Group Support Systems: experiments with an online system and implications for same-time/different places working

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Group Support Systems: experiments with an online system and implications for same-time/different places working

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Abstract— We present an analysis of the Group Explorer Group Support System (GSS) from the perspective of its implementation as technology that can support same-time/different-places group workshops. The purpose of the chapter is to report on our experiences with using a same-time/different places GSS, introduce issues that arise from these experiences, and discuss future prospects. The chapter commences by reviewing our current understanding of GSS and how they support the use of distributed Problem Structuring Methods (PSMs) in both single organization and multi-organization settings. The configuration and use of a cloud-based online version of the GSS is presented that highlights some of the key technological, organisational and facilitation issues involved in supporting distributed PSM workshops. The future development of such online GSS is discussed with a particular focus on two emerging research questions; the future role of the facilitator in online GSS, and the commonalities between online GSS and social media platforms as different-times/different-places group working, such as crowdsourcing, become prevalent in the context of increasing globalisation and the ongoing decentralisation of work environments.

1. INTRODUCTION

We believe more needs to be done to improve our understanding of distributed Problem Structuring Methods (PSMs), especially the role of facilitation and the possibility of overlap and synergies with social media platforms. We ground our research in the use of the *Group Explorer* GSS that supports the Strategic Options Development and Analysis (SODA)/JourneyMaking methodology (Ackermann & Eden, 2001; Eden & Ackermann, 2001), which has been designed for use in complex problem contexts and can be considered as a member of the class of PSMs. Our empirical setting is the experimentation undertaken in the process of moving the software components of the *Group Explorer* GSS to a cloud-based computing environment to support problem structuring workshops, where the participants were based in different locations and represented different organisations. Distributed GSS have long been a subject for study (Hiltz et al., 1996; Mittleman, Briggs, & Nunamaker, 2000; Paul, Samarah, Seetharaman, & Mykytyn Jr, 2004; Romano, Nunamaker, Briggs, & Mittleman, 1999; Tung & Turban, 1998; Turoff, Hiltz, Bahgat, & Rana, 1993) but it is only recently that the global availability of low-cost cloud-based computing services has suggested novel ways in which distributed GSS can be deployed. The process of experimentation has suggested new research questions about the nature of facilitation and the role of social media platforms in relation to distributed GSS.

The original motivation for our work emerged from the requirement to develop a GSS capability to support problem structuring workshops within an organisation that had a globally distributed team and was inspired by the work of Morton, Ackermann, and Belton (2007). The process of moving the *Group Explorer* GSS software components to this new online environment prompted a re-engagement with questions about coordination, non-linear agendas and asynchronous behaviours (Hiltz et al., 1996). The motivating requirement to support an organisation with same-time/different-places problem structuring workshops led to a version of the *Group Explorer* GSS that was just as accessible for participants within a distributed organisation (i.e. virtual teams (Mittleman et al., 2000; Paul et al., 2004)) as participants from *different* organisations. This prompted further experimentation during the development to support multi-organisation group workshops (Ackermann, Franco, Gallupe, & Parent, 2005; Franco, 2008) as part of an EU-funded Smart City project[1]. This was a consequence of an emerging requirement to provide a low cost means of continuing with problem structuring workshops with multi-organisation groups in Smart City planning. Furthermore, the near ubiquity of social media platforms and their undoubted role in supporting unstructured decision making[2] suggests that there could be a future cross-fertilisation of features and use-cases between distributed GSS and social media platforms, especially crowdsourcing, as we discuss in section 5.

[1] The H2020 Smart Cities and Communities (SCC) Lighthouse Project REPLICATE (REnaissance of Places with Innovative Citizenship and TEchnology) (H2020-SCC-2015 691735).

[2] Or *non-codified* decision making from a methodological perspective

We explore these questions first through a review of the literature concerning distributed GSS and problem structuring collaborative work. We then proceed to further elaborate the four-mode typology of different/same time/place workshops (Johansen, 1991; Lewis, 2010). We then discuss our questions based on the experiments conducted using this system.

2. REVIEW

Early work assessing the general capabilities of GSS was conducted by Fjermestad and Hiltz (1998) and Nunamaker, Briggs, Mittleman, Vogel, and Balthazard (1996). Experiments with distributed GSS were conducted by Hiltz et al. (1996). The SODA methodology (Ackermann & Eden, 2001; Eden & Ackermann, 2001) was originally implemented using the 'classic' tools of the facilitated face-to-face workshop – i.e. post-it notes/ovals and flipcharts – and was eventually supported by the development the *Group Explorer* GSS software. This led to an increase in the productivity of the workshops as well as affording benefits such as enabling anonymity of contribution (Ackermann & Eden, 2010b). Causal mapping (Ackermann & Eden, 2005) is central to the SODA methodology. Its use as a PSM in a *Group Explorer* GSS setting is well established e.g. (Ackermann, Howick, Quigley, Walls, & Houghton, 2014; Franco, 2014) and it has been further developed as the strategy making methodology Journey Making (Eden & Ackermann, 2018).

Problem structuring methods can be used in problem contexts that involve participants from multiple organisations (e.g. Franco (2008)) although this is less common and not without difficulties. For example, Freeman and Yearworth (2017) used a PSM with a multi-organisational group for low-carbon urban energy master planning and encountered a problem with a mismatch of power and interest of the participants taking part in the workshops. This led to lack of clarity about problem ownership and inadequate buy-in to the process, a situation unlikely to have occurred within a single organisation. However, there is nothing inherent in the properties of the *Group Explorer* GSS that limit workshops to participants from a single organisation. For example, the *Group Explorer* GSS supported case study presented by Ackermann et al. (2005) involves a certain amount of multi-organisation working (see also [ACKERMANN AND EDEN]). Moving the *Group Explorer* GSS into an online setting opens-up the possibility of a more effective supporting multi-organisational problem structuring without the need to face-to-face workshops.

Such distributed problem structuring interaction is considered by Morton et al. (2007). They make the point that whilst distributed GSS have been well studied (Hiltz et al., 1996; Kim, Hiltz, & Turoff, 2002; Paul et al., 2004; Tung & Turban, 1998; Turoff et al., 1993), there is a "*distinctively PSM view on the decision-making process*" shared by other PSM writers that sets it apart from the GSS literature (Morton et al., 2007). Inspired somewhat by the Policy Delphi process (Turoff, 1975) for reaching a group consensus view, Morton et al describe a distributed variant of the SODA methodology whereby a 'group map' was built up from rounds of participant questionnaires that were conducted over a period of time and relied on asynchronous communication e.g. email. The questionnaires typically contained

a section of a group map and associated questions to either develop it further or ascertain some degree of prioritisation of the concepts (i.e. preferencing and rating, as discussed later). Their research questions were focussed on comparing the effectiveness of the workshop-less process to a face-to-face workshop using an evaluation framework based on facilitation frameworks (Ackermann, 1996) and when it would be appropriate to use such a distributed *modality*. They were not specifically looking at the distributed mode from the point of view of the performance of a GSS, and their findings talk more to the properties of the SODA methodology that mean that it can be implemented in this distributed modality. However, their conclusions do point to the fact that this enables different groupings of participants in the problem structuring process, particularly in terms of widening participation and suggesting the possibility of "*large group interventions*" (White, 2002), a context we return to later. We see Morton et al. (2007) as setting the scene for the migration of the *Group Explorer* GSS to supporting distributed problem structuring engagements with stakeholders.

3. IMPLEMENTATION OF AN 'ONLINE MODE' FOR GROUP EXPLORER

A certain amount of technical implementation detail behind the *Group Explorer* GSS is described here as this is pertinent to the discussion when we look at questions of facilitator-less instantiations of the GSS and its relation to social media platforms. The two main technology components that make up the *Group Explorer* GSS that supports the SODA/JourneyMaking methodology are; i) the causal mapping software *Decision Explorer*[3]; and ii) *Group Explorer*, a software system that enables multiple users to interact directly with the causal map via their own user interface provided by the *Chauffeur* component and as controlled by the facilitator. In combination, we refer to the overall system as the *Group Explorer* GSS following usage of Franco (2014) and Yearworth and White (2017). A schematic diagram of the conventional *Group Explorer* GSS configuration is shown in Figure 1. We will go on to argue that the mapping component is essential to the methodology and must always exist in a recognisable form, but that the Group Explorer system is amenable to automation.

The *Chauffeur* component is a server on the private local network. The actual user interface to the *Chauffeur* runs on the local participant consoles, which can be laptops or tablets. The user interface changes according to the stage of the meeting. In the 'start-up' stage the user interface is configured to register participants joining the system. In the 'gathering' stage the user interface enables participants to contribute to the causal mapping by entering statements and later, linking them. In 'preferencing' participants are allocated coloured tokens that can be assigned to label statements in the causal map according to criteria set by the facilitator. Finally, 'rating' enables participants to vote on statements in the causal map. Between these stages the user interface is set to a waiting state. The causal map is made visible to the workshop participants by projecting the *Public* display. In addition to facilitating the workshop participants through the methodology addressing the problem structuring task at hand, the

[3] Decision Explorer is causal mapping software available from https://banxia.com

facilitator must configure and sequence the operation of the *Chauffeur* between the different stages of the meeting and also control the layout of the causal map. The complexity of these tasks sometimes requires two facilitators (as is shown in Figure 1). An additional component on the *Public* server provides a summary display of information collected during the preferencing and rating stages of the meeting.

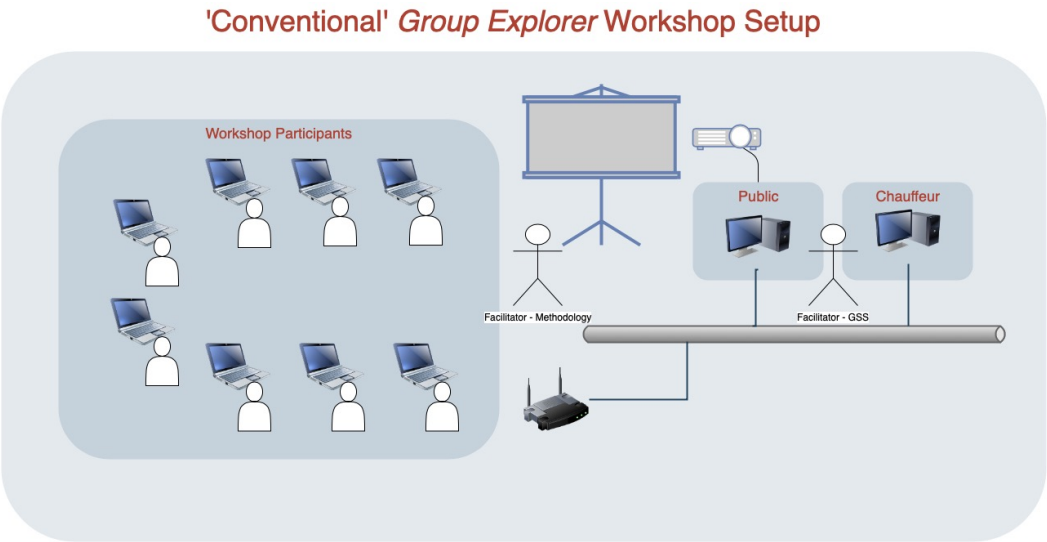


Figure 1. Schematic representation of the components that make up a conventional *Group Explorer* GSS. Although two facilitators are shown here it is possible for a single facilitator to combine both roles.

3.1. A Time and place-based typology of workshop modes

The classification of workshop *mode* according to same or different time and place of group working is shown in Figure 2 (Johansen, 1991; Lewis, 2010). The four modes each have their own distinct set of characteristics but all derive from the same underlying configuration of the *Group Explorer* GSS components. Their individual properties are described in the following sections. In addition to considering the time and place of workshops our analysis of modes considers the following issues:

1. Facilitation: what is the division of focus between facilitation of the methodology and managing the *operation* of the GSS (Franco & Montibeller, 2010; Yearworth & White, 2017)?
2. Location: is the workshop i) room based, ii) online (i.e. distributed across the internet), or iii) mixed (Morton et al., 2007; Yearworth & White, 2017)?
3. Time boundary: how time-bounded are the participants in the workshop? A room-based workshop, or sequence of them, is fixed to specific times and durations for obvious reasons, whereas online workshops are clearly more flexible.

4. Sequencing: are the changes in the stage of the meeting, and their associated configurations, under the control of the facilitator or could they in principle be *devolved* to the participants' control?
5. Anonymity: to what degree is anonymity affected by the mode? One of the strengths afforded to participants by most GSSs is the anonymous labelling of contributions (Ackermann & Eden, 2010b, p. 183). The four modes seem to provide a more nuanced perspective on anonymity.
6. Additional components: what additional technical components are needed for the GSS to work? In the conventional mode of same-time/same-place, no further technology is required apart from a data projector, laptops or tablets to host the participant user interface, and a wireless router. However, in the online mode, an additional third party system is required to carry voice, screen sharing, and participant-to-facilitator 'chat' messages[4] so that participants can see the causal map as it develops on the *Public* display component[5].
7. Data collection: what facilities are there in the GSS that support detailed data collection? workshops that use GSS are an active focus for research in the Group Decision and Negotiation (GDN), Behavioural Operational Research (BOR) and Problem Structuring Methods (PSMs) research communities. In addition to the data log produced by the *Group Explorer* GSS and saved versions of the causal map, researchers also use data collection techniques relevant to ethnomethodology (Garfinkel, 1996), such as video capture of the meeting room (see for example Franco and Greiffenhagen (2018); Franco and Nielsen (2018)), to study the micro processes of group decision making (Ackermann, Yearworth, & White, 2018). This is practically impossible in the online mode, but the use of the conferencing system affords the capability of producing a combined voice recording and video of the causal map as it is developed on the *Public* display component (Yearworth & White, 2017).

[4] Although not strictly necessary, they do provide a silent 'back channel' for the facilitator to provide additional help to participants experiencing problems in using the GSS in this online mode.

[5] In the experiments reported here the Citrix GoToMeeting conferencing system was used – https://www.gotomeeting.com

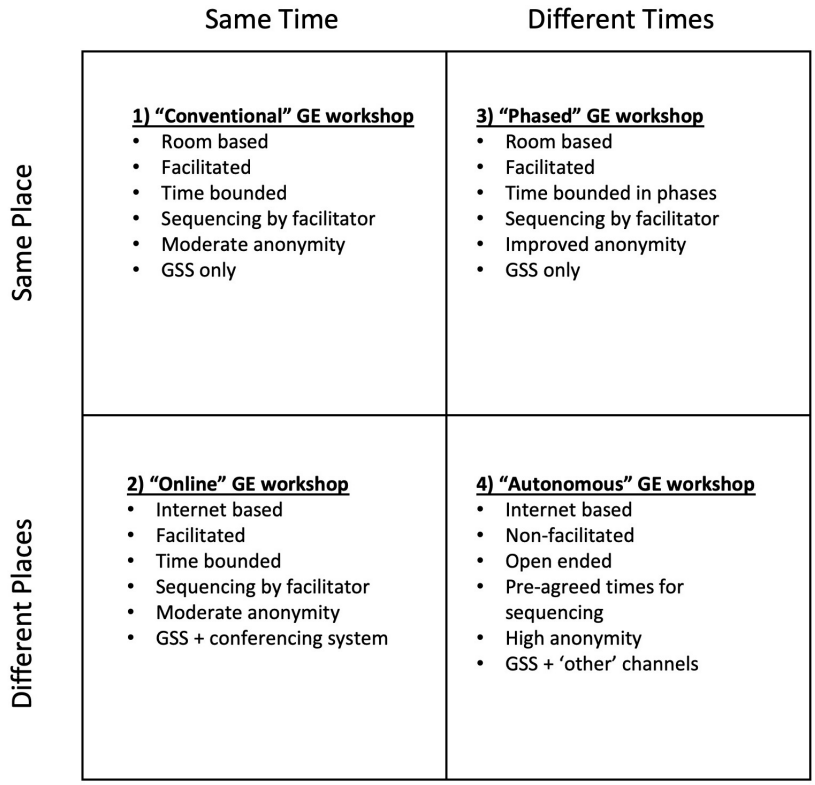


Figure 2. Four modes of Group Explorer workshops defined by same or different time and place of group working. Based on original figures by Johansen (1991, p. 221) and Lewis (2010, p. 265).

3.2. "Conventional Mode" – same time, same place

This mode of using the *Group Explorer* GSS is not discussed in depth, its configuration is as described in the previous section. Examples of research using the GSS this way are described in e.g. (Ackermann & Eden, 2010a; Franco, 2014; Franco & Greiffenhagen, 2018; Franco & Nielsen, 2018). There have also been developments in using GSS to support Group Model Building based on System Dynamics (Richardson & Andersen, 2010)[ANDERSEN & RICHARDSON] e.g. (Herrera, McCardle-Keurentjes, & Videira, 2016; Rouwette, Bastings, & Blokker, 2011; Rouwette, Vennix, & Thijssen, 2000).

3.3. "Phased Mode" – different times, same place

We do not consider this mode as particularly meaningful but is included here for completeness. It is more or less identical to the conventional mode but with potentially improved anonymity as different stakeholder groups could in theory be present in the room at different times between sessions.

3.4. "Online Mode" – same time, different places

The porting of the standard *Group Explorer* GSS installation to the MS-Azure cloud environment is described in detail by Yearworth and White (2017) and is shown in Figure 3. They discuss the effect

on participants and the implications for the facilitator of moving to an online distributed GSS for supporting problem structuring workshops. The assumption behind the configuration of this mode is that the participants would be joining the meeting from many different locations, representing different organisations, and using a range of computers to connect to the GSS i.e. there would be no controlling or supporting IT services to manage the configuration for the participants and ensure its correct operation.

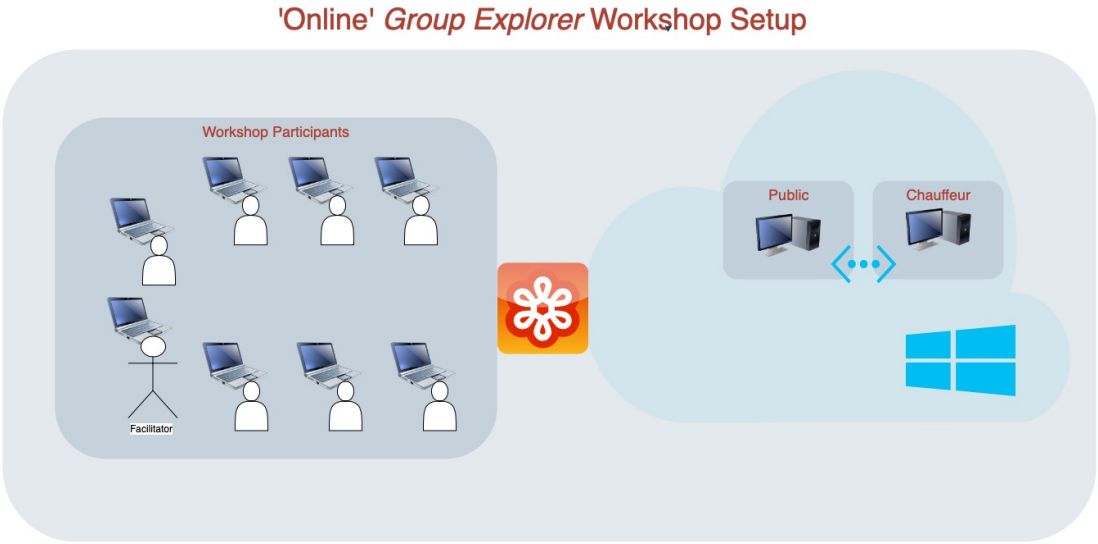


Figure 3. A schematic representation of the components that make up an online *Group Explorer* GSS. Here the servers that host the *chauffeur* and *public* components have been moved into the MS-Azure cloud environment Indicated by the MS-Windows logo. The conferencing system is represented by the Citrix GoToMeeting logo.

Yearworth and White (2017) describe a workshop focussed on making the *Group Explorer* GSS useable as a distributed GSS and used the online GSS itself to host the meeting. The map from this workshop is presented in Figure 4. One of the main implications of this move online was that it revealed to the participants a considerable amount of the internal workings of the *Group Explorer* GSS that would normally be hidden in the conventional setting, where the initial setup and configuration of the system would be carried out before the participants entered the meeting. The facilitator is not co-located with the participants and therefore not able to easily sort out connection problems and help the participant with managing the use of two different user interfaces, to the *Chauffeur* and to the conferencing system that shares the *Public* screen showing the model. Considerable amounts of time are required instructing the participants in how to use the system and dealing with issues with audio quality arising from the interplay between the conferencing system and participants' ICT. It is clear that the technical complexity of the online mode setup presents a real barrier to participants that needs to be overcome before the workshop proper can start (Yearworth & White, 2017). As a consequence, detailed briefing notes have been produced to help participants prepare for their first online workshop. An example can be seen in Appendix A. However, once these barriers have been overcome the "*de-*

centring" of facilitation (Yearworth & White, 2017), indicated by the facilitator appearing in the schema shown in Figure 3 in a position identical to that of a participant, provides an excellent empirical setting for its further investigation.

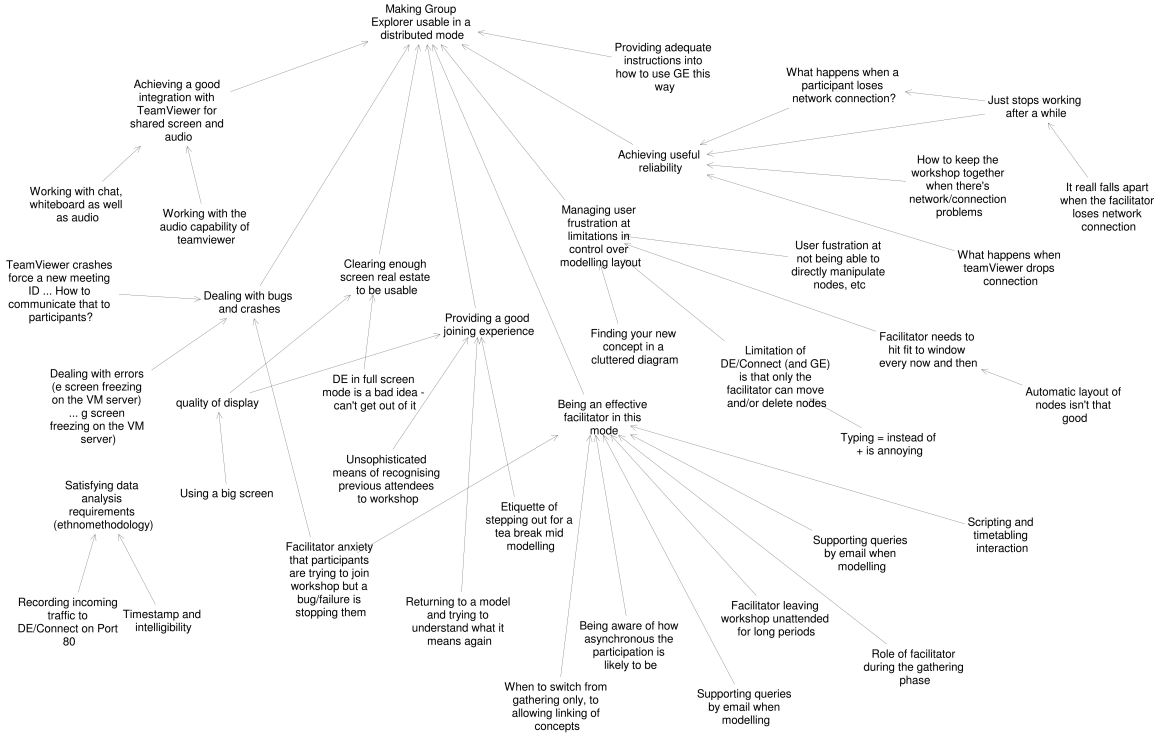


Figure 4. Making the *Group Explorer* GSS usable in the online mode.

3.5. "Autonomous Mode" – different times, different places

In this mode, as shown in Figure 5, the facilitator has been removed from the schema. The conferencing system has been downgraded to simply displaying the *Public* screen, and automation in the form of a 'script' has been introduced (as suggested by the cogs) to sequence the *Chauffeur* component through the different stages of the meeting. The *Group Explorer* GSS is this configuration needs to be capable of operating unattended over long periods of time without facilitator intervention and starts to look more like an online platform than a GSS. The rules of how it should be used would have to be explained beforehand for it to make any sense as a GSS to the participants. In this mode it starts to make more sense to think of participants less as members of a workshop and more as *users* of a platform.

An experiment has been conducted with this mode of operation in the gathering stage of a meeting (Yearworth & White, 2017) and some of the issues are captured in Figure 4. These are concerned with participants maintaining an understanding of what the map means between engagements with the GSS, especially as other participants will be adding statements to the map when there is no facilitator to modify the layout in *Decision Explorer* should it be required. However, there was no particular technical issue with remote participants interacting with the causal map whilst there was no active facilitation to manage the Decision Explorer component.

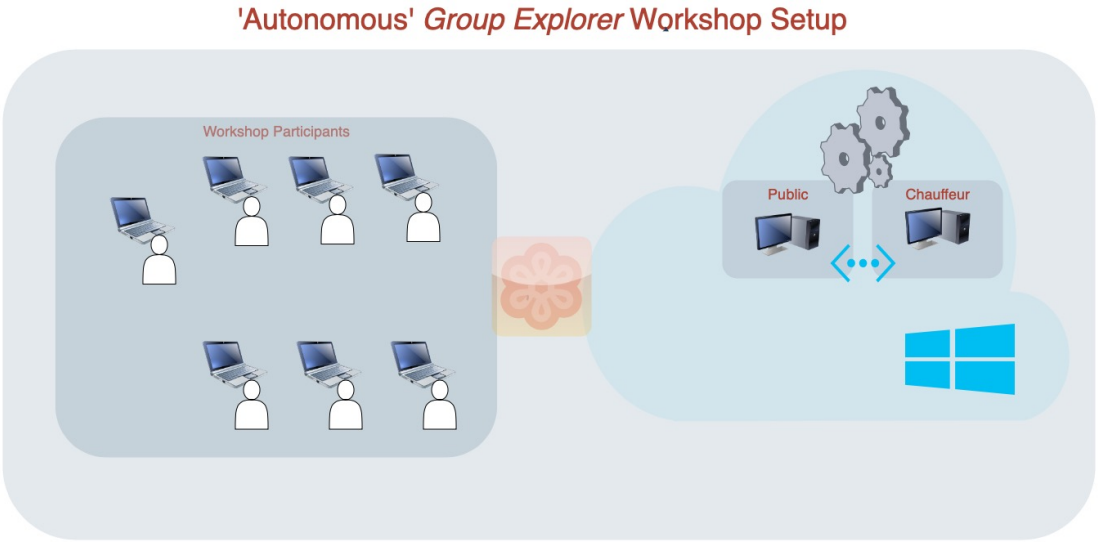


Figure 5. A schematic representation of the components that make up an autonomous mode of using the *Group Explorer* GSS. Here the use of the conferencing system is reduced to sharing the causal map. The cogs indicate that a certain degree of automation via scripts is required to control the components

3.6. Temporal Sequencing

A typical engagement with a client is likely to entail more than one workshop. In the case of the conventional mode we can just think of this as a sequence of instantiations of the GSS

$$\text{Conventional Mode}_1 \rightarrow \text{Conventional Mode}_2 \rightarrow \text{Conventional Mode}_3 \rightarrow \ldots$$

until the group work with the GSS is complete. The expectation is that between instantiations of the conventional mode the *Group Explorer* GSS would be shut down to its passive state and thus not incur resource charges in the cloud environment. This is somewhat different from the imagined situation of the phased mode, where there would not be a sequence of instantiations as such, but rather a sequence of groups using the same instance of the GSS[6].

Results from experiments using the online mode has led us to the conclusion that more can be achieved with workshop participants in the online sessions if the participants already have some familiarity with the GSS and its methodology in the conventional mode i.e. the sequence

$$\text{Conventional Mode}_1 \rightarrow \text{Online Mode}_2 \rightarrow \text{Online Mode}_3 \rightarrow \ldots$$

would be a better way of achieving proficiency with the online mode. The use of the online mode to support multi-organisation groups is an emerging need e.g. in the case of the REPLICATE project. Project meetings, which are expensive and time consuming, would provide the opportunity for a

[6] Or conceivably, the same stakeholder group re-convening in the workshop space some time later. Between workshops, the *Group Explorer* GSS would remain active and running the same meeting on the *Chauffeur*. This mode of operation is somewhat contrived here as an imagined scenario but is entirely consistent with the same-place/different-times scenario using the MeetingWorks system as described by Lewis (2010, p. 265).

conventional mode workshop to take place as a *familiarisation exercise* for interacting with the *Group Explorer* GSS. Further, if the online mode infrastructure is used to host this face-to-face workshop then it would provide the opportunity for a facilitator to 'debug' the technical issues discussed in §3.4 above. The availability of the online mode then enables a subsequent sequence of low-cost workshops. The autonomous mode is envisaged as a continuous *single* instantiation of the GSS that persists for as long as required by the users.

3.7. Scaffolding

The review of the four different modes of using the GSS and the temporal sequencing of these operational modes demonstrates that the problem structuring methodology can be thought of as consisting of three parts i) the *technology* of the modelling approach implemented by the software components, ii) the rules of how these components can be used and when, and iii) the actual process of using the GSS to support a methodology for achieving the purpose of the engagement. Yearworth and White (2017) have explored the question of how much of the first and second parts can be automated to become a scaffold[7] for the methodology.

This then leads to our core questions for discussion – what will be the future role of the facilitator as online and autonomous GSS become possible, and what are the commonalities between online GSS and social media platforms that mean that the latter could subsume some of the functionality of the GSS? Work by Yearworth and White (2017, 2018) has surfaced some of the issues behind these questions, which we now discuss.

4. DISCUSSION

To support our discussion we make use of the behavioural classification schema devised by Yearworth and White (2018, p. 814) to establish the relationship between online platforms and Operational Research (OR) practices, specifically Community OR, an area of OR addressing problem contexts arising from community needs (Midgley, Johnson, & Chichirau, 2018; Midgley & Ochoa-Arias, 2004). Their purpose was to establish the existence of *OR-like* behaviours through the patterns of interactions between participants on social media platforms not specifically designed to support OR practices. The behaviours of interest were those considered as matching the Generic Constitutive Definition (GCD) for PSMs (Yearworth & White, 2014). It was realised that the *Group Explorer* GSS in its online mode occupied a specific position in this schema and thus suggested a way of linking the analysis of problem structuring behaviours on social media platforms with the properties of an online GSS. The classification schema thus affords some analytical utility and we make use of it here.

[7] Literally a supporting framework implemented in ICT that automates some of the tasks normally carried out by the facilitator in implementing the methodology.

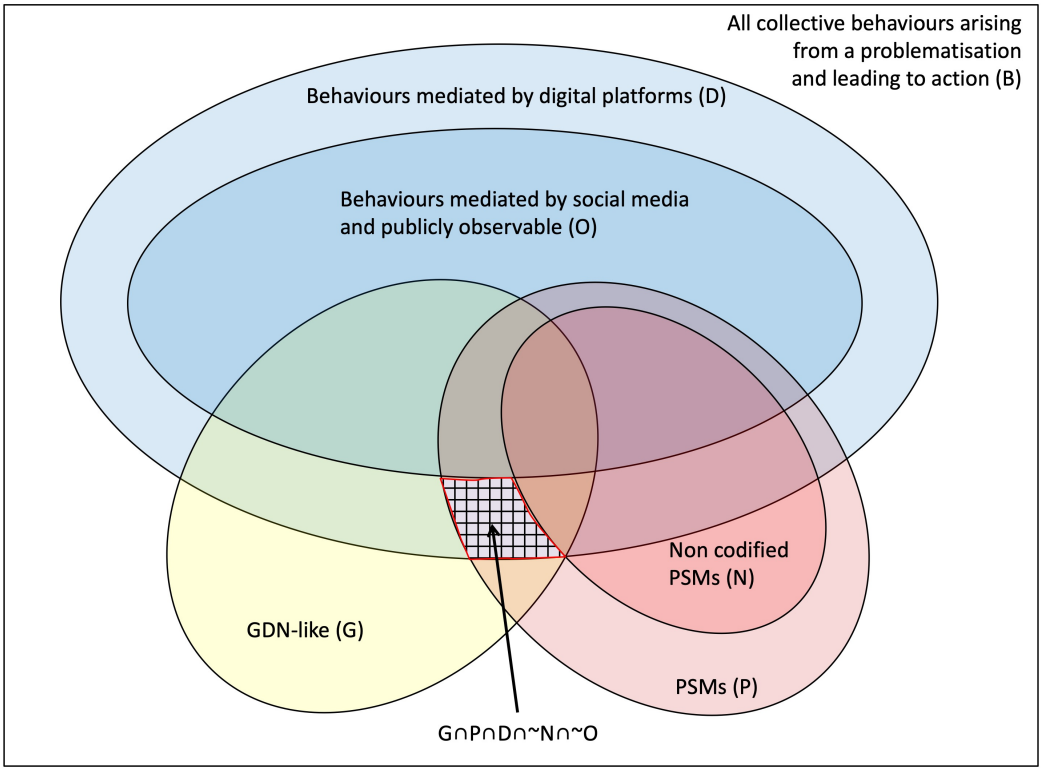


Figure 6. Classification of online mode *Group Explorer* GSS to support GDN based on the original schema devised by Yearworth and White (2018, p. 814).

The classification schema shown in Figure 6 is a development of the original Yearworth and White schema and was devised to help with classifying GSS in the context of group decision and negotiation and with a similar view to identifying *GDN-like* behaviours in the patterns of interactions between participants mediated by a GSS. The schema concerns behaviours of members of a group who perceive a problem exists and that action is required to resolve the situation. All behaviours of group members using a tool/technique/method that would be recognised by the GDN academic community as *GDN-like* are considered to be a subset.

Here the existence of non-codified problem structuring behaviours is assumed to intersect with the set of behaviours that we have called *GDN-like.* We draw attention to this because of the argument established by Yearworth and White (2018) that there is a non-zero possibility of observing non-codified problem structuring behaviours mediated by social media platforms. From this it is reasonable to assume by a similar argument that we would be able to observe GDN-like behaviours taking place via social media. We make use of this assumption later.

The behaviours associated with interactions mediated by the use of the *Group Explorer* GSS in online mode are classified as GDN-like behaviours. These are problem structuring methods that are also mediated by a digital platform but are not visible publicly[8].

We can thus restate our questions as follows. Is there any evidence for behaviours on social media platforms that look like behaviours in the autonomous mode of using the Group Explorer GSS i.e. do social media platforms enable behaviours that are GDN-like? If there is, then the GDN community might want to collect social media data to study GDN-like behaviours "*in the wild*" (Callon & Rabeharisoa, 2003).

4.1. Facilitation

We would also want to understand what has happened to the role of facilitation in this scenario. Is facilitation really necessary when working same-time/different-places? Can groups self-facilitate once the mechanistic aspects of a GSS, the *scaffolding*, have been tidied away by the development of better, more automated GSS software? Yearworth and White (2017) discussed this question using the lens of translation, a core concept in Actor Network Theory (ANT) (Callon, 1986; Latour, 1987). Translation captures the idea that in the evolution of a network of actors, such as formed by the interconnection of participants, facilitator, and the GSS, there are well defined *moments* or *phases* when the way in which the actors interrelate changes. These phases signal that a transition has occurred in the way in which the overall actor network behaves. The moments of problematisation and interessement, the binding together of the actors into a network through their interests in resolving the issue, (Callon, 1986; White, 2009) are likely to be precursors to workshops and thus independent of the use of a GSS. The existence of any mode of using the *Group Explorer* GSS assumes that the *need* to use it has already been established. It therefore becomes a tool that is used to bridge between the original moments of problematisation/interessement and the group of participants collectively agreeing about what action to take.

Certainly, in the case of the conventional mode of using the *Group Explorer* GSS, it is the facilitator that is instrumental in chaining these translations together. Furthermore, Yearworth and White (2018) observed a situation where *spontaneous* moments of problematisation and interessement mediated by social media was taking place in the event of the severe floods in a city in the northwest of the UK in 2015. In addition, Yearworth and White (2017, p. 79) have observed translation taking place in an online workshop where the expertise of the facilitator, in methodology and the operation of the GSS in online mode, was suspended and replaced by the domain expertise of the participants coming to the fore and engaging in the modelling process without prompting from the facilitator. Both these

[8] In set notation, the position occupied by the online mode of Group Explorer GSS is defined by the following relationship $GE \in G \cap P \cap D \sim\cap N \cap \sim O$ between the sets identified in Figure 6.

observations lead to the conclusion that in certain situations the conditions are right for GDN-like behaviours to be taking place on platforms without the intervention of the facilitator, at least for short periods of time.

4.2. Animating methodology

The translation observed by Yearworth and White (2017) highlighted the moment in a workshop when the entanglement between i) the expertise of the facilitator in methodology and in the mechanics of operating the GSS, ii) the GSS as a platform, and iii) the domain expertise of the workshop participants became momentarily visible as individual threads of *sociomaterial* activity (Burger, White, & Yearworth, 2019; Orlikowski & Scott, 2008). Clearly, the purpose of the GSS and the role of the facilitator is to bring the third thread to the fore, but the complexity of the methodology and its implementation through the GSS means there is a trade-off in the amount of time in a workshop that is spent in the facilitator-led phases of the entanglement to enable productive time in the participant-dominant phases. Continuing with empirical work into the nature of this entanglement through the detailed observation of micro-processes in group decision and negotiation (Ackermann et al., 2018; Franco & Nielsen, 2018) will likely contribute to further *demystification* of the role of the facilitator (Yearworth & White, 2017) and lead to a better understanding of the *animation* of methodology (Hiltz et al., 1996).

As an alternative approach, specific experiments could be conducted to investigate the effects of automation on specific aspects of the operation of a GSS. Limayem (2006) constructed an experimental setting for investigating the difference in performance between a conventional facilitated GSS and one where the facilitation was automated and incorporated into the GSS. Using a multicriteria decision model for a resource allocation task with a large sample of student participants, Limayen found no appreciable statistical difference in effectiveness between the two approaches. Wong and Aiken (2003) likewise found that automated facilitation was as good as expert human facilitation, and actually performed better than novice facilitators, for an idea generation and ranking task. These and other studies reported on by Wong and Aiken (2003) focussed on post-meeting consensus, process satisfaction and decision quality as key variables to assess the experimental findings from their work. They do point out the limitations of extrapolating from their findings to more complex tasks and therefore they may not apply to the sort of messy problem contexts that the SODA/JourneyMaking methodology would be used. However, they do suggest that there is a case for automating some of the aspects of the *Group Explorer* GSS. Some speculation about the feasibility of this is presented in Appendix A.

4.3. Social Media Platforms

Yearworth and White (2018) argued convincingly for the existence of Community OR behaviours mediated by social media platforms. Their observation opens-up the realm of academic study in group decision and negotiation away from the narrow world of workshops and corporate environments to the

open and unconstrained world of decision making mediated by social media platforms. Whilst we believe that it is worth the effort to investigate social media for evidence of GDN-like behaviours, we might discover from a preliminary search that they do not exist[9]. However, this immediately suggests that we should investigate the questions of *what* social media platforms might gain from acquiring some of the formal capabilities of a GSS and *how* these capabilities might be added? We would expect that such a development might improve the quality of debate, if not decision making, over that taking place on social media today. This is certainly a question that deserves further investigation by scholars. Here we look at how one such online development, that of crowdsourcing, might show the way forward for further work.

5. PROSPECTS: CROWDSOURCING AND GDN-LIKE BEHAVIOURS

There is an increased interest in processes and methods that can represent the interests of the widest possible range of individuals in an organisation or organisations (Bryson & Anderson, 2000; White, 2002). However, despite the progress in recent years, there is still much to learn about working with the largest group possible; indeed, the approaches to do this are stymied by attempts to get the "*whole system in the room*" (Weisbord & Janoff, 2010). Today, there is a growing interest in more distributed decision making. With the rapid rise of technology as an efficient means for the coordination of human activity, crowdsourcing is emerging as potentially a new form of problem-solving and group decision making. Crowdsourcing represents an innovative approach that allows organizations to engage a diverse network of people over the internet and use their collective creativity, expertise, or workforce for tackling complex problems (Brabham, 2013; Brabham, Ribisl, Kirchner, & Bernhardt, 2014). It can be best conceptualised as a learning process with highly distributed participants (Heylighen, 2013), where most of the physical constraints that used to govern space, time, matter, energy and information are removed (Heylighen, 2013).

Crowdsourcing transforms distributed decision making into local decision making, thereby enabling individuals to enjoy the many benefits of distributed collaboration without having to endure many of its costs (Brabham et al., 2014). Examples of crowdsourcing cases include Wikipedia, Galaxy Zoo, and Yahoo!Answers, which rely on undefined crowds and can be distinguished by their logic of process, collaboration, collection, and competition (Zhao & Zhu, 2014).

In the context of crowdsourcing, a central concept is the "*wisdom of the crowd*" which describes processes whereby people (in a crowd) solve problems and provide new insights and ideas leading to product, process, or service innovations (Brabham, 2013). The capacity to coordinate and network, is created by connective and collaborative Web 2.0 environments that enable individuals to engage in virtual social learning, communication and collaboration (Zhao & Zhu, 2014). However, there is little

[9] Although we believe that the review of crowdsourcing in the following section provides sufficient evidence that the assertion is very unlikely to be false.

understanding of this for a GDN setting. More research is thus needed on boundary conditions for crowdsourcing, which can be seen as indicative of the need to better understand the underlying processes of social learning, and the relationship between distributed decision making and organisational learning in particular.

In other words, further research is needed to gain insight into technology-mediated coordination and how collaboration in large groups can be understood (Engel et al., 2015; Lykourentzou, Vergados, Papadaki, & Naudet, 2013). Specifically, research would need to address the question of how crowdsourcing activity is related to distributed group decision making, the quality of the ideas, and the creation of trust (Jain, 2010). It is the type of task that allows group members to combine different abilities, skills, knowledge, or other physical and cognitive resources in a collective product that is more than any group member could produce alone (Laughlin, 2011). As such, it can be argued that shared intentionality, i.e. the ability to participate with others in collaborative activities with shared goals and intentions, should be considered in seeking to understanding how crowdsourcing becomes effective (Tomasello & Rakoczy, 2003).

This review of crowdsourcing suggests compelling evidence of GDN-like behaviours that are mediated by platforms that have grown from the same Web 2.0 technology base as the social media platforms. This suggests that there should be synergies between the capabilities offered by GSS such as Group Explorer and these publicly available platforms. Setting up meetings, and the preferencing and voting on options would seem to exist already i.e. the *Chauffeur* component already has analogues. However, the cognitive mapping expressed as causal maps and the group elicitation of such maps still seems to be the preserve of the specialist, closed GSS. Ideally future work would focus on questions that concern the more widespread use of cognitive mapping tools and whether there would be uptake on public platforms. Some recent developments in this area such as kialo[10], which focusses on issue-based argumentation, and kumu[11], that supports issue mapping, are worth tracking.

6. SUMMARY AND CONCLUSIONS

The process of implementing the *Group Explorer* GSS in an online mode has caused a re-engagement with research questions concerning the operation of same-time/different-places group workshops (Hiltz et al., 1996). The use of cloud-based computer resources to implement the GSS and ease with which multi-organisation group-working has been enabled injects a new perspective on the behaviours of participants. The classification schema introduced in §4 leads us to the observation that there is a relationship between the use of a distributed GSS to support problem structuring workshops and the presence of GDN-like behaviours taking place on open online platforms, especially those designed to support crowdsourcing. We characterise their relationship as representing two distinct

[10] https://kialo.com

[11] https://kumu.io

streams of development. The distributed GSS stream is essentially concerned with methodological issues and reflects its emergence from the academic concern of developing problem structuring methods grounded in appropriate theories. In the case of SODA/JourneyMaking this would be causal mapping, but we can also see similar threads in the case of the Strategic Choice Approach (SCA) and its concern with risk and uncertainty in planning (Friend & Hickling, 1987, 1997, 2005), Causal Loop Diagrams (CLDs) and System Dynamics (SD) focussed on behaviours arising from feedback loops (Sterman, 2000), or systems thinking in the case of Soft Systems Methodology SSM (Checkland, 1981; Checkland, 1999; Checkland & Scholes, 1999). Eden (1995) has specifically reviewed of the role of such *decision models* in wider group decision making processes.

The use of PSMs and GSS has largely been within organisations and communication about them restricted to academic and teaching texts. On the other hand, crowdsourcing platforms are open and have grown on the basis of meeting the functional requirements of their users. Development and communication have relied largely on Web 2.0 technologies and Open Source ideals and tools. Whether these two streams are ever likely to cross-share ideas is debatable. To a certain extent, the scaffolding provided by the *Chauffeur* is recognisable in other forms on other platforms, perhaps more as an implicit way of using them than anything that is provided by way of automation. However, the one thing that does set the two streams apart is the use of formal modelling approaches. As can be seen from the complexity of using Decision Explorer it is extremely unlikely that *formal* causal mapping[12] capabilities will find their way into open platforms in the future[13]. However, the ubiquity of open platforms means that there is potentially a ready audience for better ways of making decisions, if only a way could be found for making these more formal techniques more approachable and easier to use. As an area of further work, we suggest that heuristics could be captured from the detailed analysis of how facilitators use these modelling approaches and then used to produce highly automated versions suitable for integration into open platforms.

Unless researchers find a way of breaking out from the confines of purely academic interests in the development of GSS and PSMs then their work will likely have little impact on the development of platforms that will be used by the majority of people in the future, even in business. Furthermore, until they find a 'way in' to influencing these platforms it is possible that the quality of debate and decision making on them is always going to be less than that achievable with a well-designed GSS underpinned by an appropriate and well-theorised methodology. Perhaps the way of looking at the participant-developed decision models that underpin methodologies such as SODA, SCA, SSM, System Dynamics is that in functioning as boundary objects (Franco, 2013) they also provide a degree of *inertia* to the decision making process, providing some degree of memory to the participants as to the direction of

[12] Or CLDs, SD models, Purposeful Activity System (PAS) models (ex SSM), STRAD ('STRategic ADvisor' ex SCA), or anything else complex and formal.

[13] Although as noted earlier, developments such as kumu are worth noting.

travel and acting to resist sudden changes in group direction. Finding a way of injecting inertia into these public platforms could well be a good thing.

7. ACKNOWLEDGEMENTS

We would like to thank the many colleagues and collaborators in the STEEP and REPLICATE projects who contributed feedback on the development of the MS-Azure cloud-based implementation of the *Group Explorer* GSS and its use in the online mode. This work was supported in part by i) the EPSRC funded Industrial Doctorate Centre in Systems (Grant EP/G037353/1), ii) the Innovate UK/ NERC project Healthy Resilient Cities: Building a Business Case for Adaptation (Grant NE/N007360/1), iii) the EU FP7-ENERGY-SMARTCITIES-2012 (314277) project STEEP (Systems Thinking for Comprehensive City Efficient Energy Planning) and iv) the EU H2020-SCC-2015 (691735) project REPLICATE (REnaissance of Places with Innovative Citizenship and TEchnolgy).

APPENDIX A - SETTING UP AND RUNNING GROUP EXPLORER

The (non-standard) installation of the *Group Explorer* GSS in the MS-Azure cloud environment is described by Yearworth and White (2017, pp. 80-82). Some of the practicalities of starting up and shutting down the GSS are described here to illustrate the actions that would need to be automated in order to achieve an autonomous++ mode of using the *Group Explorer* GSS i.e. unlike the simple autonomous mode, where the facilitator merely leaves the GSS running unattended in one its meeting stages, the autonomous++ mode would not require a facilitator to control the GSS at all. The documents shown in Figure 7 are currently an essential stage in *briefing* participants in how to use the online mode of the *Group Explorer* GSS and would also need to be made known to participants for the autonomous mode. The use of a system for audio conferencing and screen sharing, such as Citrix GoToMeeting, in the online mode is not described here.

Microsoft PowerShell 'cmdlets' are used to start-up and shutdown the Group Explorer hosts *Public* and *Chauffeur* with their correct IP addresses in the MS-Azure cloud environment. These simplify management and can be 'wrapped up' as Applications on the computer used to manage the system. The operation of these cmdlets as Applications is shown in Figure 8.

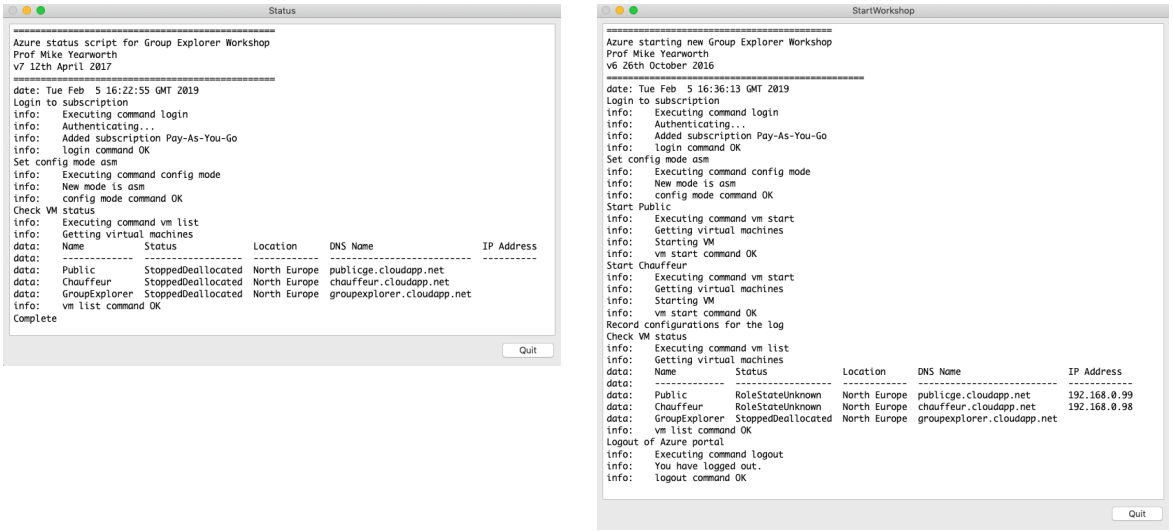


Figure 7. Simple Applications executing scripts written using Microsoft PowerShell 'cmdlets' to i) show the *Group Explorer GSS* status in the stopped and de-allocated (passive) state, and ii) start up the *Group Explorer* GSS hosts *Public* and *Chauffeur* with their correct IP addresses in the MS-Azure cloud environment. The script to shut down the hosts is similar.

Once an instance of the *Group Explorer* GSS has been established in the MS-Azure cloud environment using these simple scripting tools further manual intervention is required to start the *Chauffeur* and *Public* components of the GSS. Once these are running then the methodology requires both manual intervention to move the *Chauffeur* through the various stages of the meeting and the not inconsiderable task of managing the use of the Decision Explorer component.

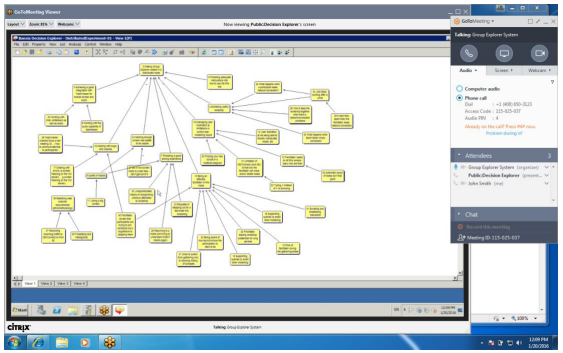
Automation of the *Chauffeur* component seems a tractable proposition and certain workshop participants (e.g. the sponsor or 'owner' of the problem) might be identified as 'superusers' and given control via a simplified interface similar to the Applications used to start and stop the servers. However, the control of the Decision Explorer component for the collective benefit of the workshop participants requires considerable skill on the part of the facilitator as can be seen from the complexity of the user guide described by Ackermann and Eden (2011, pp. 315-330). Some automation to achieve an autonomous++ mode might be achievable through the capture of heuristics from skilled facilitators that could be coded into rules that control the behaviour of the GSS and also by ceding some limited control to the same superusers. Developments are underway to achieve some of these capabilities.

Online Workshop Process

Prof Mike Yearworth
14th February 2019

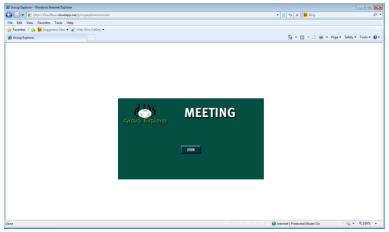
Process Description
The workshop purpose will be to form a shared understanding of a problem situation through the use of a system model (a Hierarchical Process Model (HPM)) that will be jointly developed by the workshop participants. The workshop will start with an agreed issue statement to work from. Further details will be provided by the Facilitator when the workshop starts. This document describes the use of the workshop conferencing system and modelling software on the participant's own computer. Note that the participant will have to monitor 3 different windows – the Facilitator's shared screen showing the model under development, the 'Chauffeur' console of Group Explorer to enable interaction with the model, and the Citrix GoToMeeting Console – and some switching between them will be required during the workshop.

Using the workshop conferencing system
The workshop conferencing system is implemented using Citrix GoToMeeting. Versions exist for Windows and Mac computers. Details of the links to follow to access this software together with the Citrix GoToMeeting ID and also the link to the Group Explorer modelling system will have been sent in another communication. Once installed and connected to the workshop meeting you should see the Citrix GoToMeeting window as well as a view of the Decision Explorer software screen showing the initial model.

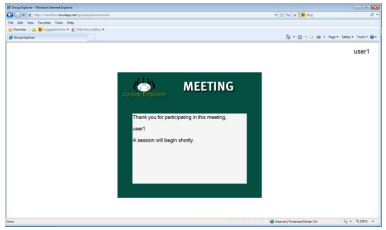


- Make sure your microphone is unmuted!
- Once you have joined the conferencing system and can hear the Facilitator and see the model you can join the Group Explorer modelling system.

Using the modelling system
Click on the second link in the joining communication which points to the modelling system console[1] – http://chauffeur.creativelinking.net/groupexplorerconsole/



Click on Join and you will get a holding screen, which displayed until the Facilitator is ready to accept participation in the group model building.



Once you have joined the workshop you will see the display change to a page where concepts and links can be entered. These will be explained further by the Facilitator. When invited to enter concepts just type them into the box and you should see the result reflected in the model after a little delay.

[1] Note that if you have indicated that you will be using a web browser other than Internet Explorer you will have been sent details of another way of connecting to the system using Microsoft Remote Desktop.

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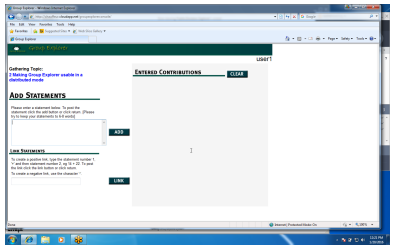
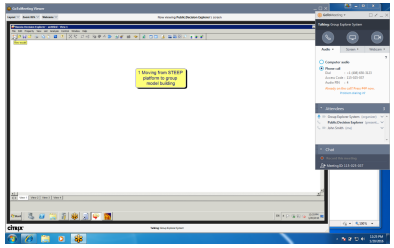
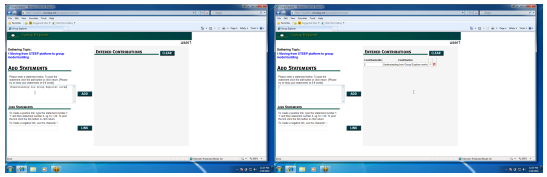
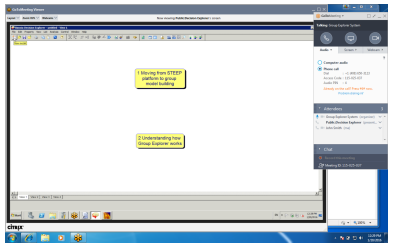
Figure 8(a). Instructions to participants for the online mode of using the *Group Explorer* GSS



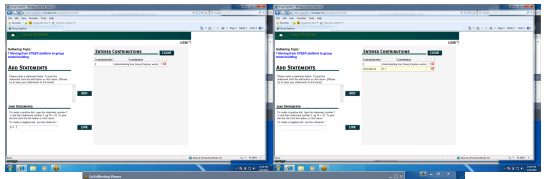
The initial phase of the workshop will be working at gathering concepts.







When invited by the Facilitator it will be possible to start entering relationships. For example, <Understanding how Group Explorer works> is clearly part of achieving <Moving from STEEP platform to group model building...>. This can be entered in the modelling console as 2+1. The link should then appear in the model, again after a little delay. More instructions about modelling will be given during the workshop.



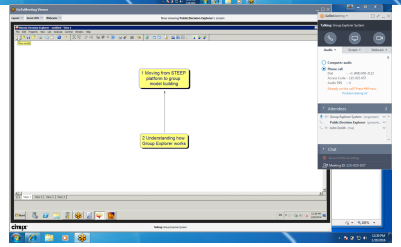


Figure 8(b). Instructions to participants for the online mode of using the *Group Explorer* GSS

Online Workshop Connection

Prof Mike Yearworth
14th February 2019

How to Join the meeting

1) The Group Explorer system was built to work with Microsoft Internet Explorer. If there is any reason you have to use another web browser (e.g. Chrome, FireFox, Safari…) please email me at mike@yearworth.com and I will provide additional connection instructions
2) If you have not used the Citrix GoToMeeting System before please would you test your connection now by clicking on this link https://link.gotomeeting.com/system-check. If you have any problems please email me at mike@yearworth.com
3) 15 minutes before the workshop is due to start please check that you can join the conferencing system from your computer, tablet or smartphone by clicking on this link https://global.gotomeeting.com/join/615542853
4) Use your computer, tablet or smartphone microphone and speakers - a headset/ear-buds is recommended. Or, call in using your telephone:
   Dial UK +44 20 3713 5028, Belgium: +32 28 93 7018, France: +33 170 950 594, Germany: +49 692 5736 7317, Italy: +39 0 230 57 81 42, Switzerland: +41 435 5015 61
   Access Code: 615-542-853
   Audio PIN: Shown after joining the meeting
5) If you have any problems connecting before the workshop is due to start please call Mike on +44 7789692266
6) At the time of the workshop please click on this link: http://chauffeur.creativelinking.net/groupexplorerconsole/
7) If anything happens that is making it difficult or impossible to continue participating in the workshop please announce over the audio channel. This is experimental work so please let all the participants know what the problem is.
8) Please use the Chat facility in Citrix GoToMeeting sparingly, if at all. Ideally all communication should be mediated via the Facilitator and/or the model. Note that the Chat channel is also recorded as part of the workshop.

Technical problems

1) If your internet connection drops:
   Send an SMS to Mike on +44 7789692266 saying who you are, that your connection has dropped, and an estimate of how long it will take to re-establish a connection and re-join the workshop
2) If GoToMeeting doesn't connect to the meeting
   Send an SMS to Mike with a summary of the problem
3) If GoToMeeting drops the meeting connection
   Attempt to re-join using the GoToMeeting meeting ID provided on the day of the meeting. If this doesn't work send an SMS to Mike with a summary of the problem
4) If Group Explorer is not allowing you to connect
   Let everyone know over the audio channel of GoToMeeting

Data collection

1) See the separate document "Permission for workshop data collection." The audio channel, shared screen and any chats between participants will be recorded for analysis and publication purposes. Note that no individual will be identified in any published work. A permission form will have been sent before attending the workshop. Anyone who has not agreed to these recording requirements will not have been sent a GoToMeeting meeting ID number.

PERMISSION FOR WORKSHOP DATA COLLECTION

Online Workshop for CoME EASY Project Demo 22nd February 2019

Types of data to be collected, processing and storage

The workshop will collect the following data: audio feed from the Citrix GoToMeeting software, Decision Explorer model files, screen shots, text typed into the modelling console of Group Explorer, and the participant chat channel of GoToMeeting. Audio data may be transcribed to produce text data. *The data will be anonymized*, i.e. names of individual participants or their organizations will not be identifiable. All data collected will be archived and appropriate data protection laws and policies apply.

Use of Data

The data identified above may be used for the following purposes:

1. Research Publication

Data may be used to identify areas for improvement in problem structuring methods (PSMs) and as a case study to illustrate PSMs in use. The anonymized analysis of the data may be included in academic publications.

2. Project reporting in relation to UKRI and EU grants and other public funding for all/part of the activity

Data may be used to document the workshop. They may be used in project reports to funding bodies. These reports may include a list of stakeholders and workshop attendees.

3. Public communication

Data may be uploaded to publicly accessible websites that contain information about the project. This may potentially include the name of participants and the name of their organization in reference to participation in the workshop.

	Please tick the boxes and sign below		
	…research	**…project reporting**	**…public communication**
I give permission to include my data (as identified above) as I participate in the workshop for…	☐	☐	☐

Print name _____

Signature _____

Date _____

*Please note that if you do not consent to your data being used for **all** of the purposes identified above then workshop joining credentials will not be sent. There is no practical way of excluding any one individual's participation/contribution in a workshop from the uses described above and non-participation is the only practical solution.*

Please sign, scan, and return this form to the workshop facilitator, Prof Mike Yearworth, by email to mike@yearworth.com at least one day before the workshop is due to start

Figure 8(c). Instructions to participants for the online mode of using the *Group Explorer* GSS

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