Annoying dynamics of adapting canonical models for specific client questions in organisational consulting

Lessons learned from unsuccessful modelling interventions

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Abstract

This paper reports several related failures of modelling interventions. Atrivé, an organisational consulting company, set out to adapt a canonical housing association model named ITS to the specific circumstances of its clients. The ITS adaptation process, however, demonstrated rather annoying dynamics and finally had to be terminated due to negative business results. This paper provides a background on the relevance of failure case studies and ventures into the symptoms and warning signs. We reflect on a systems thinking intervention within Atrivé to learn from these experiences and improve business strategy. The problems encountered correspond to several archetypes. We end this paper by summarising several known and one possibly new

factor in explaining failure of modelling projects and pose several questions for further research.

Keywords: system dynamics modelling, organisational consulting, failure case studies, business strategy, archetypes.

Background and relevance

Interventions in real world policy problems are at the core of system dynamics since its inception. Client participation in group model building has been found helpful in creating commitment to implementation of results. More and more practitioners and consultants use group model building techniques and an increasing number of case study reports is being published each year. It is assumable, however, that this concerns mostly successful cases.

Systematic research into client involvement in system dynamics modelling is on the rise as well, but still in an early stage (Lane et al, 2003). Andersen, Richardson and Vennix (1997) assert that the current state of affairs is more craft than science. Rouwette, Vennix and van Mullekom (2002) signal the need for drawing more general conclusions on the effectiveness of system dynamics interventions, in order to strengthen the learning process of the system dynamics community. Their review of 107 cases points out an overall positive outcome of system dynamics interventions. One possible bias in their data collection method, exclusion of profit setting cases, is not supported by empirical data. The seriousness of a possible second bias, exclusion of unsuccessful cases, is however more difficult to estimate.

The purpose of this paper is to provide a report on the annoying dynamics of tailoring canonical models to the situation of specific client companies. Our arguments are based on an analysis of six modelling interventions, four of which were largely unsuccessful. This paper is of interest to the system dynamics community for three reasons:

- it contributes cases to the scientific knowledge base in an underrepresented category of modelling projects, i.e. unsuccessful interventions;
- the paper identifies three specific warning signs on the route to failure;
- it substantiates learning effects by reporting on a small system thinking intervention within a consulting company on ways to boost business learning from the unsuccessful interventions.

The initial canonical model that is the subject of this paper was constructed with Atrivé (Vennix, 1996). Atrivé is a medium sized consulting firm in the housing sector and a 'general consultant', i.e. it does not have system dynamics modelling as its core business. The background for the initial modelling intervention was the transformation of the state housing policy in the Netherlands in the 1990s. Before 1990, housing associations were highly dependent on government subsidies and had no factual financial responsibility. The reforms in housing policy were aimed at cutting the financial ties between the state and the housing associations. This new situation presented housing associations with a completely new set of strategic questions. The main question was how to accomplish a viable balance between financial continuity and the social objective of providing housing for lower income groups.

Radboud University Nijmegen and Atrivé initiated the construction of a system dynamics simulation model for supporting managers of housing associations in strategic decision making. The idea of using simulation models met with positive reactions from housing association managers, so it was decided to build a canonical model which could be adapted to the specific situation of clients. The canonical model came to be known as ITS (Interactieve Toekomst Simulatie or Interactive Future Simulation). The model allowed testing strategies for achieving both the financial and the social goal, under a range of different scenarios. The scenarios included e.g. different programmes for new housing construction, renovation and demolition, different parameters for rent increases etc. The development of the canonical model on basis of the mental maps of Atrivé consultants is well documented (Vennix, 1996). The same applies to the first two experiences with tailoring the model to specific client housing associations (Rouwette, 2003). Notwithstanding initial enthusiasm, ITS failed to perform well in a business setting. After six mostly unsuccessful attempts, Atrivé decided to terminate support of the model, due to negative business results, including several unpaid bills and disappointed clients.

The criticisms of large scale modelling (Lee, 1973) bear a very strong resemblance to the pitfalls encountered with ITS: additional variables and relationships make the model more and more difficult to comprehend. More and more precise values of (exogenous) parameters are needed to increase 'realism' of model behaviour. The model adaptation process explodes into a reinforcing loop of ever more detail, burning out the modeller and ruining client satisfaction and retention, two critical success factors for organisational consulting.

Our analysis will focus on identifying the dynamics of failure in the ITS adaptation process. First, we provide a narrative account of the problems encountered in managing ITS and of the short system thinking session conducted at Atrivé in order to learn from these experiences. Secondly, we present our final dynamic analysis on basis of the core set of archetypes (Wolstenholme, 2003) including the concepts of intended and unintended loops, problem and solution links and the boundary issue.

Rouwette (2003) assumes that reports of unsuccessful group model building may be the ones that the system dynamics community can learn most from, especially when bundled together in a meta analysis. It is evident that this paper cannot draw general conclusions on success and fail factors of group model building, because it is based on one specific intervention type in a specific company setting. It does however contribute to the knowledge base and identifies ideas for further research.

Annoying dynamics of implementing ITS

The purpose of building the canonical model was to connect the mental maps of senior consultants from several departments: market, finance, organisation, and strategy. The new situation for housing associations required an innovative approach and no historic reference was available. The initial group model building project was successful. In several steps, the team constructed a working simulation model producing plausible results, which were checked by several experts. The project yielded an important counterintuitive insight: and initial drop followed by near-exponential growth of housing associations' capital, even in periods of high investments and low rent increases. This opposed popular pessimism on the long term financial viability of social housing. The effect was however recognised from financial simulations by other experts. Moreover, in 2006, it is reality. The total equity of all housing associations generously exceeds the required long term investments (Centraal Fonds voor de Volkshuisvesting, 2002; 2004; 2005; Conijn, 2005) , which spurred a political debate on measures to force housing associations to invest and on rearranging the relationship between the state, local government and housing associations (Fokkema et al., 2005).

After the first stage in which Atrivé managers were involved in group model building, the canonical model was transferred to Atrivé for further use and dissemination of the insight gained. Atrivé moved from the position of a client with a strong feeling of model ownership to the role of a modelling facilitator vis-à-vis its own clients. The purpose was to adapt the general model to the specific situation of a client and simulate different strategies. This is not typical of a group model building project and may constitute an important feature.

In the next stage, we carried out two pilot strategy-consulting projects with the ITS model. In both projects simulations on a highly aggregate level resulted in behaviour readily understandable by clients.. The clients recognised the initial drop in equity, caused by the age structure of the housing stock. They also recognised the particular feedback loop between equity level and rent increase. A rich housing association would not need high rent increases to ensure continuity and moreover, the government might intervene and limit the maximal annual rent increase when housing associations have abundant funds. It would be wise to take advantage, raise the rent and collect resources for investment before the government would intervene. One project stopped in this stage (ITS-2). The strategic simulations were successful, because they generated important insights for the housing association managers in return for a very acceptable fee. The high quality to price ratio boosted client satisfaction and before long, they would come back to us for more. In project ITS-1, the director wanted to have his strategy simulated on a more detailed level of housing blocks. This took far more work than the aggregated simulation, due to the time required for collecting the lower level data, inputting them in the model and analysing model output. This yielded far more model output to be verified, higher bills, but not an equivalent increase in strategic insights. The client was disappointed with the low quality to price ratio in respect to the first strategy project.

In the next stage, Atrivé hired an experienced modeller and acquired four more ITS adaptation projects in about two years. During this period, housing associations were rapidly improving financial management and were in need of supportive tools for accounting and bookkeeping. Competitors entered the market offering several financial prognosis software packages. These would come in deterministic or probabilistic versions, but had one characteristic in common. They were based on linear calculations adhering to accounting standards and did not portray any systemic effects at all. None of these models had a market sector that included the waiting list, demand for and construction of new houses, absorption of available land and an increasing pressure to renovate houses. Feedback loops linking for instance growth of equity to a lower rent increase did not exist in these models. The models required the user to input all data on the strategy, on the basis of which the software makes accountant proof financial calculations. The financial models have a very different role to fulfil in decision support than the system dynamics model. The latter generates dynamics and helps to find robust strategies while the former translates approved strategies into bookkeeping. Superficially speaking however, both models do the same: simulate the financial position of a housing association.

During this stage, three more projects (ITS-3 to 5) got locked up into a comparable situation as ITS-1. The client wanted more detailed calculations, hoping for more new insights, but was confronted with lots of work to get all the detailed data in. Moreover, the systemic effects in the model produced different outcomes than the accounting approach. The financial managers compared the output to their own linear calculations and complained. The modeller, not being a financial expert, unable to persuade the financial managers to accept the system's stance, hastily started modifying the model to match accounting standards. The model adaptation project got out of control. More details lead to more discrepancies with accounting standards. The quality to price ratio plunged, the client was not satisfied with the results and wanted the model fixed, meaning that the outcomes would match the expectation of the financial manager. Only one project, ITS-6, had a good performance, probably due to the fact that the amount of detail complexity in this very small housing association was not as overwhelming as in other housing associations.

In the final stage, Atrivé suffered financial damage from accounts to be settled financially with disappointed clients. The modeller accepted another job, no one within the company was able to tame the complexity of the inherited model and the board of Atrivé had no other option than to discontinue the ITS model.

Table 1 presents a qualitative analysis of project ITS-1 through ITS-6. We found a striking pattern involving (a) a high level of detail in the model and (b) client disappointment, financial damage and project failure.

Table 1. Qualitative analysis of ITS projects.

Project	Strategy	Detail	Disappointment	Damage	Success
ITS-1	yes	yes	yes	no	no
ITS-2	yes	no	no	no	yes
ITS-3	yes	yes	yes	yes	no
ITS-4	yes	yes	yes	yes	no
ITS-5	yes	yes	yes	yes	no
ITS-6	yes	no	no	no	yes

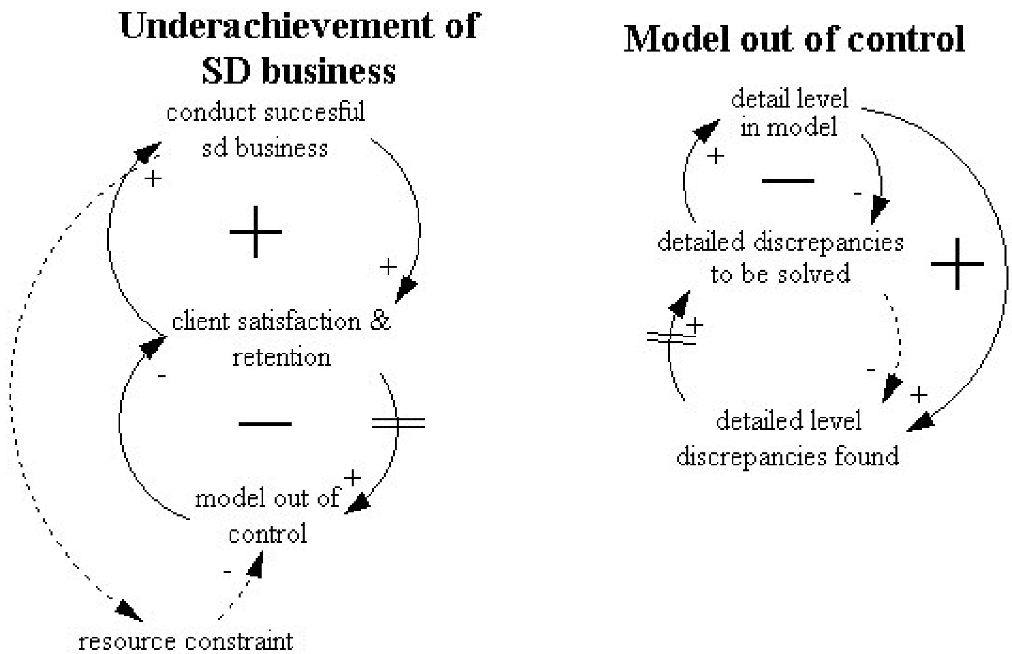
<u>The systems thinking intervention within the company</u>

This section reports on the system thinking intervention within Atrivé. Its initial purpose was to evaluate the ITS experiences, summarise them in a causal loop diagram and write down the findings in a paper for the 2005 European System Dynamics Workshop. Using system thinking as the main methodology is an obvious choice for building and improving a learning organisation (Senge et al 1994). We constructed a causal loop diagram during a three-hour session with board members and consultants involved in ITS. Regrettably, it was not possible to involve former clients or modellers in this post mortem analysis. The meeting started with discerning the different stages in ITS development, followed by causal loop diagram construction and finally a discussion on strategic management conclusions to be drawn. During the session, we found that we were not merely making a paper for a workshop, but that we were conducting a system thinking intervention into the way Atrivé handles product innovation, computer modelling and quality control in a more general sense. All participants found the meeting very insightful and the causal loop diagram will be presented to the entire board of Atrivé. The system thinking interventions changed our perspective on modelling, increased our insight into the benefits of strategy versus operationalisation and encouraged us to set realistic goals for using system dynamics modelling with our clients. We elaborate our change in perspective in the next section.

The causal loop diagram developed in the session was reworked on basis of the archetypes defined by Wolstenholme (2003), in order to single out the essential dynamics of the problem in terms of intended and unintended consequences. The core set contains both problem and solution structures and emphasises the role of organisational boundaries in perception of unintended consequences.

The ITS management problem is composed of two components, pictured in figure 1. In accordance to the core set of archetypes, the full lines indicate the problem links and the dashed lines represent the potential solution loops.

Figure 1. Archetype analysis of annoying dynamics



The left structure focuses on the underachievement of our system dynamics business. We strive to do successful system dynamics projects in order to have long-term relations with satisfied clients. The intended consequence loop is a business growth cycle of reinforcing nature. Well conducted system dynamics projects bring strategic insights to clients, thus increasing their desire to implement tactical and operational system changes. A very natural, almost inevitable reaction for clients is to increase the level of detail in existing simulation models in order to reproduce the initial new insights on a more detailed level. It is also very natural for organisational consultants to accept a follow-up assignment Moreover, the system dynamics literature claims that interventions should be focused on identifying robust solutions to real life policy problems and implementing system changes. Reality, however, did not give us time to celebrate the success of our business growth. The unintended consequences loop kicks in. Once we start adding details to the initial strategic model, both the workload for the modeller and the bills sent to the client start increasing. The model adaptation project gets out of hand. This irritates the client and stresses the modeller and thus erodes the intended outcome: client satisfaction and retention.

The second part of the problem is the model adaptation process getting out of control. In order to solve the discrepancies with accounting standards, we add detail to the model. This is the upper balancing loop of the archetype. . More detail, however, evokes even more detailed questions or issues to be resolved by even more detail. This is the unintended consequence loop. At one point, for instance, we had all 50 housing blocks of a particular housing association in the model instead of three main categories. This prompted the financial manager to say that he needed to specify different rent increases in the first five years of the simulation. In response we would cut the feedback loop and add a time series input device. The new model simulation would be very different from the initial simulation with a feedback loop. The client would feel uncertain about the huge differences and want to verify the outcome once more. He would then stumble over the fact that rent increases follow a step pattern rather than continuous growth. The already overworked modeller would fix the model to mimic this behaviour by setting dt in the model at one year and by introducing a time series input device for rent increases.. Once this finally worked, the financial manager would find out that the model does not yet reflect the effect of one-step rent increases of vacant flats (as opposed to the gradual increase in occupied flats). Etcetera We call this very annoying unintended consequence the “detail explosion loop”. It interacts with the underachievement archetype through the quality to price ratio. The workload on the modeller increases, high bills and disappointing results dissatisfy clients. All the hours worked on getting the details right will increase the price of the project. Most consultants work on a fee-per-hour basis. More hours worked mean a higher price. The model is becoming more and more detailed and expensive, but the initial new strategic insights do not reappear, and moreover, the additions bring to the fore even more questions. The perceived quality/price ratio rapidly decreases. In addition, the modeller is subject to an increasing workload and under pressure because of budgetary constraints of the project.

In hindsight, we found three important warning signs that indicated the model adaptation process was getting out of control. Two of them were already signalled by Rouwette (2003, p 182) and Lane et al. (2003). The first warning sign is the aggregation issue: a strong tendency to segment the main model variables into matrices. In the initial stage the housing stock was subdivided into only three price level categories. The next step was to introduce four different types of housing, then to combine them with the three price classes with results in twelve segments. Finally, one model (ITS-5) contained 81 segments in order to capture each specific housing block of the housing association involved. Lane et al. (2003) also indicate the problematic nature of aggregation and averages in building client confidence and model ownership.

The second important warning sign is the time series issue: when feedback loops in the initial strategic model are being cut and replaced with time series inputs. This concerns mainly policy response feedback loops. This is a strong tendency when a system dynamics model is transferred into a flight simulator- like application (Rouwette, 2003). This is also what happened with in ITS model. The combination of increasing the matrix dimension of stocks & flows plus the replacement of loops by time series for model parameters enormously increases the amount of data that need to be fed into the model. A total of 81 matrix segments with 10 time series parameters over a 50 years period means 40,500 more input data than a single stock model with a feedback loop of single inputs governing the main parameters. These structural changes (Rouwette, 2003, p 182) alter the overall behaviour of the model, and making too many changes to the model between simulation meetings with the client increases the risk of the modelling process getting out of hand (Richmond & Peterson, 1997).

Finally, we discern a third, possibly new, warning sign: the competing model issue. Competition with existing models on the “definition of reality” starts to interact with detail explosion and erodes confidence in the model. In the case of ITS, the competing models were existing financial prognosis models, built on the linear-mathematical paradigm of accounting principles. They did not portray any of the systemic effects responsible for the strategic insights in the early stages of the projects. Both models work from different paradigms, but for most clients these subtleties were hardly perceptible and it is questionable whether in all cases we have been able to explain the differences sufficiently.

In a consultancy setting, confidence of the client in the work of the consultant is an essential factor in client satisfaction. When the client has high confidence in this competing model, then discrepancies in our model will be seen as errors which need to be fixed by more details. They will also strengthen the confidence in the other model and erode client confidence in our model. Confidence in the model is the essential factor in model validation issues (Forrester & Senge, 1980). Validation is about gradual building of confidence. The issue is not about one approach being right (system dynamics) and the other one plain wrong (linear accounting), but about convincing the client of the different merits. Once the perspective of different purposes gets blurred, and a nervous overworked modeller cannot convince an irritated client, catastrophe is imminent: everything leads to ever more detail, ever less confidence in our model, an ever more overloaded modeller, an ever less satisfied client who, at a certain point, refuses to pay the bills unless we finally fix the model. The structure collapsed when the overworked ITS modeller decided to accept another job and our directors had to settle unpaid bills.

<u>Strategic lessons learned</u>

All participants in the Atrivé meeting found the final causal loop diagram very insightful. On the basis of the diagram we formulated strategic questions about the use of system dynamics modelling. We also evaluated several other consulting products against this model and found comparable dynamics. We recognised the same dynamics in one of our products, a database application for real estate management.

The system thinking exercise helped the participants to reframe their mental model of the dynamics of working with simulation models in a profit setting. Before the system thinking meeting, we would see implementation simulations as a welcome follow up to strategic interventions, so that we could increase market share and turnover. It would not make sense to hire additional modelling specialists if you are not sure there are sufficient assignments. A good quality assurance system could have slowed down the detail explosion loop by requiring formal validation of the model (Coyle and Exelby, 1999) but it would not make sense to obstruct this new innovative product with quality controls and validation issues. We were seeing the possible unintended consequences of modelling as a consultancy activity, but we were not prepared to take the risks (Wolstenholme, 2003).

After drawing up the whole picture of strategy, implementation, detail explosion and confidence erosion, the participants in the strategy session formulated different strategic questions for the company as a whole. Examples of questions are the following. How can we boost the volume of strategic assignments (as opposed to implementation or interim management assignments)? How can we create a market image of strategic consulting? Having such an image would constitute an important emergency exit out of the vicious spiral. How can we consult about implementation without getting sucked into ever more detail? More specifically, how can we cut the link between the client's desire to implement system changes and an increasing amount of detail in the models we provide? And finally, how can we implement quality controls preventing the detail explosion and confidence erosion loop? What is the best internal strategy for increasing modelling capacity, when, to what extent? How can we transfer specialist innovative knowledge to a larger group of colleagues? These new questions demonstrate a shift in perspective of the modelling issue. Another way to say this is that we climbed up Wolstenholme's ladder and perceived the issue from a (more) holistic point of view.

Taking into account our position as a small / medium enterprise and a 'general' consultant, the board realized that "large scale modelling" will never provide a feasible business opportunity for Atrivé, neither with system dynamics modelling or with other simulation methodologies. Improving the quality control process of modelling projects with formal steps, questions and contingencies in order to be successful in large scale modelling would require a significant change in staff competencies, work procedures and business culture. This, in turn, would be detrimental to our strength and desired image of organisational consultants capable of both making strategy and implementing policy changes. Paradoxically, we realized that detailed large scale modelling will not create this combination of skills for Atrivé.

The management of Atrivé decided not to attempt to fix any more ITS models working with clients. It was also decided to stop in-company development of an MSAccess database application for asset management demonstrating comparable out-of-control behaviour and to find an ICT company as a partner and transfer management and development of this database application to them. In the recent past this proved to be a robust strategy. Freeing up qualified staff from database application maintenance created room for authoring books and acquiring innovative projects in one of our lines of business. This has increased the volume of both strategic and implementation assignments. Leaving large scale modelling behind, we found that small system dynamics models can be very useful when tackling unique policy problems. An example of this type of model is the work on the dynamics of the Haaglanden social housing market (Eskinasi & Rouwette, 2004). Once we had left behind all hope of making the ultimate model, we witnessed a revival of whiteboard & marker style system thinking interventions and scenario planning. Our general assessment is that this improved our strategic image and boosted client satisfaction. In terms of the core archetype set, our solution link would be to impose a very strict resource constraint on detailed modelling capacity: no detailed modelling would be undertaken in the future. Small models can help strategy development, but making large models in order to foster strategy implementation is a myopic solution. A better answer is not to increase the level of detail in the same model, but to use different methods for implementation.

All participants in the strategic session found the system thinking intervention very useful. It has helped us review our business strategy. Several months after the intervention, we are picking the fruits and feel confident enough to claim that it is also an improvement of business strategy.

Discussion and conclusions

The experiences of Atrivé in applying system dynamics in a consultancy practice do not match the general positive image of the meta-analysis of Rouwette, Vennix and van Mullekom (2002). The majority of projects conducted by our firm got entangled in a spiral of an exploding amount of detail and a rapidly falling quality to price ratio, which in turn irritated clients and obstructed business.

We identified three specific warning signs for a modelling project is on the road to disaster. First the aggregation issue: the urge to define more and more stocks and flows as arrays, in order to store specific parameter values of different segments of for instance the housing stock. Second the time series issue: the apparent necessity to specify important policy lever variables as time series to be put in by the model user, rather than to rely on incorporating policy responses in the model by means of feedback loops. Third, the competing model issue, when an alternative ‘definition of reality’ exists, based on other calculation methods or simulation paradigms. Examples of competing approaches are the (linear) econometrist approach or (systems theory based) agent based modelling (Benenson & Torrens, 2004). Certainly, such models contain many open loops and comparing their outcomes to the system effects of dynamic models is much like comparing apples to oranges. But in the setting of organisational consulting, many clients do not discern subtle differences between simulation methodologies and just want the model to work. Therefore, we suggest that it is not a sensible *business* strategy to compete against existing software packages for highly standardised problems with home-made system dynamics models.

In hindsight, two of the pitfalls encountered were known in system dynamics literature and could theoretically have been avoided. The risk of detail explosion was first signalled by Lee in his criticism of large scale modelling in 1973. The aggregation and time series issue are known from Lane et al. (2003) and Rouwette (2003). The building of client's confidence in models has been on the research agenda of system dynamics at least since Forrester and Senge's (1980) work. It is especially annoying that through the quality to price ratio, the detail explosion loop wreaks havoc on client satisfaction and business results. We do not suggest that these issues should be ignored; neither that large scale modelling is doomed to fail. The latter is contradicted by many experiences, starting from the seminal works of Forrester (1961; 1963; 1973). Our statement is that for 'general' small or medium organisational consulting companies, large scale system dynamics modelling projects are very hard to manage and constitute a major risk of burning out highly qualified staff and destroying client satisfaction.

We are not aware of any system dynamics literature emphasizing the role of competing models as a determinant in the success of modelling. Furthermore, we found, surprisingly, that the drive to implement system changes after a successful *strategic* system dynamics intervention (providing the clients with hints and insights on the strategic level) can become a main driver of business failure, when the consultant falls for the apparently easy solution to take the strategy model and just put in much more detailed data.

Our analysis is based on evidence from one company, with a specific profile (small/ medium general consultant) and on the multiple application of one single model. No definitive or general conclusions can therefore be drawn. In addition to the contribution of our experiences to the system dynamics database, we suggest several questions for further research into failure case studies. What other dynamics exist leading to failure of modelling projects? Can these be projected onto the core set of archetypes, and be understood in terms of intended and unintended consequences, problem and solution links? How do other types of organisations (large consultants, system dynamics specialists, academic institutes, government offices) manage large and small scale models and what are their experiences? What information is available on the role of competing models and simulation methodologies? How does transferring models from one organisation to another impact further use of a model? What case studies are available of canonical models to be adapted for specific situations?

A popular myth, sometimes encountered among academics is that after hard scientific work, organisational consultants come in and make huge profits from system dynamics modelling. Our experiences indicate the contrary and we doubt whether large scale modelling is manageable at all in small of medium general organisational consulting companies. We learned from it and improved our business strategy. More case studies on successes or failures will lead to more organisational consultants doing system dynamics projects, bringing more clients to robust solutions to tenacious real life policy problems.

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