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Insights gained from a systematic reanalysis of a successful model-facilitated change process in health care

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Abstract

Health care is a complex system with multiprofessional staff and multiple patient care pathways. Time pressure and minimal margins for error make it challenging to implement new policies or procedures, no matter how desirable. Changes in health care also requires the participation of the staff. System dynamics (SD) simulations can lead to shared systems understanding and allows for the development and testing of new scenarios in silico before implementing solutions. However, research shows that the actual implementation rate of simulations is low. This paper presents a reanalysis of a successful change project in health care combining SD principles with basic action research (AR) premises. The analysis was done by a multidisciplinary research group using qualitative methodology and identifies that a fruitful combination of AR inquiry and SD modelling potentially can improve implementation rates.

KEYWORDS

action research, health care, implementation, simulation, system dynamics

1 | INTRODUCTION

Health care is a complex system with multiprofessional staff and patients which pass through a network of

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different specialties and domains of work (Glouberman & Mintzberg, 2001). Resources are limited, demands are high and continuous complex adaptations of systems (Plsek & Greenhalgh, 2001) to new contexts are required, presently the on-going shift to patient-centred care. Time pressure and minimal margins for error make it challenging to introduce new strategies when necessary, because there are no guarantees that a proposed change will produce the desired effect. Health systems include highly skilled health care professionals, from different subspecialities, who continuously use their judgement as few of their decisions are based on simple cause-effect. This means that they act in ways that are neither fully predictable nor controllable, actions are interconnected and thus create patterns and effects that cannot be foreseen from individual actions or small parts of the system. There may be desirable change which is not carried out as the professionals find it difficult to coordinate their activities to abandon established practices; Davidoff (2015) describes this as 'undiffusion,' and Brownson et al. (2015) as 'misimplementation.'

The process of implementing innovation developed in one place somewhere else is not a case of identifying the innovation and trying to get others to do the same thing by describing a simple 'recipe.' Even well-thought-out elaborate and complicated implementation plans will tend to fail (Chew, Leonard-Burton, & Bohn, 1991). Øvretveit et al. (2012) compare 12 cases of policy implementation in health care and does not find any simple method leading to success. Rather, each new place—department, practice, hospital, region or system—has to be approached as a new challenge. Learning from innovation elsewhere can still be achieved but has to be adapted and rethought in each situation, taking account of its specific context. Those involved need to understand the policy (know-why), after which they can, more easily, work out the operational details (know-how) based on their judgement, knowledge and experience of their profession and organizational setting (Chew et al., 1991).

System dynamics (SD) modelling, simulation and analysis along with other such methods allows for strategies, policies (principles) and operational details to be effectively and safely tested in silico, prior to their implementation, without disrupting work or putting patients at risk. These methods depend on how well the mutual communication skills among participants work (clients and modellers). This is key to allow participants to converge on a shared mental model of the problem at hand and thereby arrive at constructive solutions. However, even if identified solutions are successful in theory, the rate of implementation of solutions identified by way of modelling, simulation and analysis, irrespective of method, are in the single-digit percentages (Brailsford, Harper, Patel, & Pitt, 2009), somewhat higher for SD. Reasons for nonimplementation are not fully understood, but one may speculate that the resulting model did not fulfil the actual needs of the organization. A model is never implemented per se, it should help to develop solutions, which in turn are implemented. There are well-established processes for building SD simulation models (Sterman, 2000). Particular strengths with SD are that the methodology can give a systems overview of interactions, dependencies, feedback loops, queues and inherent delays, making variation explicit and requires strong rigour as to causality. SD can also bring together different perspectives of stakeholders in what can be perceived as an objective representation of reality. There is also a considerable body of knowledge on participatory modelling, also called group model building, which is frequently used in SD, most recently summarized by Scott (2018). Rouwette (2003) demonstrates that working with groups leads to participants' mental models converging over time. However, from the perspective of SD group modelling, the role of the clients is often seen as 'knowledge elicitation' (Vennix & Gubbels, 1990), that is, how they contribute to the building of a model. Scriptapedia, a shared manual for group model building in SD (Hovmand et al., 2012) and Scriptsmap (Ackermann, Andersen, Eden, & Richardson, 2011) basically follow Sterman's process and explicitly involve the participants in the model building process, requiring them to understand and use SD methodology. There is a risk that a group model building exercise might focus more on involving the participants in building and understanding a model than owning, exploring and solving their problem, supported by SD.

To potentially improve the implementation rate of identified model solutions, introducing elements from the field of action research (AR) has been suggested. One of the few described cases of combining AR and SD concerns improvement of aged care (Walker & Haslett, 2001). AR is a field of research that is concerned with pragmatic change and can be said to have been arisen as people try to work together to address key problems in their communities or organizations (Reason & Bradbury, 2008). AR often involves cycles of reflection and action. Participants meet in order to address a problem or suggested improvement; they reflect on their current practices and identify possible actions. They might work in an iterative fashion using so called Plan-Do-Study-Act methodology (Deming, 1994). The cycle means suggesting a potential solution, testing it in action, reflecting on the results of the test, adjusting the action (if necessary) and testing that action in turn to experience a new result. This is repeated in a continuous cycle until satisfactory results have been reached. This cycle is repeated until a solution has been reached that addresses the problem well enough. Insights from this process can be illustrated using iterative perspectives such as experiential learning cycles (Kolb, 2015). AR is not seen as having any implementation problems as a group explores an issue that is theirs, tests suggestions, and a solution eventually evolves that solves the original problem for the participants. Taken together, if the strengths of the AR methodology are added to the SD modelling context, it can potentially improve the implementation rate of identified solutions. And if SD is added to an AR process in health care, it can contribute by combining quantitative and qualitative data, providing a systems overview, depict patient flows and demanding causal rigour. A sufficiently knowledgeable system dynamist is, however, required for the modelling. Rowbottom's (1977) description of the AR facilitator's role captures the potential combined role of an AR facilitator and a SD modeller 'The social analyst's role is not a prescriptive one, but one which may more aptly be described as "elucidatory." It is within the role of the analyst to stimulate exploratory activity, to collect impressions and views, to analyse existing situations and problems and even to proffer alternative reconstructions.' As a model only can capture part of reality, its role is more elucidatory than prescriptive. The facilitator can use the model to stimulate active participation, experimentation and exploration. Based on model behaviours, the modeller can explore the boundaries of the group's knowledge by asking 'what-if' questions.

The purpose of this paper is to deepen the understanding about the interplay between SD and AR by doing a retrospective analysis of a project in health care that was implemented successfully using an approach where SD principles were combined with basic AR premises. It was not conducted in a traditional group model building setting, where the group participates in the actual building of a model. The modelling work was done between meetings. We studied the iterative processes which drove the work forward to identify and quantify critical insights and their interrelationships as the mutual understanding of the model contribution and the problem grew over time for the involved clients and the modellers.

2 | MATERIALS AND METHODS

2.1 | Materials: The studied project

The project under review concerned an obstetrics and maternity care department at a midsized/larger Swedish hospital. The hospital encountered problems characterized by long waiting times and staff dissatisfaction at their facility for screening new-borns 3–5 days after birth. A policy decision to change follow-up procedures had been taken. However, there was significant uncertainty on how to operationalize the policy decision. SD was used to understand departmental effects caused by the changes to the workflow. The department's overall goal was to increase visitors' and staff satisfaction. The part of the case relevant for the reanalysis below was carried out between April and June 2010, with the manager of the obstetrics unit providing all data needed.

2.1.1 | Organization of department, problem statement and baseline data

The obstetrics and maternity care department had 90 employees, of which 80 were midwives and 10 were assistant or children's nurses. The department was part of the larger gynaecological clinic, which provided physicians to obstetrics when needed. The task of the studied service was to conduct a first after birth visit once mother and child had left the maternity ward, and screen for five diseases in the child as well as to follow-up on the breastfeeding status (about 3,350 family visits/year). One of the tests, that for phenylketonuria (PKU), is time critical and should, according to guidelines since 1965, be conducted as soon as possible after 48 h after birth. At the time of the project, the aim of obstetrics department was to carry out the PKU-test within 3–5 days after birth.

Of the planned visits, 28% were scheduled later than 5 days, not conforming to the target set for the test. There were several reasons for this: an increase in the number of births per year, significant daily variation and a $\pm$15% seasonal variation. Another problem was that 19% of visitors arrived later than the appointed time, causing delays during the day so that mothers that arrived on time were annoyed. An unknown number of visitors were also double-booked, due to clerical errors. Staff was also dissatisfied, stressed by complaints and by what they perceived as overcrowded waiting rooms. To be posted to the new-born screening was considered undesirable and deliberately avoided by some.

Members of the staff had suggested abandoning scheduling of visits and instead allow patients to drop-in. The department had surveyed when visitors wanted to come during the day. The results showed a mismatch between appointment times desired, peaking during the middle of the day and the actual staffing levels that were evenly spread out across the day. It was clear that, although desirable, drop-in might lead to more dissatisfaction. Management decided to seek help in how to operationalize a drop-in system and contacted the quality improvement unit of the hospital. The quality director had experienced SD previously and had recently received a research grant to test methods for improvement. The manager of obstetrics was therefore presented with the possibility to use SD as an aid to address their question.

2.1.2 | Project group, meetings and evaluation of results

A working group was formed that included a project leader from the Operational Development (OD) department of the hospital, six representatives from the department in question (two managers, three midwives and one assistant nurse) and two modellers with substantial experience of health care projects (including obstetrics and maternity care) of which one facilitated the meetings while the other took part in discussions, observed, reflected and provided feedback on the process.

Altogether, 10 meetings were organized throughout the project. At those meetings, problems as well as potential solutions were discussed, in part based on an interpretation and analysis of simulation results originating from the models developed and presented in the course of the project. Four 3-h meetings encompassed the entire working group, and five shorter meetings included only the two modellers. The larger meetings were typically held in conference rooms adjacent to the ward. The lead modeller spent about 23 h, between meetings, building and testing models. The model structure was shown and explained to the participants. They engaged in the design of the user interface that was adapted to their issues. After the modelling process, a general meeting was held in August 2010, where all staff were invited to participate. The meeting was led by the managers and the OD project leader. Effectively, the meeting became the link between the SD/AR process and the implementation. In this meeting, the modellers used the model to demonstrate how the solutions proposed by the working group would perform in a variety of scenarios. This resulted in a pilot project that was based on the recommendations by the group and which was carried out in September 2010. Based on this pilot, the solution was adjusted during the months that followed. The final solution was evaluated during 2 weeks in February 2011.

It was decided that visitors who did not need follow-up of breastfeeding or counselling could drop in any time, within 3–5 days, to the obstetrics ward for the screening tests. This would significantly reduce the numbers needing check-up and counselling. For those, a new workflow was implemented, where visitors were allowed to drop-in to the screening facility for new-borns during a specified half-day and nudged to come at times when few arrivals were expected. A Kanban–'visual label system' of allocating times allowed for quickly adjusting capacity without any advanced planning system. Waiting rooms were to be adapted to alleviate any waiting time.

The evaluation showed that 58%/85% of the visitors waited less than 15/30 min and 72% of the visitors were satisfied or highly satisfied with their experience. In the written evaluation, the managers stated 'The result of the project was better than expected. The survey showed even more satisfied patients and shorter waiting times than what we had hoped for. Systems modelling was helpful. We could see where the risks were and take the necessary actions to avoid long waiting times. We achieved better results than we dared to believe at the beginning.'

2.2 | Method: Case reanalysis

The reanalysis of the case presented above was made by researchers from several disciplines, all providing different and complementing perspectives in the final presented results. The first author, an SD modeller with 30 years of experience as a process consultation facilitator for projects in health care, was accompanied by two professors (SD and clinical sciences, respectively), one associate professor (experienced in information sciences in health care) and one Ph.D. (experienced in AR in health care), the second SD modeller involved in the original project as well as a Ph.D. student with a project involving SD applied to health care.

All field notes, emails and model iterations were revisited and compiled into a 45-page document in order to reanalyse the contribution of the client participants and modellers to project progress. Critical insights gained by participant subgroups and modellers, which lead to a successful project outcome, were identified by how levels of understanding progressed during the process as well as how the simulation model evolved. A summary showing the progress from the lead modeller's perspective was created, which captured the voices of the participants in the original work group. This was finally condensed into the enclosed Meeting Analytics Summary (Data S1).

Rowbottom (1977) suggests four questions/stages in an AR process, which can be highly relevant in a, SD context and which we used to further understand how the project moved forward: (1) What is manifest? How is it supposed to work? (2) What is assumed? How do the participants believe it works? (3) What is extant? How does it actually work? (4) What is requisite? How could it work?

The analysis was carried out by four of the researchers (PH, CO, PD and FB). First individually, then in discussions, comparing and contrasting individual

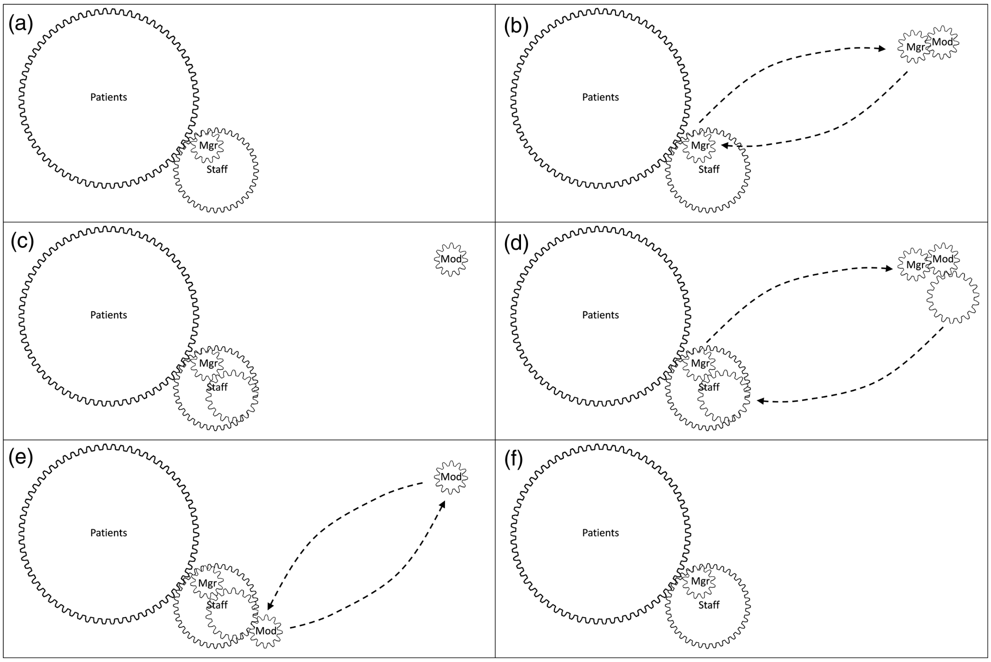

FIGURE 1 The dynamics between the project group and the patients and staff at the obstetrics and maternity department throughout the project. The size of the cogwheels gives a relative approximation of the number of individuals in each unit. Initially, the managers break out and meet the modellers. (a and b) During meetings, managers and staff break out and engage with modellers and then return and take their learnings with them; meanwhile, the modelling work continues, and participants are reflecting about the modelling process as they work. (c and d) At the end of the project managers, the work group and the modellers engage with all staff after which the organization adapts and implements the solutions (e and f). An animation of the interactions is presented in Data S2

observations and thoughts with each other over three full-day meetings and four web-based meetings. Agreement was reached following fruitful conversations enriching the nuances in the results.

2.2.1 | Macro perspective

For the reanalysis, the research group used a study-specific cogwheel analogy as an analytical framework to visualize the dynamics and effects of interactions between the different groups participating in or being affected by the project outcomes. Altogether, this analysis involved interactions from three perspectives over 10 meetings: between the work group and the entire staff/the modellers, between the management and the work group/the modellers. In addition, a causal loop diagram was developed to further understand the overall iterative process of interactions and model development throughout the project.

2.2.2 | Micro perspective

Information about the interactions between participants in the working group, that is, representatives from the hospital side and the modellers, were extracted from the complete document and condensed into a structured matrix for the reader to draw their own conclusions from (Miles & Huberman, 1994; Miles, Huberman, & Saldaña, 2014), showing the participants, objectives, meeting themes for project stages, outcomes of the meeting, tested suggestions, decisions taken and key voices/statements. Levels of understanding of problems, model contribution and solutions were assessed after each meeting (Data S1).

3 | RESULTS

The interactions between patients, staff, managers and modellers throughout the project are illustrated in Figure 1 and are animated in Data S2. The overall project process is summarized in a causal loop diagram in Figure 2, with details enclosed in Data S3.

We found that the project moved through five stages with the following meeting themes: (1) Exhaustive inventory of problems and objectives, (2) Factfinding, (3) Problem visualization, putting the problems in a systemic context, (4) Experimentation, testing numerous suggested solutions in silico and (5) Verification, finalizing the

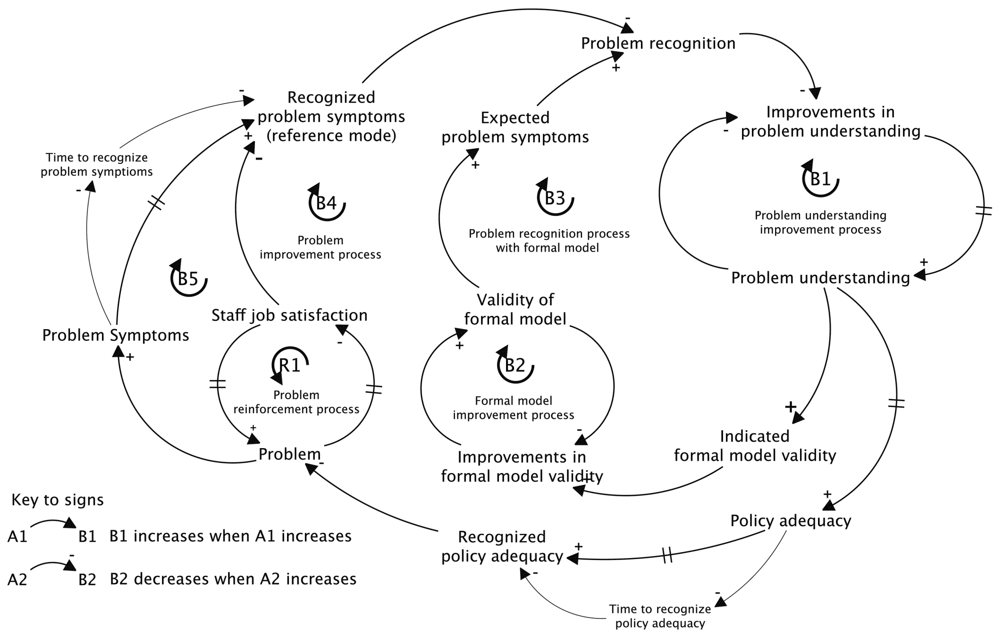

FIGURE 2 Prior to the project, there had been reduced job satisfaction among staff, fuelled by stress and patient complaints about waiting times adding to a list of problems (R1 problem reinforcement process). The actual problems led to problem symptoms, which, over time, became recognized problem symptoms that formed the problem base for the modelling process. Initially, the project strives to improve problem understanding until it can form the base for model development. The model goes through several iterations until it has sufficient validity to replicate the expected problem symptoms. At this stage, it can form the base for testing and discarding solutions, and, over time, leads to adequate policies and as such may following implementation have an actual effect on the problem and dissolve staff dissatisfaction (B4 problem improvement process). A detailed description of the whole process is presented in Data S3

scenarios and deciding on solutions. There was engagement, interaction and exploratory mutual learning activities between participants throughout the project. Meetings began by the facilitator asking for reflections since the last meeting and ended with shared reflections. The facilitator ensured that the voice of each participant, and profession, was heard at all meetings by repeatedly talking in turn around the table.

At the outset of the process, the participants were highly aware of their list of problems. The work in the group and the use of systemic models quickly led to them seeing how the problems were interconnected. As the participants began to understand how the model and simulation could contribute to their thinking and the development of solutions, they actively contributed to conceptualizing next steps of the model. They enthusiastically built on each other's insights and actively contributed to the construction of a shared knowledge base. They were introduced to the symbolic language of SD, to understand the underlying notations, but were at no point required to use such knowledge or take part in the actual building of the model. A user interface was designed, using terms that were relevant to the participants and that they actively could work with when experimenting with the model.

3.1 | Model development

The first model was built with the intention of giving a basic understanding of how SD simulations could contribute to the issues at hand. (Table 1). No user interface was included, the model was 'owned' by the modellers. When the second iteration was developed, basic information about actual births and staff scheduling was not yet available, so the model focused on highlighting the consequences of births 7 days a week and screening 5 days a week, creating a mismatch between needed staff and actually scheduled staff during the week. A basic user interface was introduced but did not allow for scenarios to be tested. The third iteration was informed both by the overall problem descriptions and complete data. The user interface was completed and allowed for multiple scenarios to be tested. The fourth iteration contained minor visual adjustments.

TABLE 1 Model iterations with associated changes in building blocks, user interface and tested scenarios

Model iteration number	1	2	3	4
Stocks	2	2	3	3
Flows	3	3	4	4
Variables	5	14	97	97
Nonlinear relationships	1	0	1	1
Equations	8	16	95	95
User interface variables		7	75	75
User interface graphs		2	2	2
User interface graph variables		5	6	6
Scenarios		0	Multiple[a]	3

[a]Examples of scenarios tested: Drop-in according to patient wishes; Shorter consultations; Flat staffing every day; Increased staffing Mondays and Fridays; With and without randomized arrivals; Staff scheduled according to patient arrival wishes; Nudging patients to arrive evenly over day; Early morning staffing; Additional staff before lunch break and at end of day; Seasonal variation ±15%.

3.2 | Awareness and understanding of problem and model contributions

The estimation of problem awareness and understanding with respect to model development and contributions in the project group over the course of the identified project stages is summarized in Table 2.

In the first project stage, the modellers had only a moderate understanding of the problems as they perceived them as an unconnected list. As facts came in

TABLE 2 Problem awareness and understanding with respect to model development and contributions over the course of the identified project stages

Project stage	Participants	Modellers
1. Problem and objectives inventory	High problem awareness, but no systemic understanding. Optimistic that SD can contribute, but no sense of potential model contribution.	Moderate problem understanding. Realizing that a substantial fact base is required to understand and model a basic patient flow.
2. Factfinding	No change from previous stage with respect to problem awareness or understanding of model contribution.	Understanding that only assistant nurses see the actual patient flow. Clear that one significant obstacle to a solution is not understood.
3. Problem visualization	High problem awareness and deepened systemic understanding. Low, but emerging, understanding of how a SD simulation model can contribute, but no real understanding of SD as such.	High problem understanding and clear conceptualization of what is required for the next iteration of the model.
4. Experimentation	Very high problem awareness and systemic understanding. High understanding of how the simulation model can contribute. Asking relevant questions of the model and requesting additional details. Able to understand the workings of the model without knowledge of SD methodology.	High understanding of problems and potential solutions in order to fine-tune the next iteration of the model.
5. Verification	Very high understanding of problems and solutions, high understanding of simulation model contribution.	Very high sense of model contribution to the problem solving of the group.

Abbreviation: SD, system dynamics.

during the second project stage, they were able to model patient flows and their understanding of the actual problems and the system grew. By the third stage, they could build an appropriate model for the participants. In contrast, at the beginning of the project, the participants had a high problem awareness but limited understanding of potential systemic effects. Also, they were unaware of a critical issue, the mismatch caused by births every day of the week and follow-ups 5 days a week. This would necessitate higher capacity on Mondays and Fridays, whereas it was lower in the existing clinical scheduling. When all the problems were visualized in the model at the third project stage, it all came together for them and the suggestions proposed by the participants allowed for an extensive model presented at the fourth stage. They could experiment in the computer with this model, develop it and suggest solutions, which were finalized in the last stage.

3.3 | Understanding the empirical material by use of Rowbottom's four questions

Rowbottom's AR questions, their general meaning in an SD setting and their meaning in the current project are shown in Table 3. Over time, the contribution of the SD model changed from primarily highlighting the gaps in understanding of the problem to assisting the participants in identifying the solution they implemented in reality.

TABLE 3 Rowbottom's questions

Theory—Rowbottom's AR questions	What does it mean in a general SD perspective?	What did it mean for the current project?
What is manifest? How is it supposed to work?	The initial SD model will often fail, showing that it will not work as intended or that there are gaps in the knowledge underpinning the model.	The initial model showed that introducing unmitigated drop-in would most probably worsen the problems and increase dissatisfaction, basically due to the mismatch between visitor arrival preferences and staff scheduling on a daily basis. It also made explicit the consequences of births 7 days a week but receiving patients 5 days a week.
What is assumed? How do the participants believe it works?	Bringing in the knowledge and the perspectives of the participants is a shared process in building the model, where weaknesses in the model will trigger participants to see the gaps in the model. When all perspectives have been included, the model is most probably extant.	During this phase, the participants contributed their experiences into what made the model a 'multiprofessional knowledge repository.' Perspectives differed both between and within professions. The modellers asked questions to address their own knowledge gaps.
What is extant? How does it actually work?	Here, all perspectives come together in a model that works in the sense that it shows a working system and behaves in ways that all participants see as correct and relevant based on their knowledge, experiences and historical data. This can be a breakthrough point.	The model at the experimentation stage was built with the ability to manipulate variables at a granular level, effectively anticipating most questions that the participants would ask. The model coped with the random variations in birthing, which gave it credibility.
What is requisite? How could it work?	Using a validated model, it is possible to test suggested changes and test their effectiveness.	By the final stage, a probable solution had been identified and the model was used to test a large number of scenarios in the pursuit of a requisite solution and to test the limits of the solution based on varying variable settings (higher birthing rates, seasonal variation and iteration of randomized arrivals).

Abbreviations: AD, action research; SD, system dynamics.

When the model behaved unexpectedly, the participants had to describe their problem from new angles to move the process forward. Only when the model outputs matched the participants' knowledge, experiences and historical data, the group was ready to turn questions into answers.

4 | DISCUSSION

The purpose of this paper was to deepen the understanding of the interplay between SD and AR by doing a retrospective analysis of a project in health care that was implemented successfully using a combined SD/AR approach. The project used SD simulations in an AR context to gain insights about potential solutions to a problem in obstetrics concerning how to alter working methods to match patients need with external regulations and available staffing. Contrasting individual learning against organizational learning, separate and mutual insights among project participants were collected into, what we refer to as a 'multiprofessional knowledge repository,' whose contents was analysed from the perspectives of the alternating contributions from the clients and the modellers, respectively. We found that the identification of potential solutions followed the understanding of model contribution by the clients. In turn, the understanding about the problem among modellers was followed by an increasingly more useful model for the client side. In addition, the problem shifted from a listing of isolated items into a systemic context for both clients and modellers.

4.1 | Starting with a minimum viable and partially useful model

A key issue in model building is delimiting the model—what should be included or not—and remembering that all models are incomplete to some extent (Sterman (2002), Korzybski (1958), Beer (1981). Health care has specific challenges. On the one hand, the difficulty of obtaining data has been described (Brailsford, 2005); on the other hand, in some areas, there can be an abundance of data. There is a risk in attempting to build an ultimate model which will be almost impossible to populate with data and either fail or take longer time in the model building process than necessary. In the presented case, patient and staff dissatisfaction were key issues, so it was considered to model those factors and run other parts of the model until positive effects were achieved. The modellers focused on the root cause, which was waiting times, ultimately expressed in the model by patients appearing to stay overnight in the waiting room. The challenge was to create a system where nobody was turned away or left by themselves. The model was built iteratively where the first version was a minimum viable model to illustrate part of the issues. This allowed the participants to have hands-on experience of the utility of SD simulations and express the questions about what they wanted an expanded model to illustrate. This interaction created reflection and learning between the participants themselves, between the participants and the modellers and between the modellers themselves. During the development of the model, many suggestions were tested, those that had no effect were discarded, and the final version was small enough to be understandable for the participants and large enough to be useful for the problem at hand.

4.2 | Dovetailing AR and SD

Rowbottom (1977) describes the role of an AR facilitator and a set of questions in an AR process, which can be seen as dovetailing (Table 3) with the role of an SD modeller and an SD process and thus can be used to bridge the two fields as briefly described in the introduction. A facilitator/modeller needs to acknowledge their naivety (Schein, 1999), strive to be truly helpful (Schein, 2009), proffer alternative reconstructions (Rowbottom, 1977) and in a sense stand naked in front of the group (Lencioni, 2010), completely shed of any preconceptions of what a useful model is. In this case, one of the modellers had previously worked with obstetrics and gynaecology, which allowed him to ask relevant questions to the group. However, his challenge was to defer his previous knowledge and be completely open to the issues of this group and have a designer mindset as to how to shape the facilitation and modelling.

4.3 | Creating a 'multiprofessional knowledge repository'

The work group consisted of midwives, one assistant nurse, managers and modellers, each with their own set of knowledge, experience and perspectives. By the nature of the integrated AR/SD process, the participants were not stakeholders in the sense that they held firmly competing opinions and had to persuade each other. Instead, it was as if they laid out a jigsaw puzzle, exploring how one person's set of knowledge fitted in that of the others in a reciprocal learning process. They became, what has been described by Kennedy, as shapeholders (Kennedy, 2017). The process and the model were used to uncover aspects of the problem that they were not aware of, and aspects of the problem that they were not even aware that they were not aware of, thus creating a deeper individual understanding about what goes on in the workplace, as well as an overall understanding of the evolving system. This all came together in the multiprofessional knowledge repository. That the role of the managers is important for organizational improvement work in health care systems have been described previously (Baathe & Norback, 2013). Here, the managers participated actively, very much by listening, and by being reflective and supportive, which led to participants sensing that they were being heard and that their investment in terms of time and engagement would be worthwhile.

4.4 | Strengths and weaknesses

The case was reconstructed from extensive contemporaneous notes from meetings, subsequent slide presentations and memories of interactions, conversations and voices. The fact that it was done retrospectively, and primarily based on the perspectives of the modellers side, can be considered a limitation of this study. Ideally, interviews and measurements would have been carried out for both clients and modellers in parallel with the main project and summarized in an evolving and complete document. However, the act of recording, observing, transcribing and measuring a process may cause an observer effect and would in itself influence the process (Von Foerster, 1995). Such a project would require an observer to observe the effect of the observer, ad infinitum. We believe that the fact that AR methodology was used from the outset of the project without the overall process being under review at the time is a strength of this work.

In conclusion, in this study, we found that acknowledging an iterative reciprocal learning process among participants by use of an AR-inspired approach, combined with SD modelling, where the understanding of the problem grew interactively over the course of the project, was a major reason for the successful implementation of a change process in health care. We believe that additional key factors for success were the active involvement by participating clients, by using AR as the basis for discussion and reflection, in creating the final solution in combination with the passive but reassuring presence from managers at meetings positively influenced the engagement from the client side. Given that organizational improvement work in health care can be difficult to realize, applying these findings to current implementation strategies may increase chances of success.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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