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Logical *Lego*? Co-constructed perspectives on service design

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Abstract
In the era of 'digital by default', internet-borne services reach out into spaces and places. One example of such a service is home-based micro-payments using Internet Protocol Television (IPTV) that depends on reliable information-sharing practices between user and service providers. Traditional business modelling and brainstorming methods struggle to articulate the influences of space and place on service requirements, especially in terms of human-to-human and cultural relations. Shared modelling with *Lego* produces three-dimensional 'rich pictures' of relational services design showing the influences of space and place upon a situated service design. However, previous studies have merely presented results as photographs without annotations explaining model dynamics. Line drawings subsequently made by the authors, based on the model, succeed in extracted recursive patterns of spatially and temporally distributed social practices. These drawings, together with the model, are prime candidates for service designers to articulate the relational spaces and the demographics of target user-communities.

Keywords: Co-constructed design, service design, social practices, Lego, drawing

1 Introduction: influences of space and place on service requirements

Micro-payments that use IPTV as one method of delivery, is a service that allows users to manage their banking account via their household television set, using an infrared remote control, and a security PIN. The TV screen displays an interface where transactions past and present can be seen, where alerts for regular costs and potential or actual overspending can be managed. The system also facilitates the hypothecation of funds (known as 'jam-jarring', the setting aside of small sums for essential payments). Information passes between the user and the service provider, and purchases can be made from third parties on the internet. Data is also stored and accessed via a cloud-provider as part of the service. All aspects of data-sharing on the IPTV platform are permissioned by the user, and a high degree of mutual trust is assumed and required for the service to function effectively.

Established methods of systems analysis most often categorise and prioritise data according to

how they impact on risk assessment [1], or on the other hand seek to design extendable logical models of infrastructure and human behaviour that can be used to partially automate the analysis of systems [2]. Many of these approaches rely upon standardised definitions of risk, and these are very often centered upon technological and organisational considerations [3], with little account given of the diversity of social practices and communities [4]. However, in contrast to these standardised models, IPTV can be called an example of a 'relational service' [5] that shapes, and is shaped by, the spaces of human-to-human relations that develop during the use of the service.

Drawing has been used in a number of ways to assist with analysing and visualising information-sharing practices. The complexity of the issue can be described as a 'wicked' problem [6] with no definitive formulation or solutions, which some authors have represented with jointly created 'mess maps' [7]. Participatory diagramming [8] is also a prominent research technique that was used during the early stages of the present study. Soft Systems Modelling (SSM) includes the use of drawings to identify and map out the key sub-parts of complex organisational problems [9]. Crucial to the creation of defensible models of soft systems is the understanding that 'models not *part of* the real world; they are only *relevant to debate about* the real world' (p.47). According to the developers of SSM, the need for the reassessment of modelling practices, stems from the inadequacies of systems engineering methodologies to cope with 'the kind of messy, ill-structured problematical situations with which managers of all kinds and at all levels have to cope' (p.50). In these cases, systems, needs, and objectives cannot easily be defined to begin with. 'Rich pictures' of working practices are recognised as important tools for organisations to understand their own thinking [10], and 'playful triggers' are especially useful in opening up discussions that otherwise would not take place [11]. *Lego* has previously been a tool for groups to share and revise their thinking about strategic planning and service innovation management [12-13]. However, these approaches to representing problematical situations do not address the intricacies of the recurring interactions between actors and infrastructures, and are abstracted from the influences of space and place on service requirements. There exists no established way of assessing these models for internal consistency, and they are represented only as briefly discussed and the photographs of study results are not annotated in any way. The method developed here extends the scope of the rich picturing approaches described above, in response to this gap.

The *Lego*-drawing method described in this paper addresses concerns raised by Akama and Ivanka about research methods involving abstraction, methods that hide the heterogeniety of communities [11]. It also draws from Wittgenstein's concept of social practice [14]. Social practices are a unit of analysis that span both high and low levels of abstraction, and are thus ideal for interpreting rich pictures and models. However, the literature rarely depicts these as anything other than discursive diagrammatic schemas [15]. Social practices are said to be enacted recursively, each enactment carrying forward and maintaining the identity of the enduring practice [16]. Individual instances of practices and their embedded rules and resources, are dispersed temporally and spatially, and may vary and evolve. The identity of the practice endures as long as these specific patterns are ordered across space and time as a 'nexus of sayings and doings', and these are distributed across material configurations of specific resources [17]. People are the carriers of practice, and recursion is defined as self-reproducing action following rules, sometimes aligned with spatial and temporal regimes and service design at a higher level [15]. Any method that visualises and analyses these patterns should be highly relevant to service designers who wish to consider the needs of future communities of use [18] that may emerge around a new infrastructural possibilities.

2 Aims

There is thus a clear need for a repeatable way of assessing rich pictures, such as co-constructed *Lego* models, and for an accessible visual method for representing the content of these models. These in turn may be used to feed back into further participatory sessions on the same topics and issues of service design. A graphical means of assessing the internal consistency of rich pictures, and a method for this that is repeatable and that does not unnecessarily distort the data obtained in the field.

An early pre-study by our information security practitioner project colleagues looked at the technological and infrastructural aspects of IPTV, some of the results of which were used as verbal prompts for the participatory workshops described in the next section. However, these formal analyses revealed very little about the environmental factors that would be likely to impact upon the user. This is precisely the area that requires attention in the design of the service, in terms of system accessibility and the control strengths attached to the service at differently situated points. It was with these aims in mind that a research method was designed for longitudinal use in our IPTV case study.

3 Action

This is a continuing longitudinal study during which we have visited the service designers five times over a nine-month period. This was composed of exploratory engagements, using specific materials to stimulate discussions and modelling activity (IPTV data-flow and infrastructure diagrams). A briefing with management established the focus of the service, and four workshops followed, attended by a core of three participants with others joining at different times (Table 1. Participation over time).

Table 1. Participation over time. Researchers attending numbered between two and four at any one time depending upon the focus of enquiry and the expert input required.

Mangement briefing	*Participatory diagramming*	*Rich picturing*	*Rich picturing Lego 1*	*Rich picturing Lego 2*
AM (male)	AM	AM	AM	AM
WG (male)				
	LH (female)	LH	LH	LH
	AI (female)	AI	AI	AI
	SP (female)			
			NK(female/CEO)	

Each of the workshops are outlined below, showing how the use of *Lego* emerged from a mixed-methods approach:

- **Participatory diagramming**: the perspective of their individual responsibilities in housing regeneration, micro-loans, and fuel-poverty. This generated a model of core business values, services and stakeholders, which together with the data from the initial management briefing, was mapped onto a target graph.
- **Rich picturing**: the target graph format was enlarged by hand to a drawing of table-top size, which was used alongside an similarly enlarged infrastructural data-flow diagram of the service. Physical avatars for the principal actors, and annotations overlaid these, producing a drawing/objects matrix. This depicted core values within

detailed scenarios that examined possible unintended consequences of service-related alerts, and the impact of this on contractual obligations with the service partners and financial underwriters.

- **Rich picturing, *Lego* 1**: a selection of bricks and parts were provided to the group. They were asked to model central actors and infrastructure on grey building bases that were to represent different locations. They were to use the colour-coding and language of ArchiMate [19] formal business modelling tool, which is built upon the FAIR risk taxonomy [1]: business roles (yellow bricks), infrastructure (green), data (blue), and locations (pink tiles). This session led to a proposed new actor to manage such alerts and other issues, a cross-organisational problem-solver, built in Lego as a 'fire-fighter' standing on a brick tower (see Figure 1. The *Lego* model. Number 17). In contrast to the 'Lego Serious Play' methodology [3], the participants worked as a single group from the start.
- **Rich picturing, *Lego* 2**: we organised a further lego session to review and revise the initial model, with three of the original participants; a new *Lego* brick colour was introduced (darker pink) to add support measures to vulnerable points of the system, including layers of encryption at points that were assessed as being open to a range of approaches by different actors (Figure 1. The *Lego* model. Points E, F, and G).

Finally, photographs of the model were traced from the computer screen, rearranging the content in such way that attention is drawn to the constellations of meaning that are embedded in the model. This process is described more fully in the following section. The drawings use simple line and graphic techniques, and are designed to act as vehicles for analysis to feed back into the continuing participatory workshops.

4 *Lego* and drawing

A development upon the *Lego* co-construction method is achieved by subsequent drawing of the *Lego* model (Figure 1. The *Lego* IPTV model). Exploratory drawing rearranges but does not aim to reduce the level of information that is represented in the model, and aims to preserve how elements are connected and the type of relationships that have been ascribed to them by the model makers (Figure 2. Interpretive drawing of the *Lego* IPTV model). The method also deliberately seeks to work in both analogue and digital modes, facilitating sharing of results in different ways. The drawing process can be summarised by the working precepts clustering around the following three areas for the analyst to work through:

1. Framing, and points of view:

- **Aerial or isometric perspective.** The items are drawn from a photograph of the model that was taken from above, and this allows the elements of the model to be viewed as an informal isometric perspective, where there is no marked diminution in the scale of objects as distance increases, a 'drawing system' which gives equal emphasis to all elements in the scene [22], and a single scale to the overall view, where the relative proportions of the model components are preserved.
- **Actor point of view.** Equally, if the analyst wishes to emphasise or to single out for study a particular actor's perspective that is represented within the model, they can do so by using a photograph of this as their source.
- **Several perspectives** upon the scenario can be combined, and can also be compared with one another. This is an important way of calibrating the positioning of elements within the drawings, since the same inscriptions can be seen from different points of view, revealing where too great or too small an emphasis has been given.

- **Acetates** were placed over laptop screen in order to trace the primary elements of the model photographs.
- **Ink drawings** were made from the photograph of the model mentioned above. Drawings were also made from **digital collages** (made in *Photoshop)*, where each of the elements are layered within a single image, in such a way that they can be repositioned at will in order to reflect current interpretations.
- **Repeatedly drawing** the model, and re-collaging in digital form, tests different arrangements of the elements. The aim is to accurately convey the meanings and particular constructs as intended by the participants.

2. Structure and shape:

- **Clockwise.** The actions and entities shown on each loop are shown sequentially in a clockwise direction, as dictated by the content and structuring of the *Lego* model.
- **Synchronous feedback loops**, can be drawn in the same way as others. For example, the authentification of the card transaction, where account details are exchanged almost instantaneosuly over cloud-based infrastructure.
- **Recursion of self-contained practices.** This is expressed by the looping of lines**.**
- **Overview.** Collectively, the loops relate to the practice as a whole.
- **Interconnection of loops.** One connects with another at a point where a separate sequence takes over in a chain of events described by the participants.
- **Every piece** on the model can be represented or accounted for in the drawing, and in a number of different ways. This can be either directly, or by being subsumed within a group of bricks.
- **Weighting and relative positioning** of the drawn elements should follow those given in the model, and can be modulated by taking account of the views of participants (see below).
- **Partially completed loops** relate to incomplete data (the energy demand that may go unpaid, for instance) or to an implied possibility of closure (the possibility that feedback may lead to the removal of the client's governmental benefits, for example).

3. Qualitative patterning:

- **High and lows** of the *Lego* brick shapes are traced with a single line, which adds an elevation value above the horizontally oriented loops.
- **Actor perspective.** Arranging the elements of the drawing takes account of comments made during the sessions. For example, the notion of a 'circle' of experience, relating to the user and their television and home, was discussed by the participants (AI, Excerpt 1, line 22: "the whole world is concentrated for them in the TV").
- **Connecting 'lines.'** The *Lego* model has a number of paths of data-transfer, and this is maintained in the drawing. In *Lego* these were made from the smallest round blue parts, to signify the movement of data (codified as blue bricks). Their placement on the model was sometimes regularly spaced, and at others staggered, and this can be reflected in the drawing if desired.
- **Positioning** within the drawing can also be calibrated against other data gathered during participatory sessions. For example, a three-level ordering of the core business values and alignments, obtained from the initial briefing with management, was temporarily imported into the digital collage, providing another framework against which the placement of elements could be assessed.

- **Boundaries and ownership** of entities featured prominently in the *Lego* building-discussions (AI, Excerpt 2, line 15: "so shall the card be in the middle?").
- **Temporal** ordering of items in related sequences, for example: the income from government to client; the data input from client to TV via remote control; financial transaction data from bank to service provider; and dispatch of service partner's agent towards the household of the client. These orderings were given in the dialogue that surrounded the building of the model.
- **Location** is referenced by the loops, but not exclusively; hence the client's home is encircled as a location, but the others encompass several locations: service provider and five partnered organisations. These were linked together, and identified as having a common business role by the participants (a yellow-brick pathway in the model).
- **Colour** is not used in these initial drawings, for purposes of clarity and ease of reproduction, but it is also possible to highlight and codify areas with colour.

When considering how to draw the model, reference was made to connection diagramming as a form in which modelling results might be displayed in an economical way. Graphical recursion diagrams are used in mathematical physics to break down complex problems into smaller solveable parts [21], and causal loop diagrams visualise the inter-relationships between different system variables [22]. These are examples of where formal graphic enquiry has been integral to the advancement of research.

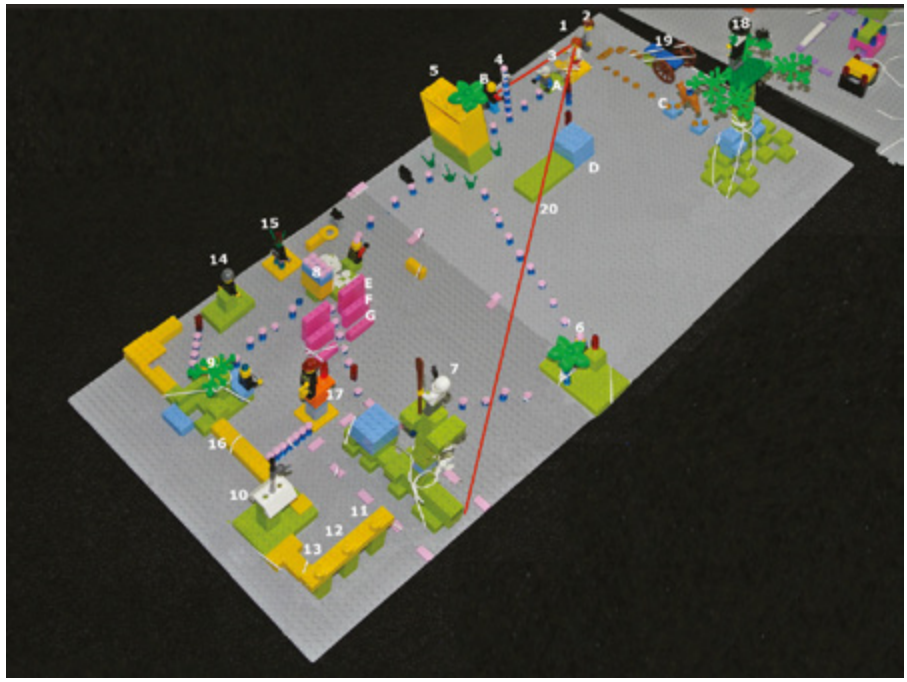

Figure 1. The *Lego* model. Photograph of the second iteration. Key: **1** User and remote, control (**A**), **2** Carer, **3** Children, **4** Raspberry Pi, **5** TV, **6** Payment card, **7** Banking platform, **8** Cloud-services provider, and 3 levels of encryption (E -high, F, G -low), **9** IPTV service provider, **10-14** Service-partner organisations, **15** Service partner's door-to-door agent, arriving (**B**), **16** Business role, bridging all partners, **17** New 'fire-fighting' role, **18** Government, **19** Income stream from benefits (**C**) and employment, **20** Energy provider, and payment demand (**D**). Superimposed red lines indicate the user's perspective (**1**).

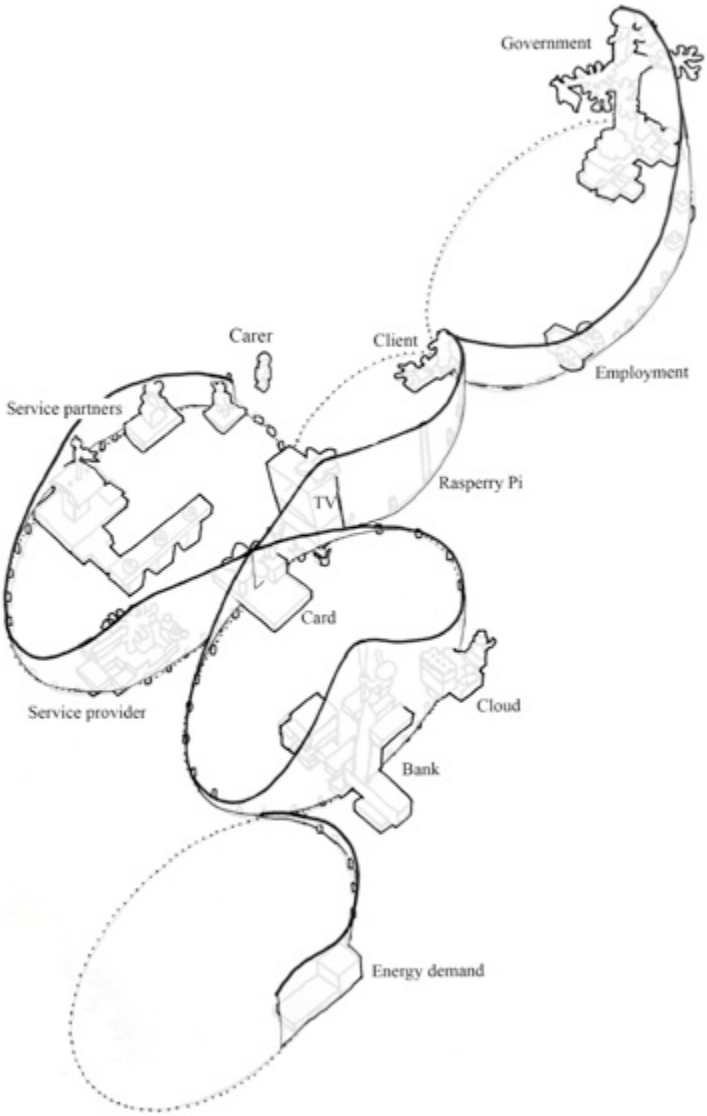

Figure 2. Interpretive drawing of the *Lego* IPTV model. It has been drawn as a connection diagram, where each loop is interdependent, cyclic (clockwise), and recursive over time and space. The television and the payment card are specific types of boundary entity, linking the sub-parts of practice that occur in each of the loops. The drawing transforms the static and solid *Lego* brick-built constructs into a manifold that follows the practice as it unfolds.

5 Conclusion: 'sayings and doings', practice as performed recursion

This continuing work has utilised a multi-part method, involving interviews, participatory diagramming, and physical modelling. The latter has been the occasion for participant's to engage in an extensive dialogue and collaboration. It raised the possibility of revisiting initial working assumptions, and devising new responses to emerging design issues. The process of shared modelling made these assumptions visible and simultaneously provided the

opportunity to rework them in full view of the group while actively engaging all of it's members in the decision-making of the design work. The physical modeling process also provided an overview that is ordinarily achieved only with a significant conceptual effort: "The best thing about this is that normally we have to try to somehow keep all of this in mind, whereas this [process] allows us to see it all at once" (NK).

The multi-part method also involved the development of a new type of thinking tool, using drawing to reconfigure the elements of the models. The arrangement of these drawn elements refers to the ways in which the participant's model broke down larger social practices into smaller units featuring recurring sets of actions. The graphic form we have chosen allows for these smaller units to be analysed individually for their strengths and weaknesses in regard to the sharing of information. They can also be appreciated as part of a larger picture containing several actor perspectives, adding another dimension to this analysis, in regard to socially constructed patterns of data-sharing and the inherent protections or vulnerabilities that this might create. The use of drawn line pinpoints an interpretation of what has been said by the participants, in purely visual terms that develop upon the visual qualities of the physical models. Moreover, any analysis derived from this method can be tethered to specific entities of various kinds that were represented by the group. Drawn lines thread through what we can call the infrastructural landscape, leading to new insights about the relations between the entities and actors, and prompting new questions about real-world design issues. This can then drive further thinking that is aimed at reshaping this landscape or repositioning an actors vantage point upon it. Such questions might be: do the negative and positive curves that populate each loop relate to the perceived technical and procedural difficulties of each step that comprises a given social practice? Where in these patterns of exchange are the likely flash-points, and how can they be managed and how can their removal be designed?

IPTV has a wide user-community demographic, and is particularly aimed at users without access to or distrustful of computers and other smart devices, and those with different levels of digital and educational literacy. For a variety of reasons these users may be inclined to either withhold or share their personal information and data at different times and under different pressures, all of which puts them at risk of being digitally excluded from the wider community. Added to this, in their use of a service such as IPTV, they may be extremely vulnerable to abuse of the system, perhaps carried out by other members of the community or from their own carers and family. Because of the sensitivities of these situations and the complexities of the social arrangements, it is notoriously difficult to obtain data about how such systems can be used and abused. This difficulty is compounded in the case of IPTV where full technical specification has not been reached and the service has not yet been tested beyond small viability trials. The *Lego* and drawing technique described here succeeds in making visible the qualitative dimensions of relations between actors and data in the IPTV scenario. The method has a significant role to play in bringing these issues to the fore, for service designers and for the users of 'relational services'.

In subsequent and related work we have asked small groups of security and computer science practitioners to comment upon the second iteration of the IPTV model by building their own models to show how data from it would be handled and then analysed within a semi-automated procedure for organisational risk assessment. They used very similar *Lego*-building parameters to construct their models (with the exception that figures were not provided, since we wished to facilitate abstraction within the modelling). Each of these groups took an individual actor perspective from the IPTV model as their starting point. The results show that the described *Lego* and drawing method is indeed repeatable, variable, and scales up to work with much larger groups. The literature demonstrates that *Lego* has been

used in a variety of situations with smaller and larger groups with some success [23]. The present method, including explorative drawing, is aimed at developing upon this success while moving towards a deeper understanding of the models themselves, and carrying insights about situated human-to-human interactions into our related work. Drawing provides a way of accessing the detailed results of physical modeling, while simultaneously abstracting away from the high level of detail contained in the results. It also promises to extend and reinforce the brainstorming process by operating as a way to give feedback in our future work with the same participants and other interested parties. Our methods encourage reflection on the situatedness of information-sharing practices, and seek out interpretations of how relational services may be designed. In this regards, it is important that the method be flexible and adaptable, each iteration meeting the highly specific demands of different contexts.

A significant challenge for our future work is how to represent organisational and other policies that might be in operation, and as one participant from our subsequent work stated, how to unpack 'the processes running in each node'. Our future work will concern the layering of these processes and analyses upon the IPTV model, using closely related visual methods to graphically connect higher-level spatial, cultural, and organisational regimes to the ones that have been modelled here. The method for constructing drawings from *Lego* models is by no means a finalised one, since alternative criteria for constructing drawings are likely to emerge in the face of new and unforeseen design challenges.

It could be argued that dismantling the *Lego* IPTV model and remaking it according to an interpretation would be a viable (and to some, perhaps preferable) alternative strategy to drawing the model. This option is indeed attractive but would be subject to the same limitations of purely physical modelling, such as the tendency to 'black-box' certain elements that could and perhaps should be subject to further logical decomposition. Notwithstanding the multitude of possibilities that are afforded by *Lego* as a medium for constructing metaphors for the world, there will always be a number of practical and physical constraints on what it is possible to build with *Lego* bricks. There is no doubt that these limiting factors are also partly responsible for the many creative uses that the bricks are put to, working with and through the available materials. Drawing is able to rapidly and flexibly respond to the tactile dimensionality of the models, and through the process of drawing we can observe and record how participants join and frame the spaces that they construct in their models. Collages and drawings, as well as the models, can be shared as part of a repeatable method for building and interpreting rich pictures.

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