NOTES AND INSIGHTS

Reflecting on factors influencing long-lasting organisational effects of group model-building interventions

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Introduction

Researchers and practitioners recognise that many organisations, to different extents, deal with nonroutine, complex problems that hinder their performance and constrain them from fully delivering their mission. These situations are often characterised by lack of agreement about the scope and depth of the problem at hand, as well as conflicting views and agendas regarding the desired course of action (Eden and Ackermann, 2001; Franco and Montibeller, 2010; Howick and Ackermann, 2011; Huz, 1999; Mingers and Rosenhead, 2004). Decision support approaches like Group Model Building (GMB) have been widely used to aid on solving these complex problems (Franco and Montibeller, 2010).

The usefulness of GMB, and other facilitated modelling approaches, in complex and ambiguous situations resides in using a transitional object to improve problem understanding and communication among the parties involved (Rouwette *et al.*, 2002). This transitional object is a representation of a problem built by stakeholders with help of a facilitator that can be used to update and align stakeholders' mental models (Black and Andersen, 2012). In GMB interventions, the transitional object is either a diagram or a simulation model that is mostly built and discussed during participatory workshops involving those with a stake in the problem.

Many field studies have shown the advantages of GMB interventions (e.g. Rouwette and Vennix, 2006; Videira *et al.*, 2012). So far, researchers have mainly focused on assessing immediate effects at the individual (e.g. mental model refinement) and the group level (e.g. consensus and commitment) (Rouwette *et al.*, 2002; Scott *et al.*, 2016). The assessment of long-lasting effects of GMB interventions, and participatory modelling methods in general, on organisations has remained largely unexplored (Howick and Ackermann, 2011; Luoma, 2016; Schilling *et al.*, 2007).

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This gap in the literature was recently highlighted by Randers (2019) while reflecting on the 60 years of the system dynamics field. In his reflection, Randers pointed out that, while there has been a lot of progress, the issue of how to achieve organisational change through modelling insights remain largely puzzling (Randers, 2019). Ultimately, system dynamics interventions, such as GMB, add greater value if they influence behaviour and enhance organisational performance (Luoma, 2016). It thus seems a matter of good practice to reflect on assumptions underlying design and process choices and to examine the long-lasting organisational effects of GMB interventions (cf. Ormerod and Ulrich, 2013).

In this Notes and Insights essay, we reflect on how system dynamics interventions, and GMB in particular, could support organisational change by looking at the long-lasting organisational effects of boundary objects created in GMB interventions. In this regard, Black (2013) offered us a useful framework to reflect about why the objects we use and the processes that we follow are not always effective in developing shared understandings and "actionable," practical guidelines. We built on this work by deliberating about how we can manage boundary objects produced during the GMB process.

Case studies

In 2014, we conducted an experiment involving two client organisations based in Lisbon, Portugal. The first (Organisation 1) is a small private enterprise focused on hospitality services to international students. The second (Organisation 2) is a medium-sized public body responsible for managing domestic waste across the country. The objective of the experiment was to compare real-world differences between two variations of a GMB script. In each of the two organisations, we worked with two comparable groups addressing the same problem. This was a rare opportunity since, like Rouwette *et al.* pointed out, "It is unlikely (…) that a management team confronted with a real-life problem would voluntarily split up in two or more (comparable) groups which then each use a specific method to work on the problem" (2011, p. 788). Developing such kind of experimental conditions in a real-life context allowed us to limit the number of independent variables to consider in the analysis and to make relatively objective comparisons.

Figure 1 offers an overview of the process followed in the interventions. It is worth noting that for 'Workshop 1: structure elicitation', we used different scripts for each of the two groups in the same client organisation. In each case, there was a group following a 'traditional' GMB approach using causal loop diagramming (CLDs) as the main elicitation technique and another group using Strategic Options Development Analysis (SODA) with the same purpose as proposed by Ackerman *et al.* (2011).

Fig. 1. Overview of the process followed in the Group Model Building case study. Adapted from Herrera *et al.* (2016, p. 11)
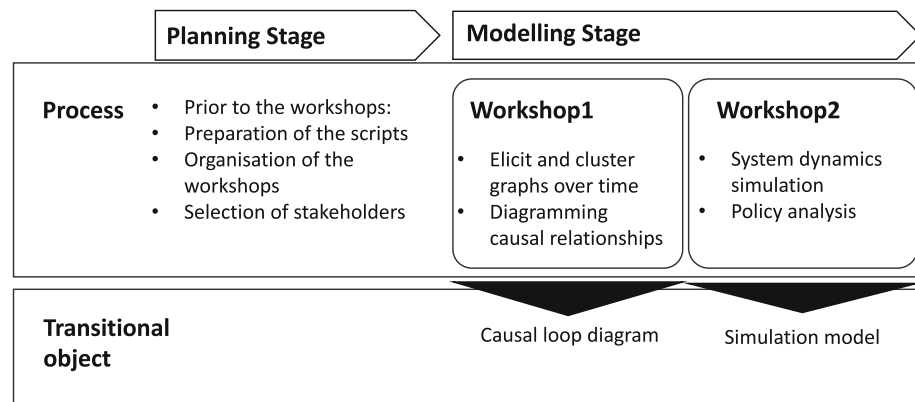
The participants in the experiment (a) did not have previous experience working with facilitated modelling approaches; (b) had adequate language skills to understand and participate in the workshops conducted in English; and (c) were not aware which specific strategic issue would be analysed before the experiment started to avoid negotiations between participants before the workshops.

As in other case studies described in the literature (e.g. Huz *et al.*, 1997; McCardle-Keurentjes *et al.*, 2018 l Rouwette *et al.*, 2009; Rouwette *et al.*, 2011; Scott *et al.*, 2013), our assessment focused mainly on evaluating the process and outputs of the workshops. Namely, we evaluated quality of communication, perception of consensus, and commitment. The communication among participants was assessed by analysing the conversations happening during the workshops. Next, the perception of consensus regarding potential solutions and participants commitment to take these solutions forward was measured through questionnaires (before and after each workshop). Finally, the overall perception on the usefulness of the intervention was captured through interviews with a sample of participants (eight out of 17) at the end of the intervention.

We recognise that the controlled environment set up for an experiment bounds the insights that can be gained regarding ownership of the model and power conflict between stakeholders because the impact of political agendas is to some extent limited by such environment. However, the same environment allowed us, to the extent possible, to separate the effect of the method on the final outcomes from the effects of other factors – for instance, by controlling for group composition.

Recognising that the long-lasting effectiveness of the interventions remains largely unexplored, we contacted the case-study participants 5 years after the workshops with the aim of assessing what happened after our engagement. Overall, six participants (out of the 17 that originally participated in the intervention), including the two gatekeepers, agreed to participate in this recent round of interviews (see Table 1).

Table 1. Participants interviewed in each of the studied organisations

Participant	Participant code	Interviews at the end of the modelling phase	Follow-up interviews (5 years after the intervention)
Gatekeeper Organisation 1	1G	*	*
Participant 1 Organisation 1	1P1		*
Participant 2 Organisation 1	1P2	*	*
Participant 3 Organisation 1	1P3	*	
Participant 4 Organisation 1	1P4	*	
Gatekeeper Organisation 2	2G	*	*
Participant 1 Organisation 2	2P1	*	*
Participant 2 Organisation 2	2P2	*	*
Participant 1 Organisation 2	2P3	*	
Participant 2 Organisation 2	2P4	*	

The follow-up interviews were conducted through video calls in two sessions. The first session focused on eliciting the outcomes of the intervention in terms of solutions implemented and behavioural changes seen in the organisation. Namely, we asked participants about three concrete potential impacts of the intervention: (a) implementation of solutions proposed during the workshop; (b) changes in behaviour following the workshops; and (c) lessons learned from the workshops.

The second round of interviews was designed after revising the answers from the first round of interviews and aimed at understanding what elements in the process could have increased the impact of the intervention. We did this by directly asking participants what they thought that could have helped to increase the workshops' impact. Moreover, we asked them to reflect on their expectations and understanding of what the workshop were supposed to achieve. In the next section, we present the highlights from these interviews to later reflect on the factors that may influence long-lasting effectiveness of GMB interventions (e.g. the occurrence or absence of long-term organisational effects).

Results

During the first round of interviews, participants stated that the solutions proposed in the workshop were not implemented (see Table 2). Two participants did not have explicit recollection of the solutions proposed, with one of them not recalling at all the solutions that were discussed during the intervention (see answers in Table 2). Those that remembered that solutions were proposed pointed out that suggested strategies to solve the problem

Table 2. Excerpts from participants' responses to the first round of follow-up interviews, 5 years after the GMB intervention

	Do you remember if any of those strategies was implemented?	Do you think (name of the organisation) changed the way it conducts its meetings after experiencing the GMB intervention?	Do you think (name of the organisation) learned something from the workshops?
1G	*Mmmm…implementation in real life you mean…well…the intervention was good, we had a good discussion and I had the opportunity to present my vision to the team. This was particularly helpful to me, as some of them have not been positive or open to some of these ideas in the past. However, the intervention had little impact on our tactical plans as we did not engage with the operational levels to implement the strategies discussed.*	*I think in some point we were thinking to…but the diagramming is difficult. Well probably not for you but if you have not done it in the past it is probably not something you will do easily on your own and there are other ways we can collaborate and work together. We use a lot of graphical methods in our meetings, like roadmaps and so on*	*I think we probably learned about specifics of the strategies we were discussing rather than the methods. Well…we probably kind of knew a lot of the things we discussed anyway…so probably was more like getting a summary…some concise explanation rather than…full revelation.*
1P1		*I do not think we did. I think we could have incorporated some positive elements from the workshops on our daily routine, but to be honest, we just continued using same practices we had.*	*It is difficult to say whether the ideas in the workshop have real impact. Think in a conceptual way they did… you know they inspired us to do something different but we never landed in something tangible, so it is difficult to say.*
2G	*We really did not have a plan for taking actions after the workshop. We got good ideas from it, but we did not act upon them. Like when we were drafting plans sometimes ('name of participant') will say something like 'remember we need constant investment' or 'remember people will forget if we stop the campaign'. But do not think we really implemented any specific idea proposed during the workshop. You know like we got some principles but we did not really have follow up plan or a concrete meeting for developing a project about how to deliver any concrete action.*		
1P2	*No, I do not think we had any strategy so, no we did not implement them. I think we probably picked some ideas about the challenges that we probably used later on…You know like…"remember this is going to be challenging because logistic constraints" or "remember we need to aware of the transport fleet capacity"… stuff like that.*	*I would like to say yes, but I do not think so. I think it was a nice experiment but it will be difficult to have a facilitator for every meeting. I think for big meetings or some strategic topics 'name of the organisation' was bringing some external moderator, but I think it was the exception…you know something special.*	*We probably learned something, but I do not think the organisation itself did…I think organisational learning is way more complex than that…and as I said…I do not think the workshops really gave us the opportunity of learning the methods and techniques.*

were not taken forward because there was not a concrete action plan from those responsible for implementing the strategies after the workshops (see 1G and 2G responses in Table 2).

Likewise, when asked if they saw changes in the way meetings were conducted in the organisation, participants also indicated that there were not visible changes. However, all interviewed participants recognised having incorporated some elements of the GMB workshops, for example, using diagrams to facilitate the discussions in other meetings, mainly for planning and collaboration (see answer from 1G in Table 2). They also provided some hints on the justifications for such effects, by pointing out the need of having a trained facilitator in order to be able to incorporate some of the scripts used in the workshops in their regular meetings.

Finally, when asked about organisational learning outcomes, participants indicated that their organisations did not learn from the experience (see responses in Table 3). This is particularly interesting when we compare their latest answers to those they provided immediately after the intervention. Immediately after the intervention 12 out of 18 participants agreed or strongly agreed that they "learn more about the issues surrounding the initial question of the workshop."

During the second round of interviews participants provided their views about things that could have helped us to increase the impact of the GMB intervention. The suggestions proposed by participants included: hosting more workshops, agreeing on concrete actions and next steps during the workshops, and having some prior training on the modelling and diagramming methods. The latter suggestion also surfaced several times when we asked participants how they would have seen the workshops making a difference in their organisation.

In terms of expectations, most participants remembered they were interested in learning about system dynamics and GMB, with some interviewees stating they did not have any expectations for the intervention. Learning was also mentioned when asked about what they wanted to get out of the workshop. When answering this question some participants also mentioned more concrete outcomes, such as eliciting new ideas, next steps for tackling the problem at hand, and a simulation model.

Reflections and insights

There are many examples in the literature valuating the impact of GMB interventions based on participants feedback immediately or a short term after it took place. Like many of these cases, we also got positive feedback and concluded that the GMB interventions have been, to some degree, successful in improving communication, reaching consensus, and raising commitment among participants (see Herrera *et al.*, 2016). These results contrast with the feedback provided 5 years after the GMB sessions.

For the evaluation of our initial intervention, we need to refer to our original study done by Herrera (2014). In our case, participants mostly

Table 3. Excerpts from participants' responses to the second round of follow-up interviews, 5 years after the GMB intervention

	What were your expectations about the workshop?	What were you expecting to get out of it?	How would you measure the success of the workshop?	How could the intervention have had long lasting impact?	How would you see the workshop making a difference?	What would have you done differently to increase the workshops' impact?	Were there any soft (social) benefits? (e.g. improved your relationship with your colleagues)
G1	*I was curious about systems thinking and thought the workshop will be a good way to get an introduction for me and the team. I also thought it could be good to take a different perspective to our day to day problems.*	*New ideas, new views about the issues we faced back then to attract and retain customers. We were growing back then and I wanted to take get a systemic perspective of the challenges we were facing.*	*I remember you passed some questionnaires and asked us our opinions about the workshop itself. I think that is a good way to measure how successful it was.*	*I think it did. Maybe not concrete actions but we definitely got a new perspective*	*We probably could have done more with the model. You know like really understand it and how did it work. I remember we really liked the results and the interface and the opportunities it offered but we never got to work on it*	*You mean, like practical things? Mmmm...probably an introductory talk to system dynamics would have been helpful. I think some in the team were not sure what the workshop was about. It probably would have been good to spend additional time talking about 'so what'. Like what are we going to do know with the things we have learned and the model you prepared. Maybe two workshops were not enough.*	*I think I know what you mean. We are and we were a very good organisation in terms of listening peoples views and opinions, so I think this was just a different way to have our meetings. You remember we are a small team and I have always emphasised team work.*
1P1	*I do not think I had to many expectations to be honest. Do something different? Maybe have the opportunity to discuss some important issues?*	*Nothing in particular. Maybe to get some ideas about how we could better work with clients.*	*Mmmm...that is a difficult question, I'm not expert in this kind of things...perhaps by the amount of ideas we proposed?*	*You mean the workshop? ("yes") I think we probably could have done more after that experience. We did not have more workshops after that. I think the workshops were just like an introduction, but we never got into the detail. For example, I remember you presented this software in the second workshop but we never did something with it afterwards. I think we just went to our daily jobs and never used again. Maybe if we would have had more workshops.*	*I think is the same than previous question. We needed to spend more time and to have more workshops. You know it was really like a one-off and we did not see it as something that was part of our jobs. So as soon as we were done with it, we did not do anything about it anymore*	*I do not know. I think it was not about the workshop itself but the fact it was a test or a 'trial' rather than a real project. So the workshop was fine, but we needed to implement this method as part of our work.*	*Do not think so, we were a good team. Maybe it would have been different if we would have had some of the administrative managers in the group. I think then it would have been a good opportunity to discuss some issues we never discuss, but the four of us that were in that workshop were quite close anyway.*

(Continues)

Table 3. Continued

	What were your expectations about the workshop?	What were you expecting to get out of it?	How would you measure the success of the workshop?	How could the intervention have had long lasting impact?	How would you see the workshop making a difference?	What would have you done differently to increase the workshops' impact?	Were there any soft (social) benefits? (e.g. improved your relationship with your colleagues)
1P2	*To be honest I did not know what to expect. It was the first time we had one of this. I had been in similar workshops before but not modelling workshops...so I did not know what to expect. I think using the computer and mapping was good, different.*	*Perhaps, learning something new. As I said, I did not know what to expect so I was quite open about the outcomes.*	*Maybe by the amount of things we actually accomplished afterwards? I'm not sure...On one hand we talk a lot of how housing was a constraint. I remember thinking that we needed to grow fast and then consolidate...you know like a strategy, so that was good, but then we did not move to action.*	*As I said before, we needed a concrete plan coming out of the workshop. I remember it was more like a discussion but we did not came up with an action plan.*	*Particularly for me it would have been good to understand the model you prepared a bit better. I was very interested in some assumptions and the way some variables were calculated but could not get into it on my own. Probably if the model would have been more clear I could have used later for some analysis*	*As I say before, probably spend more time discussing the model. I thought it was good but I did not understand it properly so I could not use it later. I think it would have been good to get a report about the workshop, you know with the diagrams and the summary of the model...* (*"I think I sent you a report"*) *Ohh... maybe you did...I do not remember. Maybe then just having.... like a wrap up session to discuss the report and how we could used the model and diagrams later.*	*Actually for me, in particular was good. I remember that I was relatively new to 'name of organisation'. Was a good way to get to know the other members of the team. I think it was not often that we were together in the office so it was good to have these workshops and get together.*
1P3	*To discuss our future strategy and to agree on next steps for developing the business.*	*Concrete steps actions we needed to take in order to develop the business. Back then the organisation was growing. 'Name of the CEO' was hoping to get more customers and more properties to rent but they were facing normal challenges any organisation faces when trying to develop. I thought the*		*Do you mean long lasting impact on...?? like impact on the strategy? ("yes") I think it could not have long lasting impact because the organisation changes. We were discussing the problem we saw back then, but then we faced other problems and...well... we just moved on. I think you cannot*	*They make a difference...they help to solve a problem, but problems change. The problems you are facing today are different from those you faced yesterday. Back then the workshop helped us to address a problem*	*Well, if you really want to have an impact you probably need to adopt the workshops as part of your regular way of working. You see, the problem is that in many cases we have these meetings but only one person speaks, but when you introduce a facilitator, then it is different. So, if you*	*Absolutely. In my perspective the best part of any job is to have good honest conversations with your colleagues. The meetings we had were good opportunity to do so.*

(Continues)

Table 3. Continued

	What were your expectations about the workshop?	What were you expecting to get out of it?	How would you measure the success of the workshop?	How could the intervention have had long lasting impact?	How would you see the workshop making a difference?	What would have you done differently to increase the workshops' impact?	Were there any soft (social) benefits? (e.g., improved your relationship with your colleagues)
		workshop would help us to address some of those issues. 'Name of the CEO' was quite energetic but he did not listen to us. I thought we could have been a good opportunity for us to be honest and finally get him to listen some of our ideas.		expect a single meeting to have an impact beyond addressing a problem. You find a problem, you discuss about it and then you move to the next one		are trying to find a way to change the business, well probably by having a facilitator all the time. But that might be expensive.	
2G	I think wanted to learn more about system dynamics, and the process you follow to build the model. We also were trying to get some new ideas about how to achieve our recycling quotas. I think the simulation results were good.	I think we wanted to get a model, something we could use to identify strategies and to find optimal solutions. We remember that system dynamics was very good for addressing this kind of complex problems and we thought we could get a model we could use later on.	I think the workshop itself was successful, the problem was that we did not follow up. Like the workshops were good but, we had good discussions and I particularly learned a lot.	Well the workshop was an isolated event. We were having it to help with your research and to learn more about system dynamics, so it was not part of a project. I think for this kind of workshops to have an impact you need to have them as part of a process. Someone needs to do the project management and get everybody to take actions, ownership of outcomes, etc. We often face the same issues with other meetings, if we do not get people to agree during the meeting then nothing happens. And you need someone chasing people afterwards to be sure they are actually doing something	Is kind of the same question. To have an impact, to make the difference you need to make this part of a wider project. You need someone chasing actions coming out of it, you need people to commit to timelines and deliverables		I think immediately afterwards kind of did. You see I remember we discussed that having this kind of interdisciplinary group was very good and incredibly helpful for problem solving. This was not the way we had meetings in 'name of organisation'. But we really saw the big difference it makes when you have a diverse team versus just people from the same function.

(Continues)

Table 3. Continued

	What were your expectations about the workshop?	What were you expecting to get out of it?	How would you measure the success of the workshop?	How could the intervention have had long lasting impact?	How would you see the workshop making a difference?	What would have you done differently to increase the workshops' impact?	Were there any soft (social) benefits? (e.g. improved your relationship with your colleagues)
2P1	*Well...we were thought you will be introducing the mapping the method. I heard of the models before and was interesting to learn more about it. Well... and I was encouraged to join the workshops by 'Name of the gatekeeper'.*	*Learning about system thinking models.*	*I think you first need to define success. I think the fact you managed to have the workshops in the first place can be already described as a success. You can also think as how successful were they on teaching us how to use this new method. From that perspective, they (the workshops) were probably unsuccessful because we did not learn how to produce those models.*	*Well probably we needed training on the modelling method. What we saw was a very short example and there were many steps that happen behind the scenes. I think we found the experience interesting but we did not follow it up.*	*Once again, you probably needed to spend more time with us explaining the method and the model and so on. You were also missing the right people in the room. You see, from what I remember only few of those in the room were actually into using models or anything like that. For many of us was a new experience.*	*Involve the right people, having more sessions so that we could fully understood the method, applied to a real project so we could see the benefits...*	*No, I do not think so. I think it was a good experience but do not think any significant social benefits came out of it.*

agreed that the workshops helped them to learn or gain insights about the situation presented. For example, 11 out of the 17 participants agreed that the workshop helped them to change their mind about the problem at hand, 12 out of the 17 agreed or strongly agreed they learned more about the issues discussed, and 14 out of the 17 agreed the workshop challenged their initial mental models. All of these are often seen as signs of mental model refinement and considered as a positive sign of the outcome of GMB interventions.

Even more important, 14 out of 17 agreed or strongly agree that they felt committed with the implementation of the solution proposed during the workshop. When we interviewed them a couple of days after the workshop, six out of the 10 participants interviewed agreed they thought the solution proposed during the workshop was the best alternative to tackle the issue discussed, and five out of 10 were willing to present the proposed solution to the decision makers in their organisation.

What happened after the intervention that diminished its practical impact? What could we have done differently? We framed our analysis on the work of Black (2013) and Black and Andersen (2012) regarding using visual representations as boundary objects. Many authors have proposed that the outcomes of GMB and other facilitated modelling methods derive from using diagrams or models as boundary objects that facilitate the cognitive process that enables learning and facilitates consensus. According to Black, "boundary objects are visual representations that synchronously span a boundary of expertise or objectives among multiple individuals" (2013, p. 80).

As discussed by Black (2013), GMB workshops provide the conditions for using system dynamics models and diagrams as boundary objects by facilitating effective multidirectional communication (Rouwette *et al.*, 2011) among multidisciplinary groups (see Figure 2). In our case study, multidisciplinary teams used diagrams and simulation models to diagnose the problem, propose solutions, and prompt those in the workshops to act on the proposed solution. At the end of the intervention, participants' responses to the postquestionnaires suggested that we created boundary objects that improved communication and helped to reach consensus.

However, Black (2013) proposes that an important and often neglected characteristic of boundary objects is iterate-ability or the extent to which the objects remain easily transformable by the users. We hypothesise that this characteristic might be particularly important to understand long-lasting effects of GMB interventions. If boundary objects are not easily transformable after the workshops to be used and updated by the organisation, they stop their functionality for the long-lasting effectiveness to the organisation. If this happens, the potential boundary object becomes a unidirectional object that will not have any effect in the long-term.

Fig. 2. Conditions for using system dynamics representations as boundary objects. Adapted from Black (2013, p. 81)
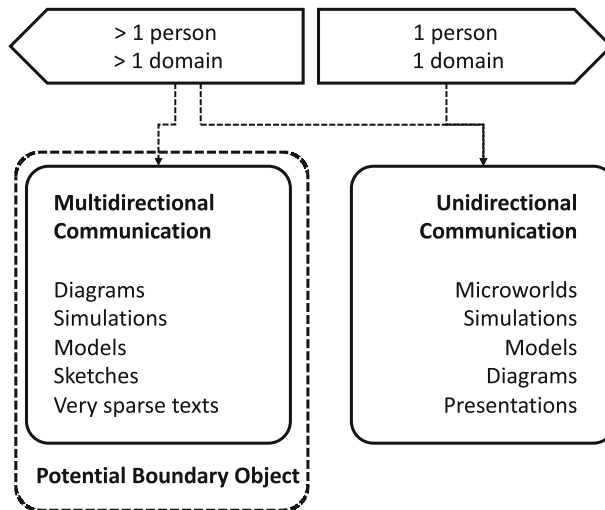
From the case study presented above, as well as other experiences in which we have collaborated, we reckon that in the majority of GMB interventions there was no one in the organisation who was able to use the diagrams and models produced to engage with other stakeholders that were not part of the workshops. Although we often communicate our results through reports and even share the model with the participants, these representations are not easy to transform and may regress into unidirectional forms of communication. In fact, during the interviews, participants indicated that this lack of iterate-ability was indeed a problem. For instance, participants revealed that they would have needed further training on the method and would have benefitted understanding the model in more detail: *"We probably could have done more with the model. You know like really understand it and how did it work"* (1G Table 3).

Using our experience and participants' feedback, we are proposing a framework for investigating when and why completed boundary objects created during GMB interventions transform into unidirectional ones. For simplicity, we hypothesise that this transition happens at two points in time (see Figure 3). In the short-term, e.g. a couple of weeks after the intervention, this may happen when participants realise that, although they grasped the model during the GMB session, they are not comfortable enough to explain the model to other stakeholders that were not present at the workshop. Moreover, participants realise that even if they share the model with others, they are not capable of changing it to incorporate missing elements or to test hypotheses provided by these new stakeholders. Therefore, models and diagrams quickly stop being used by the organisation and the impact of the intervention fades away.

Fig. 3. Simplified hypothesis for the transition between boundary and unidirectional objects
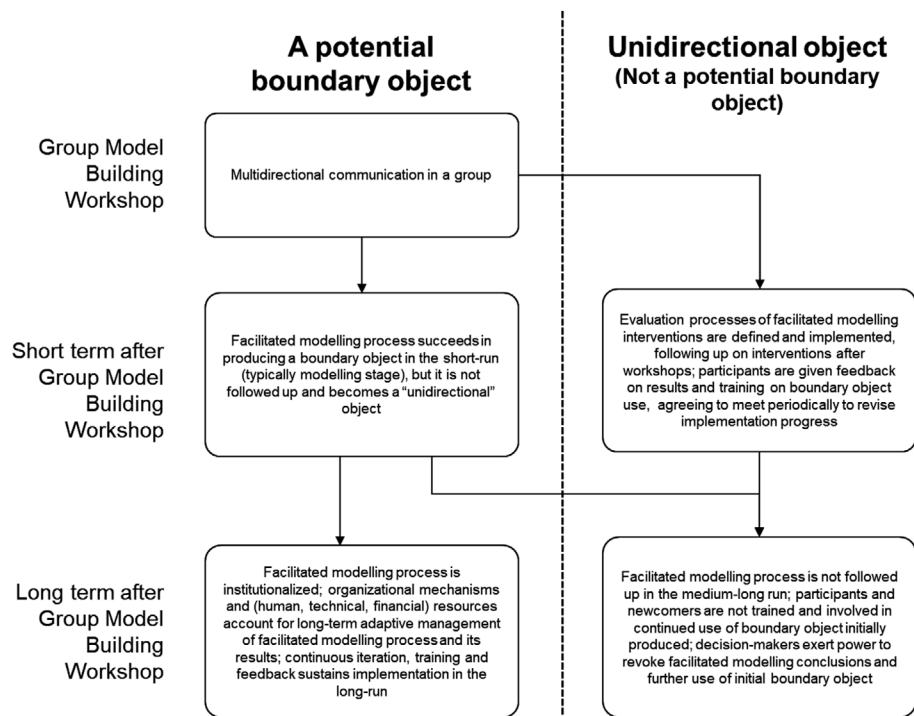
Furthermore, even if participants are comfortable enough to use the model and communicate its results, these objects still risk becoming unidirectional objects if the process for transforming the object is not institutionalised and, for example, newcomers are not trained and involved in continued use of the boundary object initially produced. Institutionalisation of the process is important because organisations are not static. As the time passes, new staff joins the team backfilling for those who left, priorities change, and constraints emerge and disappear. This is particularly important for interventions addressing long-term problems as the completed boundary objects, the solutions proposed, and the insights gained will need to be constantly updated before fully implementing a solution.

In practice, institutionalisation of the process requires the facilitating team members think about what will happen after the workshops have been delivered. Based on the feedback we received, there are at least two elements that need to be considered while planning the workshops. First, the team needs to support the organisation to move from forecasting and testing proposals into 'action planning'. This need for thinking on implementation has been already identified by Größler ([2007]) when reviewing system dynamics projects that failed to have an impact. In his reflections Größler ([2007], p. 447)

Table 4. Hypotheses for factors influencing long-lasting effects of Group Model Building interventions

Milestone	Suggestions for practitioners
Milestone 1 – Setting for success	• Engage with a wider group of stakeholders (in addition to the gate keeper and/or project sponsor) during the planning stage. • Prepare a detailed scoping statement for the GMB intervention, which makes clear the problems to discuss, the expected output (tangible and intangible), and the outcome of the intervention.
Milestone 2 – Link the intervention to a wider purpose	• Keep the project sponsor and the senior decision-makers informed of the progress of the intervention. • Communicate model results and insights from the workshop(s) to any stakeholders potentially involved in the implementation of solutions proposed in the intervention. • Allow time for socialising the workshop(s) results with senior stakeholders who were not present in the workshop(s). • Train organisational members and ensure that modelling competencies are kept in the organisation for follow-up and monitoring stage.
Milestone 3 – Self awareness	• Run a test facilitation session where the rest of the facilitating team can provide critical feedback to the facilitator regarding their own biases. • Ensure more than one facilitator whenever possible.
Milestone 4 – Plan beyond the workshop	• Prepare a project plan that makes explicit the strategic context of the intervention, practical considerations for next steps, and other related supporting activities.
Milestone 5 – Introduce the stakeholders to a new language	• Prepare and distribute material explaining the diagramming method and nomenclature before the first workshop.
Milestone 6 – Keep an eye on the process	• Organise the agenda in a modular way. This will foster flexibility if the elements in the agenda need to be reshuffled or scrapped. • Have a separate team member play on the role of the process coach keeping an eye on the mood of the group and reworking the agenda whenever necessary.
Milestone 7 – Hand over of the model	• Agree at the beginning of the workshop about the delivery of the tangible output (diagrams, reports, model) after the sessions. • Use a "workbook" to validate the diagrams produced and participants understanding of the model. • Prepare and distribute interactive material (e.g. Stella interface, videos) summarising the main insights from the modelling report.
Milestone 8 – Develop an implementation and follow-up plan	• Start building the follow-up roadmap in the planning stage. • During the workshop(s), go back to the follow-up roadmap regularly.

concluded that missing this step was, as in our case study, "the reason why many good potential solutions were never implemented."

Second, the facilitating team also needs to plan for developing organisational capabilities that will enable stakeholders in the organisation to fully understand the objects created (diagrams and simulation models) so they can update and modify them (Hovmand, 2014). Building organisational capability has been an aim in system dynamics projects since Senge (1990). However, this step in the intervention process is often neglected due to time and resource constraints (both among organisations and facilitating teams). As shown in the feedback we got from participants in our intervention (see Table 3), without an explicit effort form the facilitating team, participants might not feel comfortable explaining the model to others not to say making changes to it.

A road map towards long-lasting organisational effects

Considering the effort and time we often dedicate to creating boundary objects and its widely accepted importance towards achieving mental model refinement, consensus, and commitment, it is paramount to understand how we can manage the completed boundary objects so that they remain transformable by and accessible to everyone in the organisation. Using Figure 3 as a framework, we propose a road map with eight milestones towards achieving long-lasting impact that happen along the way of the intervention.

Milestone 1 – Setting the stage for success: The facilitation team needs to understand and manage the expectations that the client organisation has for the interventions. Individual agendas need to be accounted for, including the agenda of the gatekeeper(s). The facilitation team should carefully select the stakeholders who will participate using the goal of the intervention as reference point. Scripts available in ´Scriptapedia´ (Hovmand *et al.*, 2011), like 'Creating a Shared Vision of Modelling Project' might be a useful starting point in this process.

Milestone 2 – Link the intervention to a wider purpose: One-off facilitated modelling interventions are unlikely to have high impact unless they are part of the organisation's ongoing strategic management processes.

Milestone 3 – Self-awareness: While planning the intervention, it is important to make a critical assessment of the process bias the facilitator brings to the discussion. For instance, in our case study, the facilitator was focused on keeping a similar pace in all the groups so that the results between groups could be comparable. However, this meant that the time spent discussing the diagrams and the model itself was insufficient for some participants.

Milestone 4 – Plan beyond the workshops: The targeted impact of the intervention needs to be clear, and the planning should account for medium and

long-term activities to achieve, and for risks to mitigate, from the very onset of the process. While it is likely that facilitating the team will move on after the workshops have been completed, it is important that the team considers what would happen after – for instance, who will own the model going forward? What actions will need to be taken after the workshop?

Milestone 5 – Introduce the stakeholders to a new language: The method should be made accessible (easy to understand) to all the participants (Hovmand, 2014). In some cases, it might be useful to introduce/train the group on system dynamics modelling/diagramming methods during the planning stage, as well as providing training on model use afterwards. This is paramount not only to improve understanding and participation during the workshops, but, maybe even more, to keep the transitional object accessible to the client organisation. This does not mean that stakeholders can necessarily build a similar diagram on their own, but at least some of them should understand it to the extent they can explain it and make small adjustments.

Milestone 6 – Keep an eye on the process: A member of the facilitation team, for example, the process coach (see Richardson and Andersen, 1995), could help the facilitator to adjust the process depending on the observed group dynamics. This is particularly relevant when there is a tension between formal and informal procedures of GMB defended by a majority of participants. This can be seen as the natural follow up to Milestone 2.

Milestone 7 – Hand over of the model: Insights gained during the workshop(s), especially those of dynamic nature, should be captured and shared with the group if they are to endure. Preparing a brief or a short report after the workshop(s), a workbook (Vennix, 1996), or having a 'wrap-up' session could be good ways to increase the chance that long-lasting impact will be realised. Handing over a simulation model might be more difficult than handing over a diagram, and the facilitation team needs to spend enough time making sure the model remains understandable and accessible for the organisation to keep using and adapting it.

Milestone 8 – Develop an implementation and follow-up plan: Regardless the purpose of the intervention, follow-up activities should be included as part of the modelling programme (see Größler, 2007; Videira *et al.*, 2017). These activities might include, for example, helping the group to draw concrete plans or protocols for the solutions proposed, using the simulation model, and/or interviewing participants.

In Table 4 we complement these milestones with some suggestions for practitioners to consider as part of good practice.

While further research and reflection will test whether any of these milestones could substantially improve long-lasting organisational effects of GMB interventions, in this note and insights essay we provide food for thought to both researchers and practitioners who are aiming to advance our field. We see

our work as a contribution to an ongoing debate aiming to inspire our community to plan and review their projects with a different lens.

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Conflict of interest

The authors declare that they have no conflict of interest.

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