

System Dynamics Modelling: A Case Study from the Software Industry

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Abstract

This paper describes a project we have conducted in the software industry. The client's department involved in the project can be described as a newly established department performing software factory-like activities. The client's expectations of the department's performance are very high. A rapid growth of the department is anticipated (in terms of amount of personnel, numbers of orders etc.). However, the growth should neither lead to a decreasing level of quality nor to an increasing throughput time of orders.

To show the dynamics of the growth of the department we built a model. This model helps our client to take better decisions concerning inflow of new personnel and the amount of orders accepted over time.

In the project we used the Participative Business Modelling approach. Participative Business Modelling (PBM) is a consulting approach which is a combination of business modelling from a System Dynamics point of view and from a process consulting perspective.

In this paper we focus on aspects from the consulting process from a practitioner's point of view. We will not describe the model in detail.

Introduction

Increasingly we see in our business, the software industry, that developing software is becoming a commodity. The amount of enormous time-consuming software projects - sometimes even not delivering what the client has asked for - is decreasing in favor of short, well defined projects. To be able to deliver services on this basis you can see new sorts of IT-departments emerging.

These departments perform their activities on a so-called software factory-like basis. Projects are divided into a number of increments. Each increment consists of a specific amount of function points. This number of function points can be seen as a certain amount of work. The work process of these new IT-departments is tightly adjusted to the function points.

Our client is a newly established IT-department of a well known Dutch insurance company. The activities of this department are performed according to the software factory principle. At the moment this department is in a startup phase. This means that at this point in time a number of

decisions have to be taken concerning the moment and amount of hiring new personnel, the amount of training given to personnel and the number of orders accepted. A lot of issues are dynamically influencing the future performance of the department. From this point of view this is exactly the right time to learn about the dynamics of the system and the abilities to influence the behavior of the system.

Participative Business Modelling

In this project we used our Participative Business Modelling (PBM) consulting approach. With PBM we try to improve the effectiveness of strategic decision making processes. In PBM we build models to improve the mental models of our clients by making them explicit. These explicit models sometimes can be quantified leading to models which can be used to simulate.

However we have learned that there are a number of disadvantages in performing the consultant's role as an expert model builder. Building a model for a client from a traditional expert point of view generates a lot of knowledge about the problem among the expert consultant. The consultant has to transfer, if applicable, this knowledge to his client and tell him what to do to solve his problem. However, because the model is a representation of the consultants mental model of the clients problem, the model and solutions presented lack the commitment (and trust) of the client because he was not involved in the building of the model. The model in itself gives the client no ability to figure out the solution for himself. This is the reason in PBM we do not build models for clients, but build models with clients. In a number of group sessions the client develops the model facilitated by experienced modellers/process facilitators.

During projects, if applicable, you can see a shift from qualitative, conceptual models to quantitative, simulation models. Of course each stage in the process requires from the coaching consultant(s) a different combination of content expertise, process expertise and modelling expertise.

In this way our experience is that we do not solve our client's problems, but we help him to solve his own problems. And in this way we try to create optimal solutions not only regarding the content of the problem but also regarding involvement, ownership, commitment, consensus etc.

The Project

We did 4 workgroup sessions with our client:

- Session 1: Hexagon brainstorming and causal loop diagramming.
- Session 2: Finishing the causal loop diagram.
- Session 3: Global causal loop diagram and preliminary model.
- Session 4: Quantifying the model.

In the first session we organized a hexagon brainstorming session on the problem. The session gave a wide variety on issues related to the problem. The issues were grouped in a limited number of clusters. Next we used the clusters as a starting point for building the causal loop diagram.

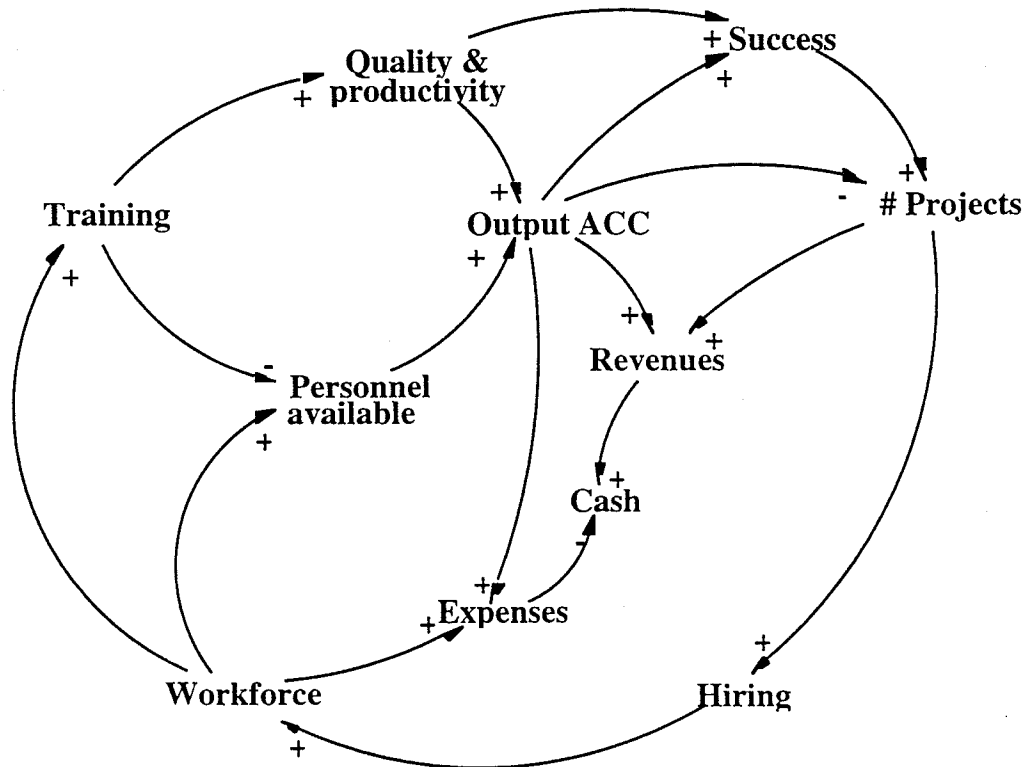
In the second session we finished the causal loop diagram. We felt that we had captured more issues than we originally intended to. However, we felt during the session that each participant

had to be able to bring up all issues he or she wanted. Conducting the workshop this way led to a fairly complicated spaghetti diagram.

On our question at the end of this session if this is what we wanted, and if we should try to build a simulation model of this causal loop diagram we got a negative answer: this was much more than we aimed for! However, our feeling, which was shared by the participants, was that this has not been a waste of time. This extensive study gave all the participants involved a chance to be part of the process. Moreover, the causal loop diagram had given them a number of new insights in a lot of issues influencing the performance of their department, and how these issues are related to each other.

Because of this situation we proposed to reduce the complex causal diagram to a simple diagram focusing on the real issue: the process of growth of the department related to personnel and orders. Before the third session we promised to build a preliminary stocks and flows model based on the simplified causal loop diagram.

In session 3 we discussed both the simplified causal loop diagram and the preliminary stocks and flows model - after we explained the stocks and flows notation and logic.



In session 4 we discussed all quantities and relations in the model.

At the end of session 4 we had all the information needed to complete the simulation model.

And we had the very important feeling that the model built corresponded with the shared mental model of the participants and that this model would be able to answer the questions stated at the beginning of the project.

Results

In a number of meetings (we are actually still in at the moment) with the manager of the department we validated the model and conducted a number of experiments (growth scenarios). The client is extremely satisfied about the model and the results of it are very useful to him. The time invested by the client is limited to less than 12 hours for the participants of the workshops. The manager has spent some more time in validating the model and conducting experiments.

References

- Akkermans, H.A. (1993) Participative Business Modelling to Support Strategic Decision Making in Operations. In: International Journal of Operations & Productions Management Vol 13, No. 10, pp. 34 - 48.
- Akkermans, H.A. (1995) Modelling with Managers. Participative Business Modelling for Effective Strategic Decision-Making. Doctoral Dissertation, Technische Universiteit Eindhoven.
- Boersma, S.K.Th., Hoenderkamp, T., Roos, E.A.E.M. (1995) Simulatie: een moderne methode van onderzoek. (Simulation: a modern method for investigation). Academic Service, Schoonhoven.
- Forrester, J.W. (1961) Industrial Dynamics. Productivity Press, Portland
- High Performance Systems, Inc. (1992 - 1993) Introduction to Systems Thinking and Ithink. High Performance Systems, Inc. Hanover, New Hampshire.
- Morecroft, J.D.W., Sterman, J.D. (eds.) (1994) Modelling for Learning Organizations. Productivity Press, Portland.
- Schein, E.H. (1988) Process Consultation Volume I. Its Role in Organization Development. Addison-Wesley, Reading, Massachusetts.
- Schein, E.H. (1987) Process Consultation Volume II. Lessons for Managers and Consultants. Addison-Wesley, Reading, Massachusetts.
- Senge, P.M. (1990) The Fifth Discipline. The Art & Practice of the Learning Organization. Doubleday, New York.
- Senge, P.M., Kleiner, A., Roberts, C., Ross, R.B., Smith, B.J. (1994) The Fifth Discipline Fieldbook: strategies and tools for building a learning organization. Doubleday, New York.