Models and Modelling: A Case Study



(Magritte, 1929)

# Dell’s Channel Transformation: Leveraging Operations Research to Unleash Potential Across the Value Chain

## Introduction

The purpose of this essay is to reflect on aspects of models, as used in the field of Management Science, and on the modelling process itself, with particular reference to the industrial case study (Martin et al., 2014) that appears in the title above. The article chosen was published in the Operations Research journal *Interfaces* in January 2014 and was a finalist in the 2103 Franz Edelman Awards competition, an annual contest designed to highlight exceptional examples of OR/MS practice.

At the time of publication, Dell Inc. was the world’s third largest personal computer vendor in terms of market share (iCharts, 2014). In their paper, the authors describe three main “solutions” [models] that were developed in response to Dell’s transition from a predominantly configure-to-order (CTO) sales approach to a supply model that emphasised delivering fixed hardware configurations (FHCs), as part of a response to evolving customer attitudes to purchasing technology, including personal computers. For the purpose of this essay, the focus will be on just one of these three models, namely that which the authors refer to as the “Online Conversion Rate Accelerator” (“OCRA”).

## Online Conversion Rate Accelerator

The Online Conversion Accelerator is a model of the various components that appear on a sales web page on Dell’s website, along with certain technical and business constraints, formulated as a non-linear, mixed-integer program. More specifically, the objective function is to maximise the “conversion rate” (that is, the proportion of customers browsing the web page who then progress to placing an order) which is modelled as the sum of the “main effects” and “interaction effects” relating to a specified set of permissible webpage components, such as “buttons” and “deal banners”, with each component represented by a binary variable and an associated coefficient. The model constraints include a specified minimum and maximum number of page components; merchandising restrictions on certain combinations of FHCs being displayed on the same web page; a restricted permissible set of combinations of page components; upper and lower bounds for product prices; limitations on permutations of website navigation elements; and an upper limit on the time taken for a web page to load.

The stated purpose of the OCRA model, as defined by the model’s objective function, was to maximise the online customer conversion rate. The authors report that “various merchandising changes made as part of OCRA helped increase the online FHC sales mix from seven percent in 2010 to 38 percent in 2012”. There are a number of issues with this statement. To begin with, the proportion of sales that are FHCs is clearly not the same as the stated objective, that is the proportion of visitors to the sales page who subsequently go on to complete a purchase. Further, as with the two previous claims, in the absence of evidence for a causal relationship, the predicate of the statement is something of a *non sequitur*: one might reasonably speculate that an increase in FHCs as a percentage of all sales could be anticipated simply on the basis of Dell switching to a FHC sales model, optimised or not, in preference to a CTO sales model.

The Online Conversion Rate Accelerator model was developed with a view to informing senior executives within Dell, specifically Dell’s “online business managers” (OBMs). Interestingly, whilst regional variations of the model were generated (on the basis of location-specific constraints), the models were implemented centrally by a “global project management team”. There appears to have been an initial degree of reluctance to accept and adopt the model, apparently owing to the fact that some of the model’s conclusions were contrary to existing beliefs: the authors describe the example of an unanticipated, inverse association between the number of deal banners on a web page and the associated conversion rate. This preliminary resistance dissipated, seemingly on account of the results of successive, incremental “pilots” of the model, leading progressively to managerial acceptance, subsequent full-scale roll-out and finally to adoption in preference to the prior approach of page design based on expert knowledge and acumen.

# What constitutes a “good” (Management Science) model, and what are the characteristics of a good modelling process?

## What constitutes a good model?

A good model should be simple, with extra detail added as required rather than unnecessary detail removed (Salt, 2008), containing only information that reveals a system’s most salient features (Little, 2004; Wahlström, 1994). Vaandrager (2014) suggests applying ‘Occam’s razor’: “among models with roughly equal predictive power, the simplest one is the most desirable” with the model’s purpose dictating ‘importance’ (Pidd, 1999), although ‘simplicity’ must be balanced with ‘completeness’ (Little, 2004).

Dewey (1938) said, “A problem well put is half solved”. Appropriate problem structuring is crucial in optimising a model’s level of detail (Pidd, 1999) and also incorporates Williams’ (2008) inducement to make use of “formal, theoretically based languages”. The expression of a problem in terms of recognised algorithms or previously published work may permit ready familiarity with the model, a quality that Morris (1967) calls “relatedness”.

A clearly stated object and purpose are desirable although one does not imply the other (Pidd, 1999) and several purpose-specific models are preferable to a single multi-purpose one (Vaandrager, 2014). Willemain (1994) also favours the creation of “a unique model for each problem”. Landry *et al* (1996) and Wahlström (1994) note that a model’s purpose incorporates elements of knowledge creation, thought promotion, increased understanding and decision support.

For a model to be useful, its output should be neither misleading nor obvious (Wahlström, 1994). The usefulness of a model is tied inexorably to the conditions that led to its creation and so a change of ownership, scenario or environment may prejudice the model’s value (Phillips, 1984). For a model to be ‘usable’ the user interface must be sufficiently intuitive (Little, 2004), although there is a trade-off between usability and adequate intricacy (Landry, Banville and Oral, 1996). Usability may also be affected by less obvious factors, such as financial and resource implications (Gass, 1987).

A good model is flexible by virtue of adaptability or extensibility. The division between these two properties is somewhat blurred, but adaptability connotes evolution of capability with retention of original objective, a feature advocated by Little (2004). Extensability, conversely, implies a branching of purpose either by progressive growth of the original model, or preferably by seeding a generation of related models designed for application to a class of similar (yet unique) problems (Vaandrager, 2014).

Robustness is a favourable quality, with a robust model being capable of tolerating deviations from the underlying assumptions to some satisfactory degree (Morris, 1967), or as Little (2004) puts it: “Robust. Here I mean that a user should find it difficult to make the model give bad answers”. The output of a model should be a plausible portrayal of the system of regard (Wahlström, 1994), although its validity is dependent on the subjective appraisal of the model’s output by those who engage with (Landry, Banville and Oral, 1996).

Salt (2008) warns against concealing the underlying workings of a model, (“the black box mistake”) because, as Pidd (1999) concurs, hidden mechanisms may engender distrust of the model (and/or modeller), potentially rendering the model useless.

In an attempt to rank some of the qualities above, Willemain asked “twelve selected expert modelers” to list the “qualities of an effective model” in order of importance (Willemain, 1994). The summary of responses was as follows: “1) validity, 2) usability, 3) value to the client, 4) feasibility, and 5) aptness for client’s problem”.

Finally, in contemplating the desirable features of a model, Vaandrager (Vaandrager, 2014) offers the following thoughts:

“Often, the criteria are hard to meet and typically several of them are conflicting. In practice, a good model is often one which constitutes the best possible compromise, given the current state-of-the-art of tools for modelling and analysis. But a truly beautiful model meets all the criteria!”