

## **FACILITATED CONCEPTUAL MODELLING: PRACTICAL ISSUES AND REFLECTIONS**

Antuela A. Tako  
School of Business and Economics  
Loughborough University  
Leics, LE11 3TU, UK

Kathy Kotiadis  
Warwick Business School  
Warwick University  
Coventry, CV4 7AL, UK

### **ABSTRACT**

This paper discusses some practical issues relevant to facilitated conceptual modelling (CM). We consider facilitated CM as a process of undertaking CM primarily in facilitated workshops attended by a group of stakeholders. Facilitated workshops are a common practice in some fields of operational research (OR), System Dynamics (SD) and Problem Structuring Methods (PSM). The associated benefits of involving the stakeholders in the modelling process are reported in the literature such as enabling the mutual exploration of the problem situation and creating a strong ownership of the formulated problem. Further benefits related to CM are knowledge acquisition from domain experts, conflict resolution, fostering credibility and creativity. Reflecting on our experience, we consider the practical issues related to undertaking facilitated CM such as the group size and composition, team roles and the facilitator and the organization of workshops. The ideas put forward could be useful to modellers interested in undertaking facilitated CM.

### **1 INTRODUCTION**

Facilitated conceptual modelling (CM) is considered an alternative way of undertaking the CM process with the active engagement of a group of stakeholders. Facilitated modelling has been described as the process of developing models jointly with a client group, face-to-face, with or without the assistance of computer support (Eden and Radford 1990, Franco and Montibeller 2010).

Stakeholder involvement is considered an important factor for the success of a simulation study (Brailsford et al 2009, Eldabi 2009). Furthermore, group involvement, rather than single client involvement, is increasingly needed in operational research (OR) in order to implement solutions across an organization (Franco and Montibeller 2010). Research in participative discrete-event simulation modelling is only now starting to emerge (van der Zee 2007, Tako et al 2010a and 2010b) so success in group facilitation is still dependent on the modellers leading each intervention. Conceptual modelling (CM) is the first stage in a simulation study and it is considered to be amenable to stakeholder participation (van der Zee 2011; van der Zee 2007, Kotiadis et al, 2012).

CM is about understanding the problem situation studied and deciding what and how to model (Robinson 2008a). Developing conceptual models in a participative environment involving stakeholders has received some attention in the DES community (van der Zee 2011; van der Zee 2007, Kotiadis et al 2012). One aspect relevant to participative CM is the development of transparent and communicative models. Van der Zee (2007) uses Petri net principles to develop conceptual models that in turn support stakeholder understanding about the problem and identification of solutions. Other research on participative CM considers the use of WIKIs as a means of capturing the exchange of information between modellers and stakeholders (Dungan and Heavey 2010). A study focussed on participative simulation modelling, known as PartiSim has put forward a framework to support facilitated conceptual modelling for DES studies through workshops (Tako et al 2010a and 2010b, Kotiadis et al 2012). Specific tools were devel-

oped to support the CM process and extracting the information relevant to the simulation study. However, the practical issues related to undertaking facilitated CM, have not been discussed in great detail.

The aim of this paper is to consider some practical issues that support the process of undertaking conceptual modelling in a facilitated environment. *Facilitated* workshops can be used as a forum where stakeholders and modellers come together in specific points during the CM process, where information is shared in order to reach a mutual and commonly agreed conceptual model (Kotiadis et al. 2012). The introduction of facilitation elements in the process can benefit the needs for CM. With the view to putting forward good practice for facilitated CM, we consider issues such as workshop organisation, group size and composition, team roles, the interaction between the modeller(s) and the stakeholders and the role of the facilitator. The ideas put forward could be useful to modellers interested in undertaking facilitated CM.

The rest of this paper is organized as follows. The next section provides an initial review of facilitation in OR before focusing on facilitation in simulation and in particular in CM. Based on our own experience, we then reflect on the practical issues for facilitated CM. We then discuss how these considerations can benefit the needs for CM. The paper concludes with future directions for research in facilitated CM.

## 2 FACILITATION AND SIMULATION

### 2.1 Introduction to Facilitation

The traditional way of conducting OR interventions is generally considered to be in an expert mode, where the OR consultant uses methods and models to analyze the problematic situation faced by the client, solves these problems and reaches an optimal solution, and then recommends these obtained solutions to the client (Franco and Montibeller, 2010). In the recent years an alternative way of conducting OR interventions has emerged, which is called the “facilitated mode”. The facilitated mode can be defined as ‘the opposite of the expert mode where OR methods and models permit the subjective analysis (e.g. many views incorporated) and the operational researcher engages jointly with the client(s) in the modelling process towards desirable and feasible solutions’ (Kotiadis et al. 2012, p. 2). This mode is considered particularly useful when tackling so-called ‘messy’ problems, where a high level of complexity, high level of uncertainty and significant conflict among stakeholders is present (Franco and Rowette 2011, Franco and Montibeller 2010).

Facilitation is a complex endeavor that requires a variety of skills and attributes (Vennix 2001, Andersen and Richardson, 2005). A number of aspects need to be carefully considered for the design of effective facilitated workshops, such as client involvement, the facilitation process (Franco and Montibeller 2010), the environment (Mingers and Rosenhead 2004), size of group (Phillips and Phillips 1993), group composition (Grinyer 2000) and client – analyst relationship (Schein 1998).

The OR consultant acts not only as an analyst, but is also required to act as a facilitator (Ackermann, 1996). The facilitator plays a key role in the effective completion of the workshop and facilitated group work (Papamichail et al 2007). During the workshops, the facilitator aims to assist the client to explore the problems and to define the expected changes and the resulting outcome of these changes (Fordyce and Weil 1971). It can be considered as a process consisting of a series of activities that help the client to perceive and understand the problems faced, with the view to improving the problematic situation (Schein 1998).

Facilitation methods can support group involvement in the modelling process (Franco and Montibeller, 2010). Franco and Montibeller (2010) identify three main modelling approaches that use facilitated modelling as part of the OR modelling process. Under each approach different OR tools are used to support the intervention process. These are: facilitated problem structuring (Mingers and Rosenhead 2004; Checkland 1999), facilitated system dynamics (Andersen et al. 2007, Vennix 2001) and facilitated Decision Analysis (Phillips and Bana e Costa 2007; Belton and Stewart 2002). Facilitated CM for DES has been introduced more recently (Tako et al 2010a; 2010b, Kotiadis et. al 2012) and therefore not listed by

Franco and Montibeller (2010). We next briefly consider facilitated system dynamics and facilitated CM for DES.

## **2.2 Facilitated System Dynamics**

System dynamics (SD) is a continuous simulation modelling approach, alternative to DES (Tako and Robinson, 2010). Different system dynamics modellers have developed procedures for involving the client in the model building process in a facilitated mode. These are often identified as group model building (GMB) (Vennix, 2001; Andersen et al 1997; Andersen et al. 2007). Most GMB interventions take the form of one or more facilitated workshops where interaction between the stakeholders and the modelling team takes place in order to build an influence diagram and if necessary to go on to build a SD model. For the equivalent SD conceptual modelling stage, scripted techniques are put forward to support problem definition, identification of relationships between variables and feedback structures in what it is called a qualitative model or influence diagram (Andersen et al 1997; Vennix et al 1990; Vennix and Gubbels 1992). GMB analysts have developed a vast experience in using facilitation to conceptualise and build SD models. The GMB research for the equivalent CM stage for SD is not transferable to CM for DES because of the different process and outputs developed (Tako and Robinson 2010). However, useful insights can be gained for facilitated CM in DES from their existing facilitation practice, activities and interaction between stakeholders and modellers.

## **2.3 Facilitated Conceptual Modelling for DES**

Conceptual modelling is considered to be one of the difficult and mostly ignored aspects in simulation modelling (Law 2007). In the last decade research focusing on CM has appeared, with presentations in major conferences (e.g. WSC and The UK OR society's biannual simulation workshop), special journal issues (e.g. the Journal of simulation) and an edited CM book (Robinson et al 2011). Research in CM is gaining momentum but is still in its early stages. In fact there is no agreed definition and agreement in what activities consist CM (Robinson et al 2011, van der Zee et al. 2011). One definition put forward by Robinson (2008a) describes conceptual modelling as the process of developing a non-software specific description of the computer model, starting from an understanding of the problem situation, to specifying the objectives, inputs, outputs, content, assumptions and simplifications of the model. While different modellers may follow different steps to define the CM, generally the two main processes undertaken are knowledge acquisition (obtaining information about the problem situation) and model abstraction (the simplifications made in moving from a system description to a conceptual model) (Kotiadis and Robinson, 2008). A number of CM frameworks have been developed (Pace 1999, Robinson 2008b, van der Zee 2007) that provide a set of steps to guide a modeller through the development of a conceptual model (Robinson et al 2011).

During the process of developing a conceptual model different challenges are faced by simulation modellers. Often it is difficult to identify a single problem owner because their problems and their solutions can involve many stakeholders with multiple views and objectives and often a politically charged environment. This is often the case in health care situations (Brailsford et al., 2010; Kotiadis 2007). A study of an organisation with several decision makers with distributed knowledge and power may require the involvement of a client group than a single client. Group involvement brings about the need for facilitation. A recently developed CM framework known as PartiSim (Participative Simulation) supports group facilitation through workshops. This framework has been explained in more detail in Tako et al (2010a; 2010b) and in Kotiadis et al (2012). A brief explanation of the PartiSim CM process is provided in table 1. The process involves three main stages, out of which two are stakeholder-oriented workshops, followed by in-between workshop activities. Stakeholders' expectations and engagement are managed through facilitation. Stakeholders and modellers engage in debate about the situation at hand, where knowledge is shared among workshop participants. The three steps involved in this process are:

- 1) Initiate the study;

- 2) Define the system;
- 3) Specify the conceptual model.

**Table 1: Overview of the PartiSim CM process, aims and outputs (adapted from Kotiadis et al, 2012)**

<b>Stage</b>	<b>Facilitation Activities</b>	<b>CM outputs/deliverables</b>
1. Initiate Study  <u>Purpose:</u> - Identify stakeholder team - Identify key problem situation(s)	A list of those key stakeholders to be involved in study are determined.	Preliminary understanding of the problem situation
<b>1.a Pre-workshop 1</b>	Modelling team and stakeholder team roles are decided. Workshop 1 and 2 venues and allocated workshop time slots are determined. Stakeholders are invited to workshops Facilitator prepares materials for the workshop.	
2. Define system ( <b>Workshop 1</b> )  <u>Purpose:</u> Agree on the problem situation and the wider system, within which it exists.	During the workshop the facilitator enables the group of stakeholders to design/determine the deliverables.	General study objective(s) A bounded system within which the problem to be addressed exists
<b>2.a Post-workshop 1/ Pre-workshop 2</b>	The modelling team liaises with the stakeholder team over correctness of workshop 1 outputs and prepares for workshop 2	
3. Specify conceptual model ( <b>Workshop 2</b> )  <u>Purpose:</u> Define specific elements of the conceptual model	During the workshop the facilitator enables the group of stakeholders to design/determine the deliverables	Model inputs and outputs Model objectives A preliminary lists of assumptions and simplifications A communicative model A list of data requirements
<b>3.a Post-workshop 2</b>	The modelling team liaises with the stakeholder team over correctness of workshop 2 outputs and commences model coding.	An agreeable to all (study participants) and feasible conceptual model describing DES study

GMB has been a source of influence to the PartiSim CM approach with respect to considering the idea of workshops and project team roles. Using the activities and tools included in the PartiSim CM process provide a starting point to the facilitation process. The tools can be used to manage the knowledge acquisition process and to ensure that stakeholders' views about the problem situation are obtained. During the CM workshops, an approach similar to that used in SSM is adopted, which is often considered appropriate to structure and make sense of messy situations. Furthermore, integrating concepts from SSM can help to reveal norms and perceptions and allow the modellers and stakeholders to understand complex

problem situations. In order for this to be possible, there is a need from the part of the modellers to be able to move between paradigms (hard to soft and back to hard) (Kotiadis and Mingers, 2006).

Franco and Montibeller (2010) argue that active group involvement in the process provides benefits, such as mutual exploration of the problem structure, a strong ownership of the problem formulation and the actions to be taken, a sense of acceptance of responsibility for the actions taken. Relating to CM, group involvement during the process results ultimately in developing desirable and feasible CM outputs that are acceptable to the stakeholders. These benefits can fit the needs for CM, identified in the existing literature. Kotiadis and Robinson (2008) identify knowledge elicitation as one of the steps undertaken during the CM process, whereas Balci and Ormsby (2007) suggest involving subject-matter experts in the process. We believe that facilitated CM enables knowledge elicitation to take place by involving domain experts in the process. Additionally, resolution of conflict is another CM need which is supported through the introduction of facilitation in order to reach consensus. Furthermore, facilitation can also assist towards achieving CM credibility, which involves ensuring that clients believe that the model is sufficiently accurate. (Robinson, 2008a). Creativity is considered important for CM (Pidd, 2007; Kotiadis, 2007), but it is little understood in DES. Creativity is considered to encompass 'seeing a problem in an unusual way, seeing a relationship in a situation that other people fail to see, ability to define a problem well, or the ability to ask the right questions' (Büyükdamgaci, 2003, pp 329). However, being creative on an individual level is difficult because by nature the brain is 'hard wired' by its inherent abilities and predispositions (personality type), as well as the individual's past experience to function in a particular way (Büyükdamgaci, 2003). However, group involvement can engender creativity as many personalities are brought together with different knowledge and experience.

The explanations of PartiSim so far, have mainly focused on the CM framework and outputs rather than the practical issues related to undertaking facilitated CM. In the rest of this paper we reflect on our experience of undertaking CM in a facilitated mode focusing on the practical issues that we found useful in the process. We believe that these issues can support facilitated CM particularly with respect to its needs, such as knowledge elicitation, conflict resolution, creativity and credibility.

### **3 PRACTICAL ISSUES FOR FACILITATED CONCEPTUAL MODELLING**

In this section we reflect on practical issues that are generally considered important to support the facilitation process which include the group size and composition, the team roles, the role of the facilitator and the organisation of workshops. The views expressed in the existing literature on facilitated modelling are combined here with our reflections based on our experience of undertaking facilitated CM for two separate studies.

#### **3.1 Group Size and Composition**

A facilitated workshop can be described as a gathering of a group of stakeholders (usually face to face) that take part in an active process of exploration guided by a facilitator or a group of facilitators. In our experience, these workshops are normally attended to by a group of stakeholders from different parts of the organization (e.g. hospital manager versus nurse) and different perspectives (e.g. cost reduction most important for participant X versus delivery of care most important to participant Y). Capturing a number of views is often necessary in the CM process of knowledge acquisition (Kotiadis and Robinson, 2008). A key consideration in facilitative CM is to identify the individuals that will form the group of stakeholders. This is not an easy decision in large organisations where the system of interests spans across a number of departments.

Group size and group composition (Papamichail et al, 2007) are important when designing the CM workshops. Phillips and Phillips (1993) describe that the number of participants taking part can have a major influence on the balance between individuality and group. In fact, the suggestions of group size are different depending on different types of group. For a group that the participants had worked together before, no more than around 6-8 members is recommended (Miller, 1956; Belbin, 1981). When the partici-

pants only have little experience in working together previously, the most effective group size is considered around 12-14 (Phillips and Phillips, 1993). Other research suggests that the brainstorming in a small group is less of an advantage than in a big group of round 20-25 members (Nunamaker et al, 1998). This is because, in an effective facilitated group, it is expected that each participant can represent different perspectives on the problem, relevant to the different skills and their understanding to implementing a solution (Mason and Mitroff, 1981). However, it is generally thought that the effectiveness of a group meeting declines when the group size increases (Grinyer, 2000; Ackermann, 1996). This is because more and more problems will occur in the decision making task such as alternative findings and difficulties in reaching a common action plan (Shaw et al, 2004).

The PartiSim experience of group size in facilitated CM is very similar to the general views expressed above. Two interventions, using the PartiSim approach, had group sizes of less than 12 individuals which made it possible for all individuals to contribute to knowledge acquisition.

Another related aspect is group composition; which is about different personality types and roles of group members (Ackermann, 1996). Striking a balance between these elements is important to achieve creativity within the group. In the PartiSim experience, personality types that were more outgoing volunteered information more readily than those that were not. However these personality types were not many, which on occasions made them appear to be as overpowering individuals rather than helpful. In one of the interventions using the PartiSim CM approach the group contained quieter individuals on the whole making it important that the membership was larger (10-12) and all members were present in the workshops to ensure the steady flow of views and expressions of opinions. The roles will be discussed next.

### 3.2 Team Roles

Another aspect considered important to organising and running facilitated workshops is the setup of the project team and assigning the relevant roles to those taking part in the intervention and who are invited to attend the workshops. These roles are briefly described in table 2. We distinguish two teams: the modelling and stakeholder team. Ideas about team roles have been put forward in the literature on group processes (Friend and Hickling 1987, Schein 1998) and GMB (Vennix, 2001, Roberts 1977). Assigning different roles can have a positive effect on the group work (Belbin, 1981). For example, a key role is that of the final decision maker whose involvement can help increase the likelihood of implementation (Mason and Mitroff, 1981). In the PartiSim approach we do not assign a specific role but we recommend that this person is identified within the key stakeholders role and is invited to the workshops. The team roles defined in Table 2 are based on the existing views found in the literature, but adapted to fit the requirements for undertaking a simulation study and to fit with the PartiSim approach.

**Table 2 Descriptions of project team roles**

<b>Roles of project team:</b>	<b>Description of each role:</b>
<b>Modelling team</b>	
The simulation modeller (model coder)	Someone experienced in DES modelling, particularly in coding the model. Is responsible in communicating the viability of transforming the conceptual model into a computer model within the agreed timeframe.
The recorder	Take notes and generally observes the situation and is on hand to provide the facilitator with assistance in organising the workshop particularly in terms of pre-workshop (e.g. sorting agendas preliminary outputs etc) and post-workshop activities (e.g. disseminating the output of workshops or chasing up data or information). Recording equipment cannot replace this role if confidential information is discussed. Also if recording equipment is used then this role can safeguard in the event of an unexpected electronic failure.
The facilitator	A person that leads activities within a workshop with good facilitation

	skills such as active listening, chart writing, managing group dynamics and power shifts and reaching closure (Franco and Montibeller, 2010). A workshop can be led by one or more facilitators whose role is to enable the group to meet their workshop objectives within the available timeframe by guiding the participants in any activities undertaken, keeping the interaction among the participants relevant and at the centre of the room.
<b>Stakeholder team</b>	
The project champion	This person could be either someone enthusiastic about the study or the initiator of the study (Brailsford et al, 2009). He/she serves as a link between the modelling team and the stakeholder team. The project champion will motivate other stakeholders and help to organize workshops.
Key stakeholders	People with tacit knowledge of the organisation involved and usually with decision making power in the stakeholder organisation.
Other stakeholders	People with tacit knowledge of the organisation.

The modelling team comprises of the simulation modeller(s), the facilitator and the recorder. As a group, they manage the process and stakeholders' expectations, but also encourage participation. Although the facilitator role and the computer model coder roles can coincide (the same person); one member of the modelling team will always be needed to record the information during the workshop (the recorder). Hence the modelling team could consist of as many as two individuals. The descriptions of each role in Table 2 provide further guidance regarding the required skills and person specifications for each role.

The stakeholder team will typically include subject matter experts, who have an involvement in the organisation or institution of interest. After an initial stakeholder analysis the different stakeholders and their roles in the organisation are considered in order to decide who should be invited in the workshops. The main roles that we have found beneficial for the workshops and important to involve in the study are: project champion, key stakeholders and other stakeholders. Involving key stakeholders in the study enables a broader level of ownership of the simulation study and its results within the organization (Robinson, 2008a). Particularly positive for the study is the identification of the project champion (Brailsford et al. 2009), called gatekeeper in GMB literature (Richardson and Andersen, 1995). From our experience, the project champion has had a huge impact in the successful completion of the study, not only for providing useful information to the modelling team, but also for promoting the study within the organisation.

### 3.3 The Facilitator Role

Given the importance placed on the role of the facilitator we consider this role in more length here. A facilitator should have interpersonal and communication skills in order to manage the group interactions during the workshop. Rosenhead and Mingers (2004) suggest that the facilitator should be 'disinterested', acting as a guide to effective conversation and avoiding to project their own opinions on the group. Vennix (2001) furthermore points out that the facilitator should be sensitive to the mood, power relations, politics, and personalities of individuals and the group. There are different views taken about the role of the facilitator during the workshop. Ackermann (1996) for example suggests that two facilitators should be assigned so that one focuses on managing the process, (i.e. making sure that clients' participation in discussions is fair, avoid unnecessary talk over and suitable timing control) and the other focuses on managing the content (i.e. paying attention to the content of the meeting, data and issues displayed). Others believe that the facilitator does not need to be knowledgeable of the problem domain as he/she should concentrate on the process, leading the discussion, providing structure and creating consensus among the stakeholders (Vennix 2001).

From our experience of undertaking two interventions using the PartiSim CM approach, it was mainly simulation modellers who took on the role of the facilitator during the workshops. This was partly for trialing purposes and to provide the modellers chance to learn the art of facilitation by practicing it. This was also aimed in order to test the role with different modellers and different personalities. In our opinion, facilitation is to a large extent an art that is difficult to teach but observing others helps either to pick up good practice or to learn from mistakes. Also, the CM workshops were scheduled for approximately two hours each, in line with the stakeholders availability. This meant that it would be quite difficult for a single facilitator to keep the degree of concentration for that length of time. In our experience, ideally a facilitator should change over after about an hour. This is because of the concentration required to advice and guide the stakeholders through the stages of knowledge elicitation and model abstraction so that the CM outputs can be derived. In addition, to ease the pressure on the facilitator the second facilitator would normally provide a brief and punchy summary of what was discussed at the end of each activity. Although we do not believe it is necessary that facilitator is familiar with the context, it is preferable that he/she is a simulation modeller and has experience of model building.

For inexperienced facilitators it may seem an overwhelming task to undertake facilitation as it requires co-ordination of the process at different levels. In our experience, rehearsing the group activities within the modelling team and thinking through potential pitfalls was helpful in keeping to time and keeping focused in our role as facilitators. A list of the tasks carried out while facilitating that other modellers could find useful includes:

- Listening – developing good listening skills;
- identifying relevant information and keeping the discussion within topic. We would normally introduce the concept of the “parking lot” if we felt that issues irrelevant to the topic were raised.
- (it may involve) managing difficult personalities or conflict within the stakeholder team;
- making notes on flipcharts or board visible to all participants;
- presenting information clearly, in an interesting way and avoiding technical simulation language.
- drawing stakeholders, especially quiet ones, into the discussion.

In summary a CM facilitator is an information seeker, a guiding force, a clarifier, a consolidator of opinions, a peacekeeper, a motivator and a technical advisor with respect to the technical aspects of the simulation model/study.

### **3.4 Workshop Organisation**

Providing a comfortable environment that is deemed enabling for discussion is considered important in facilitation (Mingers and Rosenhead, 2004). To enable a more effective discussion, a venue away from the ‘stressful’ workplace is recommended by Rosenhead and Mingers (2004). However, from our experience of dealing with particularly busy health care practitioners, we had to be flexible and to fit the workshops into stakeholders’ busy schedules.

We have had the opportunity to run workshops either in dedicated conference facilities or in clients’ institution i.e. hospital teaching rooms. When using dedicated conference facilities outside the work place, it was possible to create a better rapport with the stakeholders as well as a more relaxing atmosphere to encourage their participation. Furthermore, there were opportunities for social interaction between the modelling team and the stakeholders during the breaks as well as before and after the workshops. It also made it possible for stakeholders at different levels in the hierarchy to participate and interact in the workshops. In our experience it is important that workshop participants can see each other so that conversation is at the center of the room and not in small groups. This can be achieved with a circular or U shape seating arrangement.

As part of the workshop organization, the modelling team tended to undertake different activities pre- and post- workshop, as indicated in Table 1. As part of pre-workshop activities the modelling team would prepare a workshop plan, relevant smaller tasks (group or individual activities). Furthermore, we would consider and resolve in advance issues such as scheduling breaks in between activities, the availability of



refreshments, room seating, the availability and use of equipment such as a flip chart, a computer projection screen. We tend to vary the activities in order to keep participants' interest and attention. We would also bring in the workshops preliminary outputs, prepared based on our initial understanding of the situation, which were useful to initiate the debate. Developing these outputs from scratch during the workshops could be time-consuming and unproductive (Vennix 2001).

After the workshop, the note keeper would provide a full report of their notes to the rest of the modelling team. The forms completed by the participants and the graphs developed during the workshop would be tidied up and re-arranged in a neater format suitable for circulation. A document summarising the key CM outputs was developed and circulated to the stakeholders for comments between workshops. For example, following the second workshop we sent a document that included: the project aims and objectives, a summary of the problem situation, a process flow diagram, assumptions and simplifications, a table of available data and requirements. This document provided a representation of the CM and if necessary could be used throughout the study as documentation. In our experience this document acted as a simulation contract between the modellers and the stakeholders and supported conceptual model validation. We also used this document to identify further questions that had not been resolved yet or for data collection purposes. Changes to this document were made after each workshop, based on the comments received from the stakeholders.

#### 4 DISCUSSION: BENEFITS OF FACILITATED CM

In Section 3 we put forward our reflections on practical issues such as group size and composition, team roles and workshop organisation that can support the process of undertaking facilitated CM. We now consider how these practical issues can in turn support the needs for creativity, domain knowledge elicitation, credibility and resolving conflict in facilitated CM that have been already mentioned in section 2.

The choice of group size and composition have an impact on *creativity* within the group. From our experience of undertaking the PartiSim CM process, with two different groups of stakeholders in healthcare, we have come to realize that it is important that workshop participants are able to readily share information. This is in order to gain a common and relevant view of the problem situation from different perspectives, which in turn can lead to seeing things differently. We have observed that in larger groups, quieter individuals were less inclined to air their opinions, whereas smaller teams were more creative. The group that had quieter individuals overall required more prompting from the facilitator than the group with more forthcoming individuals. In such instances facilitation skills can enhance creativity.

The different team roles and group composition are closely related to *knowledge elicitation* and *resolving conflict*. In the two studies we undertook, we aimed to identify and invite to the workshops all relevant stakeholders, who held tacit knowledge of their organization ensuring that they all had the opportunity to contribute to the development of the conceptual model. In addition, being aware of how to manage the different personality types was useful for us as facilitators. In our interventions using the facilitated Partisim CM process we went out of our way as facilitators to treat all stakeholders as equals regardless of their position and seniority within the organization. This meant that on occasions we would tell very senior stakeholders that their issues would be "parked" and considered in further studies if necessary.

Developing a CM that is transparent and accepted by all members of the team, can support *credibility* of the CM and of the simulation study. The facilitator plays an important role in the study, ensuring fair participation and that it is shaped around the problems that are considered important by the stakeholder team. In our experience of conducting the CM process in the expert (non-facilitated non-group) mode, we found on some occasions, stakeholders would argue or tensions would emerge among them about feelings of not being included as much as some other stakeholder in the same organization. Involving key stakeholders in a 'hands on' approach meant that such disputes did not emerge. In fact, we were told 'off the record' that two individuals in one group, who usually had opposing opinions and could have brought the process to a standstill, seemed to finally agree to a fair deal. Additionally, the organisation of the workshops can support conceptual model credibility. Throughout the PartiSim process, stakeholders have the

opportunity to provide feedback about the CM developed during the facilitated workshops and in the dedicated post-workshop stages.

From our experience, facilitated CM is most effective when dealing with many stakeholders with conflicting views of problems and with no clear objectives. However, for problem situations with the exactly opposite characteristics (i.e. clearly defined objectives and single client), an expert mode of undertaking CM may be more suitable.

## 5 CONCLUSIONS

Facilitation can be useful in DES conceptual modelling in order to explore the problem situation and to agree on what should be modelled. This paper has put forward some guidance for good practice in facilitated CM. The factors that can support facilitation during the CM process were discussed including the group size and composition, team roles and the facilitator role and the organization of workshops. Although our focus has been on facilitated CM some insights will be true for other facilitated modelling approaches beyond simulation and also other stages of the DES modelling process using a facilitative mode. However, the ideas suggested are more likely to be useful to simulation modellers that are interested in undertaking conceptual modelling in a facilitated mode. Facilitated modelling is a relatively new area in DES. The opinions put forward in this paper are based on our experience of using the PartiSim CM approach presented in Table 1. Interested readers can find further information about the framework, including the aims of each CM workshop and activities involved in Tako et al (2010a; 2010b) and Kotiadis et al (2012). There is however a need for further research in this area, especially to identify alternative ways of undertaking facilitated CM and DES in general and to provide guidance to the facilitation process. A factor that should be considered is the process followed to undertaking CM. Future research could also consider the effectiveness of facilitated CM workshops by assessing the factors that affect the success of CM modelling. In addition, research into developing further facilitative CM frameworks for DES would be also welcome.

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## AUTHOR BIOGRAPHIES

**ANTUELA A. TAKO** is a Lecturer in Operations Research at Loughborough University, UK. She holds a PhD in Simulation and an MSc in Management Science and Operational Research from the University of Warwick. Her research focuses on the comparison of simulation approaches (Discrete-Event Simulation and System Dynamics), facilitative and participative simulation modelling and conceptual modelling. She is an Associate member of the Operational Research Society (AORS), UK. Her email address is [a.takou@lboro.ac.uk](mailto:a.takou@lboro.ac.uk).

**KATHY KOTIADIS** is an associate fellow of the Warwick Business School (UK). She holds a BSc (Hons) and PhD from the University of Kent. Her main research interests include facilitative and participative DES modelling, conceptual modelling, health service modelling and combining problem structuring approaches with DESM. She was awarded the K.D Tocher medal (2007/08). Her email address is [kathy.kotiadis@associate.wbs.ac.uk](mailto:kathy.kotiadis@associate.wbs.ac.uk).