is to benefit industry as a whole, not just the few business partners and the research team. We will therefore provide handbooks, write papers, make presentations, etc. to document and disseminate the findings.

Summary & Conclusion

The paper described the tools and methods that make up the LSE Complexity Group’s integrated methodology. Some of these tools and methods are not new, but the way that they have been brought together is quite unique. Not only do they complement each other by providing different but overlapping perspectives on the organisation, they also ensure that both the qualitative and quantitative characteristics of organisations are considered as part of the whole. In addition, the approach places each organisation within its broader environment by emphasising the co-evolutionary process and the reciprocal influence exercised by the organisation within its social ecosystem.

The approach is underpinned by the theory of complex social systems, developed by the Group, which is based on the sciences of complexity and on organisational theory. The logic of this approach argues for the co-creation of enabling environments that facilitate the creation of new order in the form of new ways of working and relating, new structures, cultures, etc.

At the end of our complexity thinking workshops we summarise the characteristics that an organisation needs to enable, from a complexity perspective, to provoke discussion. One of our business partners has called them the 'Holy Grail', they are:

A successful CES organisation:

- Facilitates (does not inhibit) emergence

- Encourages self-organisation

- Explores its space-of-possibilities

- Facilitates co-evolution

- Understands connectivity and interdependence

- (e.g. relationships, not isolation, fosters a collaborative culture)

- Creates variability - large repertoire of responses (diversity – people, cultures, products, markets; speed and cost, cope with change)

- Copes in unpredictable environments

- Not too organised and not too random (“fuzzy matrix”)

- Emphasises enabling infrastructures

- Facilitates the emergence of:

 - New ways of working and relating

 - New organisational forms

 - Generation and sharing of knowledge

- Continuously re-invents the organisation

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