Empirical Modelling as a Method for Creating Business Optimisation Tools

0207025

Abstract

This paper discusses the need and suitability for an Empirical Modelling approach for the provision of business optimisation support. This is with particular reference to the fast food industry, with a model of this environment being created. Its limitations, and those of EM as a whole in this area are also discussed.

1 Introduction

1.1 The need for modelling in the fast food industry

The fast food industry is highly competitive and relies on immensely efficient service. Customers will be unhappy if they have to wait too long to be served, or if their food is cold, and there are many competitors waiting to take advantage of this. The low sales prices of fast food chains means that they rely on serving as many people as possible to be able to make reasonable profits.

Clearly efficiency optimisation is a primary target for businesses in this industry, and tools to provide decision support may aid this.

1.2 Why Empirical Modelling?

A fast food restaurant is a complex real world environment. Consequently it is virtually impossible to create a model that will cater for all possible scenarios, and a sense of completeness is difficult to achieve. Empirical Modelling allows for constant redefinition of the dependencies that the model relies on, meaning that these unknown scenarios, when observed, can be added to the model. The principles of Empirical Modelling promote its flexibility, leading to the suggestion that it is a suitable discipline within which to construct such a model.

It can be argued that the most significant application of a model as a business tool is the possibility of creating *what if* scenarios. As it is not necessarily known previous to creating such a model which observables and dependencies and required for adjusting, Empirical Modelling methods can be applied to produce a flexible testing environment.

In 'The Use of Interactive Situation Models for the Development of Business Solutions', Beynon(2000) claims that "an EM approach is particularly suited to a strategic support system". This is due to the 'human user playing an essential, interactive role'. This statement was to be explored by producing such a model and assessing its suitability for such a role.

2 The Fast Food Restaurant Model

2.1 EM principles used as a basis for the model

Dependency, observables and agency are three major aspects to any Empirical Modelling model. If a model can be likened to a spreadsheet, the observables relate to the spreadsheet's cells, the dependencies to formulae, and agents initiate state changes within the spreadsheet's cells (Russ 1997).

The whole modelling process was to be done purely through observation and experience of the real-life artefact to be created. This experience was minor and purely from a customer's point of view. It therefore seems natural to question whether or not such minimal knowledge of such an environment allows a model with uses in decision support to be created. The initial conception was made through observation and experience, revisions of the model were made through observation and experience, *and* decision support for real-life scenarios would be made through observation and experience of the completed model.

The limited amount of knowledge of the author in this area also lends itself to the idea of constructionism. This would not necessarily be a goal, but an evaluation of constructionism in building business systems could be considered by reviewing the amount of understanding gained during model construction.

2.2 Creating the model

Wastage of cold burgers, and burning of fries if not attended was implemented within the system based on dependency. This was reliant on the age of the burger, and the 'cooked level' of the fries respectively. A graphical visualisation of this was also provided to demonstrate clearly to the user what was happening at any point. The target level for each type of burger is also displayed graphically, and a dependency is used to determine which item should next be cooked if a cooking employee becomes idle.

The steps taken to create a burger is stored in a list, step by step, much like an employee may imagine the steps required within their mind.

If an ordered burger item is not yet cooked, or no cooked fries are available, a serving employee makes a request to a cooking employee for that item to be cooked. To ensure the customer's wait is as short as possible, this job is made a priority by the cooking employee and they will commence production as soon as they have completed their current task.

One specific example of the implementation of Empirical Modelling principles was the requesting of an item to be cooked made by a serving employee. The most efficient way of representing this in a traditional computer program would be to have a list storing all requests which cooking employees can check once they have completed their current task. However, this is not true to the real world as a list of requests made by serving employees is not recorded. The serving member of staff simply shouts their request and an instant response by a cooking staff member willing to fulfil the request is made. If this request is not accepted immediately, it would simply be forgotten and not fulfilled. To imitate this in the model, when a request for an item is made, it is immediately assigned to a member of staff, and added to their queue of tasks. This is more difficult to model than the method that may be adopted in traditional programming methods, and may not produce the best results in terms of efficiency, but as this was the observation made of this scenario, it was modelled in this way.

The model in its current state allows direct manipulation, through a graphical user interface, of the target levels for each item to maintain, the number of tills (up to three) that are open, and the number of cooking staff (up to five) working in the kitchen. It is also possible to add a customer with an order specified by the user, to allow unusual or specific scenarios to be tested. There is also an 'auto mode' that has been implemented which introduces customers with weighted random orders at random times. This is to allow observation of the model over time. This feature can be toggled on or off at any time through the graphical user interface. A possible extension of this would be to represent the time of day and busy periods. This would also allow for scheduling of employees breaks to be considered and managed.

2.3 Limitations of the model

The graphical representation and interface, which is essential to make the model accessible to the non-modeller, limits the systems flexibility as each item (shape) has to be defined explicitly. This makes tasks such as adding new employees difficult as their graphical representation must be hard-coded and cannot rely purely on dependency. An obvious trade-off between usability and flexibility becomes apparent.

This was also experienced when making the model more complex. While the model was simple, allowing flexibility was far easier than later on in the model development process.

2.4 EM approach to this solution vs traditional modelling methods

When using an EM approach to modelling, in the best case scenario a model identical to that of the modeller's observations and experience would be created. However, this would not be considered to be such a success outside of Empirical Modelling if these observations and experiences are not consistent with the real workings of the artefact. That is to say, if the modeller's perceptions are not correct the model will behave inaccurately. Take, for example, an observer with no previous knowledge of a car. It may appear to them that when the car's right indicator light flashes, the car turns right. However, it is not due to the indicator light that the car is turning, but because the driver is steering in that direction. Thus a false model would be produced if based on this observer's observations. This highlights the reliance of a true-to-life model on the modeller's interpretation of their observations.

With respect to the model, it is very likely that there are many underlying aspects to the everyday running of a fast food restaurant that are crucial for formulating business strategies, that without working in such an environment could, and would, not have been observed. As a result these observables and processes are not included in the model, thus lessening its effectiveness as a business aid. This clearly illustrates the importance of whom exactly the modeller is, or at least the modeller's knowledge of the environment. If the modeller was in fact the manager of the particular restaurant being modelled, it is almost certain that a truer likeness and more complete solution would be produced. A model cre-

ated using empirical modelling effectively creates an artificial version of the modeller's perceptions. If an expert in the field of the application were to produce such a model, it would provide a safe environment for testing various scenarios based on all the relevant knowledge they possess. Unfortunately such a situation is unlikely to occur. It is improbable that a fast food restaurant manager will possess the necessary skills to create a computer-based model, as few individuals will be trained in both of these required disciplines.

To some extent, *what if* scenarios can be tested using traditional programming methods. It must be questioned whether or not Empirical Modelling methods produce results far superior to this. On one hand, EM allows for unexpected dependency or observable changes, making a more flexible environment. An example of this in the fast food restaurant model would be the ability to observe the effect of changing the processes undertaken to create a hamburger. This can be done 'on the fly' and its results immediately noticeable. On the other hand, it is questionable if this greater flexibility is required or even useful. As computer models of business applications have been produced for over forty years now, it may be the case that all scenarios that need to be tested have already been identified. No doubt improvements have been made over the years, and changes made as businesses do, but with more than forty years of history, the business modelling field can be considered reasonably experienced.

When describing a model that is "typical of EM", Beynon (2004) states that "Redefining any observable is a legitimate interaction for the modeller but a typical 'user' interaction [is limited to certain interactions]". This is also the case with the fast food restaurant model, but possibly highlights a flaw of Empirical Modelling as a whole. It is not always the modeller whom the redefinition of all observables is most likely to benefit. An example of this is in the fast food restaurant model, where the most useful interactions would be made by the restaurant manager. However, to improve usability for this 'typical' user a graphical interface has to be implemented, and as a result interactions are immediately limited. These limitations imposed are precisely the same as those with traditional approaches to modelling. The *what if* scenario testing remains, but it is restricted to those defined in the construction of the interface. Another point to note is that future observations will be made by the typical user, i.e. the manager, not the modeller. This also renders EM somewhat redundant as the manager will not be in a position to revise the model based on future experiences.

It is possible that in some situations, traditional programming methods can be considered more flexible than their Empirical Modelling equivalent. As mentioned previously, it is difficult to keep the graphical representation of the model flexible and reliant on dependency. However, in traditional programming approaches, the use of objects allows for easy multiple item creation within the graphical interface.

3 Conclusions

It is almost certainly the case that an empirical approach to modelling business systems for decision support has the potential to provide methods for producing a model more akin to its real-world equivalent than traditional programming approaches. As long as the experiences of the individual modeller are well-informed and/or reviewed and updated sufficiently it is possible that this potential can be achieved.

However, it remains to be seen if these principles can be applied practically and become a major force in business strategy decision support. The main factor restricting the use of Empirical Modelling in business environments is the fact that the intended user of such models would not likely be the modeller himself. As a result the inherent flexibility of a model created in this way could not easily be exploited. It is also the case that in terms of experience and observation, the modeller is unlikely to be the person best suited to the job of creating a model for business decision support. A far better solution would be produced if it were possible to model the experiences and observations of an individual with an in-depth knowledge and history in the specified business area.

References

W.M. Beynon, S. Rasmequan, S. Russ. The Use of Interactive Situation Models for the Development of Business Solutions. *Proceedings workshop on Perspective in Business Informatics Research (BIR-2000) Rostock, Germany*, March 31- April 1, 2000.

M. Beynon, C. Roe. Computer Support for Constructionism in Context. *Fourth IEEE International Conference on Advanced Learning Technologies*, pp216-220, 2004.

S. Russ. Empirical Modelling: the computer as a modelling medium. *BCS Computer Bulletin*, pp 296-301, 1997.