Complex Multi-modal Multi-level Influence Networks - Affordable Housing Case Study -

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Abstract. Most influence networks are depicted as nodes and links operating in the manner of a feed-forward neural network where both nodes and links appear to be homogenous in their nature. Experience has shown that not only do these networks fail to deal adequately with reality, but also that practitioners struggle to understand why. This paper addresses this challenge by examining the rich, multi-level and multi-modal nature of influence networks and proposes an approach drawing inspiration from complexity science - leading to multi-perspective techniques which enable influence networks to be used to more effectively to capture, visualise and understand complex situations, so providing insights to support effective decision-making. The paper gives evidence (from a case study looking at the provision of affordable housing in the UK) which illustrates how the techniques have been employed and what benefits accrued.

1 Introduction

The thesis of this paper is that not only are the 'nodes' in influence networks[1] heterogeneous and complex in themselves, but also that the 'links' are too - as are the dynamics of influence. This paper addresses the nature of this complexity and variety and illustrates its effects, focussing on the rich, dynamic aspects of the links.

A first key concept is that influence networks are multi-dimensional - for example, in the 'levels' of their granularity (micro to macro) and in terms of the ways that influence is mediated and propagated through networks. This leads to the realisation that networks are operating at different levels of influence, where effects at one level may be 'hidden' from nodes operating at another. This paper will discuss the kinds of mechanisms and techniques that operate at these different 'levels' and will examine how influence can reverberate among and between the levels. We extend the work of Morowitz [1] where we have provisionally identified around 60 emergent transition levels[2] (not covered in detail this paper).

[1] In this paper, the term Influence Networks is used to describe patterns of interactions of any type, strength or duration (whether persistent or transitory). Over time, these patterns evolve and can be used to represent a flow or 'trajectory' of influence. Our focus is not so much on the 'nodes' (which themselves can be persistent or transitory) but on the phenomena that arise (which depends on the nature and degree of interaction and 'connectedness') from the linking.

[2] These 60 or so 'emergent transition levels' will be the subject of a another paper from The abaci Partnership in its 'Exploiting Complexity' series.

J. Zhou (Ed.): Complex 2009, Part II, LNICST 5, pp. 2054 – 2063, 2009.

A second key concept is that influence is multi-modal - for example, influence may propagate via changes in the environment, by direct contact or via emissions of mediating energy. What follows from this is that, depending on the sensing and perceiving techniques of the observer, influence may seem to become 'invisible' (as it propagates via another modality) - which may lead the observer to substitute false influence mechanisms and even, in the human case, develop conspiracy theories.

As a simple example, consider the role of money in a society. If a financial influence network is mapped, it may be difficult to understand how actions in the financial sphere affect health, without generating an influence network at the bacterial level which shows how disease is able to exploit the fragile health of the poverty-stricken - and then showing the influences between the two. The authors use the term Complex Multi-modal, Multi-level Influence (CMLI, pronounced 'seemly') networks for these sets of interactions and for the behaviours which emerge.

The third key concept is that it is not possible to understand these complex behaviours by trying to break them down in a reductionist manner. Instead, this paper uses a 'Complexity Framework' (described below) and shows how it can be used to enable the different aspects of these Influence Networks to be captured, visualised, understood - and then the understanding exploited to support decision-making.

Finally, the paper will show how a version of the CMLI networks and Complexity Framework were employed to support policy making and public engagement in a study into the provision of affordable housing in small towns in the UK [2]. The authors hope the paper will lead to collaboration with other practitioners who are exploiting complexity and with those researchers developing similar techniques.

2 The Complexity Framework

The emergent properties of complex interactions are often portrayed as unwelcome, chaotic and destructive, but nothing could be further from the truth. In reality, emergent phenomena become interconnected, interdependent and creative and the whole world depends upon it (as in ecosystems and living creatures for example). These Complex Multi-modal, Multi-level Influence networks display persistent, emergent patterns which are adaptive over time. It is well understood that these complex behaviours cannot be understood by breaking them down in a reductionist, linear manner - instead approaches from complexity science must be used.

It is outside the scope of this paper to provide a tutorial on complexity science. There are many excellent resources available [3, 4, 5, 6]. Also, the paper will not examine the philosophical or spiritual aspects - though they are obviously relevant.

In complexity science, the persistent entities[3] and emergent patterns arising from interactions in CMLI networks have been called Complex Adaptive Systems (CAS). In the social and human context CAS have additional elements such as purposeful[4] sensing, learning, problem-solving, prediction and acting. The term Complex Adaptive Reflexive Systems (CARS) [7] has been used for these purposeful entities -

[3] In this paper, the term 'entity' is used to refer to anything capable of interaction, however primitive the interaction. An entity should not, therefore, be assumed to be sentient.

[4] In this paper purposeful behaviour is considered in its broadest sense, covering behaviour from the impulsive and whimsical to the highly deliberative and formalised.

examples of which extend from social groupings to the brain. Human communities, such as those which are the subject of this paper, are also CARS and we assert that the Complexity Framework we describe here, based on the understanding from complexity science, can be used to capture, visualise and understood their behaviours.

This Complexity Framework, therefore, is used to enable the systematic examination of the complex phenomena at work in the Complex Multi-modal, Multi-level Influence networks of the CARS we examine in this paper. It is important to note that if we only focussed on the dynamic activities of these networks we would miss many critical enabling factors (such as the role of the environment and the properties of the interacting elements). The Complexity Framework is designed to address these potential shortfalls by using four distinct 'perspectives'. Each of these perspectives (described briefly below and developed further in the rest of the paper) focuses on the different aspects which affect how emergent phenomena come about:

Perspective 1: Precursors and Enablers (The Givens / Environment). Emergent phenomena from CMLI networks could not arise, nor complex systems exist without the persistent existence of certain things. These include, for example, enduring 'precursors' of influence (such as the geography of an area) which are relatively fixed and those things which are 'enablers' of influence and which people can affect (such as social class structures). This perspective considers the environmental contexts (the so-called 'substrate') which enable interaction in CMLI networks to occur.

Perspective 2: Purpose and Intent (Design-time). Given the purposeful nature of both social activity and policy-making, there has to be some expression of intent, some formulation of a design and / or of goals - however transitory. These expressions shape much of the direction in which future endeavours go. A key aspect of this is the way in which the design is either captured, 'formalised' and disseminated through artefacts or employed through on-the-fly behaviour to communicate intent. In the context of this paper, leaders and policy makers issue formal laws and guidelines. In contrast, people may take to the streets and indicate intent through protest. This perspective considers the 'design-time' factors that can drive the purposeful behaviour in CARS that shapes the range of possible behaviours in CMLI networks.

Perspective 3: Components and Composition (Architecture / 'Assemble-Time'). Emergent phenomena arise from interactions between 'components' in some environment. The nature of the possible interactions, their interdependencies and influences is largely dictated by the properties of those components - their abilities to sense, communicate, interact and shape their environment. These determine the nature and range of repertoires of behaviour of nodes and the ways in which the entities can group themselves. This perspective considers how the properties of these components (eg, people) and their 'composability' (eg, sociability) affects nodes in CMLI networks.

Perspective 4: Dynamic Change (Behaviour and Perception - Run-time). During life, dynamic adjustment and adaptation are the norm. The interplay between three aspects is key to emergence, adaptation and evolution: the top-down influence of the 'leaders'; the self-aware and self-regulatory behaviour of the people and their community the bottom-up effects which arise from individual personalities, motivations and competencies. Most importantly, there are the influences of culture,

religion and society whose perceptions, involvement and reactions can have profound effects. In addition, the environment in which the CMLI networks are active which will have its own influences - though it should not be forgotten that the environment itself can be purposefully 'interfered with' to change aspects of the outcomes. This perspective considers the dynamic context.

Employing the Complexity Framework - Required Mindset. The perspectives above are not independent - they are always interconnected (not always in the most obvious ways). It is easy to forget this and to make limiting assumptions. Hence, it is essential to adopt a suitable multi-perspective mindset[5] when using Complexity Frameworks to analyse CMLI networks. It is beyond the scope of this paper to describe in detail the pitfalls to avoid when engaged in 'complexity thinking', but one example will give an idea. It is important to always avoid drawing arbitrary boundaries. For example, the notion of a community meeting sounds like something with a clear start, middle and end - but this is not so. The way that a meeting will turn out starts long before the event and continues well after it - trains are late and people have a 'bad day', relationships and animosities are formed, and consequences follow - all these 'external aspects' impacting on the behaviours. Indeed, these aspects can be purposefully manipulated, and frequently are, either to disrupt or coerce.

3 CMLI Networks – The Technique

Most influence networks are depicted as nodes and links operating in the manner of a feed-forward neural network where both nodes and links appear to be homogenous in their nature. The assumption is that each link represents a direct 'cause-effect' mapping. Experience has shown that not only do these networks fail to deal adequately with reality, but also that practitioners struggle to understand why not. Smuts [8], recognised the limitations of this everyday cause-effect thinking and pointed out that usually the notions of 'cause' and 'effect' are hopelessly simplistic and too tightly bounded. Models based on these networks fail to deal with reality, both because of their naivety and also because that very naivety means they easily fall prey to Gödel's Incompleteness Theorem (the subject of another paper). In contrast, this paper recognises the rich, multi-level and multi-modal nature of influence networks and proposes an approach drawing inspiration from complexity science.

Employing CMLI networks. The techniques described here enable influence networks to be used to more effectively capture, visualise and understand complex problems to provide insights in support of decision-making. The first part of the technique exploits the first key concept mentioned above by representing the multi-dimensional (for example, in the 'levels' of their granularity, micro to macro) aspects of influence networks. This leads to the realisation that networks operate concurrently at different levels of influence, where effects at one level may be 'hidden' from nodes operating at another. Different kinds of mechanisms and techniques can operate at these different 'levels' and yet other influences can also reverberate among and between the levels or

[5] The principles involved and a description of 'the Multi-perspective Mindset' will be the subject of a another paper from The abaci Partnership in its 'Exploiting Complexity' series.

nestings. We have provisionally identified around 60 emergent transition levels (not covered in detail in this paper, but available from our website [2]). Examples of relevance to this paper include:

- Levels related to a human individual, such as those described by Maslow [9].
- Hierarchies and structures within government, local authorities and enterprises.
- Social and 'tribal' groupings and aspects of class / caste.

The second key concept is that influence is multi-modal - in terms of the ways that influence is mediated and propagated - both across levels and through networks. For example, influence may propagate via changes in the environment (so-called 'stigmergy'), by direct contact, via emissions of mediating energy, by social pressures. Such influence is very complex and the challenges that arise have been called 'wicked problems' [10]. In this paper, we add an important aspect - perceived influence. It is not enough to map out tangible and emergent influences, we must also consider different human viewpoints and group perceptions. This is important in the social housing example used in this paper because, depending on the sensing and perceiving techniques of the observers, influence may seem to become 'invisible' (as it propagates via another modality) and be ignored - which may lead the observer to substitute false influence mechanisms and so deduce malice, bigotry or invent conspiracy theories to explain what seems to be happening. These factors were found to be particularly important in the affordable housing context.

4 Using CMLI Networks – Affordable Housing Example

The technique for using CMLI networks is partly adapted from Howard [11] and involves taking one of the four perspectives at a time (in an order determined by the spirit of the exploration), identifying a number of relevant viewpoints related to that perspective and then working with the individuals and organisations concerned to identify the factors and influences arising from each of the viewpoints. This includes analysis of the 'what do I think' and 'what do I think they think' types. Viewpoints within and across perspectives can be compared to expose contradictions, alternatives, 'invisibles' etc. The added value that the CMLI network approach provides is that, by examining a rich variety of levels and modalities, novel influences, effects and linkages can be identified which would normally go unnoticed. Even in a basic form, this analysis has proved to be a powerful technique for triggering insight and debate.

The social housing case study was concerned with public opinion in small towns on the border between England and Wales in the UK. In late 2001, communities were considering how their local plans needed to be changed to accommodate new planning guidance [12]. This case study focuses on one of the market towns in the area which has a population of around 11,000 people. The town has very diverse businesses from traditional agriculture, light engineering and construction work through to so-called 'creative clusters' [13] of artists, designers and cyber-technology startups. The local plans had to balance the following:

- Social Housing; Town Centres and Retail Developments;
- Sustainable Development in Rural Areas;
- Transport and Planning and the Historic Environment.

This activity involved individuals and a number of organisations and institutions who were each asked to submit their views. These views then had to be collated and, to some extent resolved, before submission to higher authorities. One of the organisations was the local Civic Society (a voluntary, non-elected local decision-making body with over 500 members) who's focus was the conservation of the historic fabric of their town and its sustainable future. This group became extremely divided and strongly polarised on the issue of the provision of social housing. The Society initially formulated the influence network at Figure 1.

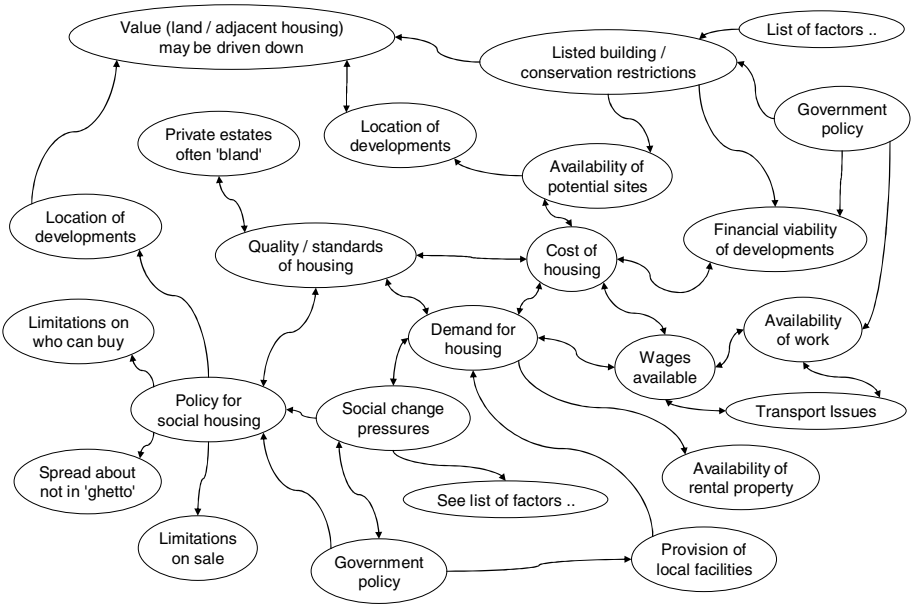

Fig. 1. Civic Society - Initial Influence Network

Though this diagram seemed helpful at first, it became apparent that it did not assist the Society in understanding how change in one issue affected another. A version of the CMLI network approach was applied leading to the insights below and to a revised diagram as shown in Figure 2. Firstly, Figure 1 was examined from each of the Perspectives below and the nodes were annotated accordingly to show to which Perspective they were mostly relevant. Next, the links were examined from several representative viewpoints (single parent, pensioner, local policy makers, etc) and were annotated with their significance as seen from each of these viewpoints. Even though these viewpoints were generalisations, useful trends and indicators became apparent.

Perspective 1: Precursors and Enablers (The Givens)
This perspective enabled people to identify aspects over which they could have no effect (precursors) and aspects which, though policy, social and economic change, could potentially be influenced (enablers). The precursors included obvious things such as the geography of the area and the heritage of the town (which made it

attractive to visitors). It became evident that the social housing requirements were enablers which arose from the agricultural nature of employment in the area and the low wages associated with this work. In other words, some social housing was required because people were disadvantaged and some was required simply because of the economy of the area - things which could be changed. This led the Society to begin to tabulate a set of 'Principles' around which they would base their views.

Perspective 2: Purpose and Intent (Design / Composition)
This perspective enabled the Society to consider its own intent and that of all the other 'actors' involved. As richer sets of viewpoints (related to these various actors) became apparent, there was a risk of the insights becoming unmanageable. This risk was mitigated by maintaining a clear focus on one viewpoint at a time. Mapping between viewpoints occurred subsequently - with viewpoints only being re-examined when it became apparent that key influences had been overlooked. This was one of the most useful activities which enabled the Society to identify their relationship to others in the community, such as: those with whom they could collaborate, those with whom they might form allegiances, those who seemed to be in opposition (but who should be approached). It also enabled the Society to consider issues such as relative degrees of power and influence and identify vulnerable groups who would need support. Subsequently, it turned out that some of their perceptions were wrong which led them to make changes to the way they influenced, leading to more constructive progress than had been expected.

Perspective 3: Components and Structuring ('Assembly')
This perspective embraced three aspects. Firstly, the 'components' of the community were considered - eg, the people. This involved looking at demographics, skill sets and even the temperaments and personalities of some of the key individuals. Potentially a very sensitive area, the Society dealt with it in an open manner by approaching some of the people concerned to seek their engagement. This in itself had a beneficial effect in fostering trust and openness (though this obviously may not work in all cases). Next the 'Configuration of the Community' was considered, its social mix, factions, groupings and institutions. This analysis mapped out the various groupings and their overlaps and exclusions and tried to see if there were any social groups who were being overlooked or which were having undue influence. Lastly, Leadership Roles within the Community were examined to try and identify issues such as: 'nodes' who were influential but who did not hold 'formal' positions in the community or others who held positions but who did not really represent anyone. It turned out that some roles overlapped in the same person (eg, the Mayor was also very influential among those applying for social housing because she came from humble origins), and that some roles were quite isolated. This led to a consideration of alternative ways that the community could be linked up to enable new, beneficial, interactions.

Perspective 4: Dynamic Change (Behaviour and Perception)
The dynamic perspective is the most challenging. The Society approached it by trying to identify the triggers of change and time-critical issues rather than trying to chase down every consequence (an impossible task in any case). They first looked at ways that influence could be applied from the Top-down and considered their position in relation to a number of options and identified which ones they would support / oppose.

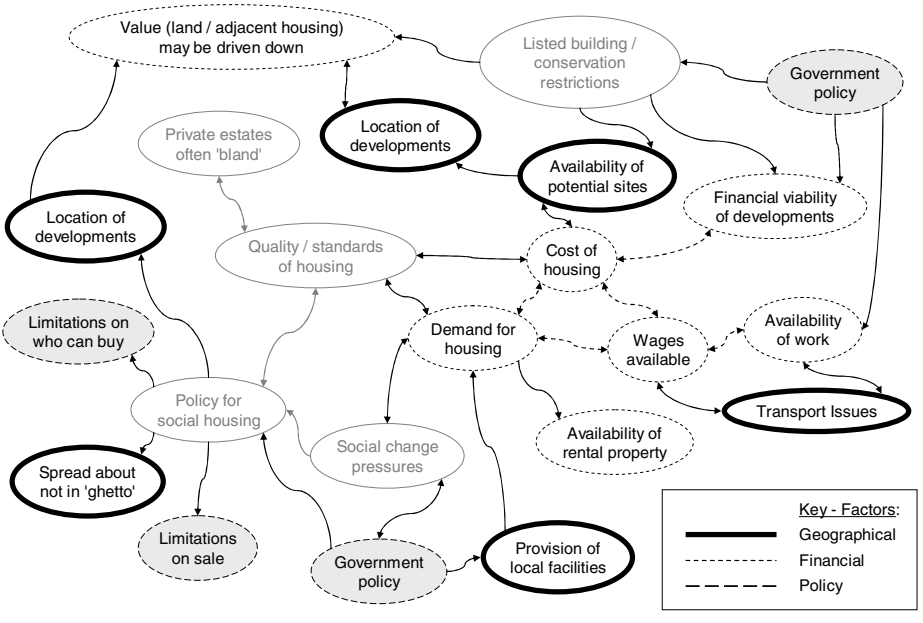

Fig. 2. Example high-level CMLI Network Reflecting three Factors

Next they considered influence through Self-regulation and looked at the balancing, creative and negative mechanisms at work in the town and decided how they wished to engage with them and to what effect. Then influence from the Bottom-up was considered both in terms of what members could do individually and though social networks in the community (which included influence exerted through Public Opinion, ie influence those who were just Observers in the town, the 'lookers-on'). Next they considered whether there would be influence from the Environment and discovered that a landowner near the town was considering building many inappropriate houses. The potential physical impact of this change was used to influence opinion. Lastly, the Society discussed their options in terms of how they might collaborate, compete, coerce or disrupt and used this work out which indicators of change would be significant to them and how they could monitor them.

Comment on the Outcomes from the use of the CMLI network Techniques

While the analysis of perspectives was going on, a number of CMLI network diagrams were produced of which Figure 2 is an example. Here, three factors (geographical, financial and policy) reflecting different modes of influence are highlighted.

This clarification enabled different factors to be better understood in terms of the nature of their 'connectedness' and of the effects they generated. The result of this CMLI network analysis was that the Society was able to develop a rich and defendable set of principles which they employed in their submission - a small selection of which follow. In relation to social housing they recommended to:

- accept that this housing will be smaller, low cost and may be less profitable;
- realise that this may require pressure to be applied to encourage 'social responsibility' from developers, banks etc;
- understand the social mix that such housing will generate;
- encourage the design of affordable housing which is pleasing and not uniform;
- understand that Housing Associations often can't buy land as it is too expensive;
- ensure that such housing is 'dotted about' - not in a 'ghetto';
- understand that social pressure from within 'ghettos' will increase social cost;
- ensure that low-cost housing is bought by 'low-cost people';
- try to provide housing where people work - to counteract environmental impacts.

In relation to policy they noted that:

- there are problems with the formula used for calculating district council funding;
- local plans are often out of date - leading to ill-informed decisions;
- they should lobby for the Government to encourage the use of the existing housing stock - reversing the migration away from / collapsing prices in certain areas;
- the council tax banding / housing stock evaluation is so out of date;
- they would challenge the figures about the demand for housing;
- they should have a developed view on longer term and wider implications - even if this means supporting apparent inconsistencies in short-term decisions - such as:

  a. population trends / social issues;
  b. restrictions on incomers;
  c. letting villages die.

In conclusion, it was felt that the techniques had been very valuable in many ways - including helping to build bridges between parts of the community which have previously been in opposition.

5 Summary

The thesis of this paper has been that not only are the 'nodes' in influence networks heterogeneous and complex in themselves, but also that the 'links' are too - as are the dynamics of influence. A first key concept is that influence networks are multi-dimensional - for example, in the 'levels' of their granularity (micro to macro) and in terms of the ways that influence is mediated and propagated through networks. A second key concept is that influence is multi-modal - for example, influence may propagate via changes in the environment, by direct contact or via emissions of mediating energy. The third key concept is that it is not possible to understand these complex behaviours by trying to break them down in a reductionist manner. Instead, this paper has used a 'Complexity Framework' and has shown how it can be used to enable the different aspects of these Complex Multi-modal, Multi-level Influence Networks to be captured, visualised, understood - and then the understanding exploited to support decision-making in the context of the provision of social housing.

This paper has drawn from complexity science and has likened communities and social groupings to so-called Complex Adaptive Reflexive Systems (CARS). Complexity

science shows that, to understand CARS, alternative perspectives are required to be analysed from different viewpoints and the paper has used a Complexity Framework for its analysis covering four of these perspectives:

- **Environmental:** Considering the precursors and enablers (the Givens) that must be in place before any activity can occur (such as geography and social types);
- **'Design-time':** Covering purpose and intent (which set the context and goals for activity such as formal policy or informal, organised protest) are communicated;
- **'Assemble-time':** Components and structuring ('Assembly' / Rehearsal) which allow the properties of the individual entities to be considered (people or councils);
- **'Run-time':** Which covers the perspective of how to exploit dynamic change (performance and perception) where adaptation and emergence come to the fore.

This paper has examined a case study concerning the provision of social housing using this multi-perspective / multi-viewpoint approach and has indicate how their use in the CMLI networks analysis helped shape policy and public opinion. The authors hope the paper will lead to collaboration with other practitioners who are exploiting complexity and with those researchers developing similar techniques.

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