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Balancing global customer needs and profitability using a novel business model for new model programmes in the automotive industry.

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Abstract

Business models need to evolve and respond to changing customer requirements and this is only further exaggerated when considered in the context of a 'Global Market' which has shifted in the last 60 years from 'Manufacturer' led to 'Customer' led 'fashion' based industry. The automotive industry is one example of an emerging fashion based industry.
The objective of most viable businesses is to make a profit for their shareholders but, given the typical gestation period between concept establishment and the start of the production volume build, it is a challenge to establish a structured method to ensure programme and business profitability against the backdrop of a fashion based market. In this paper, a data driven methodology is proposed which focuses on data, structure, and the customer to maximise the probability of profitability. To achieve this goal, joins between Multi Criteria Decision Analysis, Parametric Cost Estimating and 'Should' Cost Estimating are explored. 'Margin engineering' is thus proposed as a new foundation for a future business model to guide medium term (one to six years) development projects towards a profitable outcome

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Keywords: Margin Engineering; Decision support.

1. Introduction

Businesses measure their success in many different ways but most will have a Business Model which sets out the scope or boundary conditions of their activities, their planned revenue and their planned costs. There is historical evidence that the means of achieving revenue and hence profit is through achieving market share, [1]. Current thinking tends towards the view that achieving customer satisfaction will increase market share [2], According to Reichheld and Sasser [3] a satisfied customer is more likely to repeat buy and exhibit loyalty to a brand. Rego, et al [4] identified the probable trade-off between a larger market share and the difficulty in maintaining customer satisfaction and highlighted the complexity of the relationship between these variables.

Chwastyk and Kolosowski, [5] describe how the current relationship between the 'Original Equipment Manufacturer' (OEM) and the Customer resembles that of the fashion industry. They identify that, whilst there is a basic need for the product to achieve a minimum functionality there is a discretionary element that drives change and the need to have the latest gadget.

In the automotive sector, to gain an insight into customer needs the current process views customer or prospective customers first as an opportunity, then as an attendee at a 'clinic' where the pre-filtered ideas of the OEM are tested with customers and representatives of the OEMs network within prospective markets. The clinics progress over time from ideas to physical full-scale models, incorporating the 'Voice of the Customer' (VoC). Interpreting the VoC using this iterative process is time-consuming and can reduce the risk of profitability due to delays in interpreting customer wants.

The hypothesis of the research presented in this paper is if the OEMs can shorten the iterative loops they will increase the

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potential profitability of projects by taking earlier note of what will satisfy the customer in such a fashion led industry.

A customer led business model means the VoC needs to be heard at the beginning of the model development to allow it to drive the outcome. The research in this paper sets out the need to evolve and respond to ever changing customer requirements and proposes a business model, 'Customer Led New Model Programme' (CLNMP) to meet the future needs of automotive new model programmes. The next section will provide an overview of the currently utilized business models followed by the presentation of the key elements of the proposed CLNMP business model in subsequent section. The processes required for the proposed business model are then enumerated followed by a discussion of the implications of the use of such a model. Conclusions drawn from the paper are then presented followed by the strategy for further research in the area.

2. Current business models for new model programmes.

The challenges of the current business models are based on estimating the cost of a 'New Model Programme' (NMP) assuming the OEM design and manufacture cars to be produced at volume, delivered through dealer network and serviced at a dealership. Figure 1 shows a pictorial overview of the current business model used generically in NMP development.

As seen in the figure 1, early VoC is taken into account but never turned into a source of quantifiable data, it passes into the subsequent process as a narrative known as a 'Vignette'. Even the measures applied to the 'Engineering Attributes' are without a consistent scale between programmes rendering them useless as a 'Brand' baseline. The early cost target development is without structure.

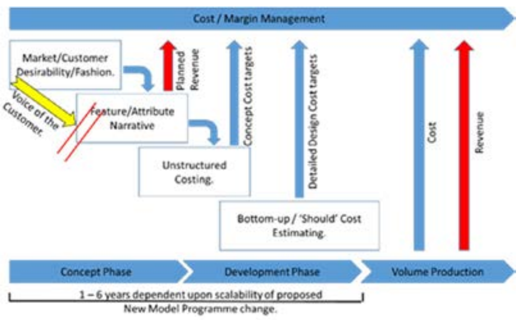

Fig. 1: Current generic business model for new model programmes.

3. The customer led new model programme (CLNMP).

The CLNMP is an evolution of the existing NMP business model to bring in VoC into the process as early as possible whilst doing this it seeks to convert opinion based VoC indicators into a statistical base-line which can subsequently be used as a comparator. Figure 2 shows the high-level overview of CLNMP, which has the customer first and at the earliest stage of an NMP and throughout the NMP. CLNMP is specified by its time-line, a central decision loop to determine features and costs and an overarching infrastructure to manage the costs, revenues and the expected margins resulting from the programme.

The time-line of the NMP is divided into three distinct sections: Concept, Development and Volume Production. 'Concept'' is the phase during which the business opportunity is identified and structured as an idea. 'Development', the phase when the idea is converted into reality through detailed design, testing and investment. 'Volume', is when the production of 'saleable' product starts and is sustained.

The major building blocks of the decision loop are: market information gathering, 'Multi Criteria Decision Analysis' (MCDA), Parametric Cost Estimating (PCE) and Bottom-up or Should Cost estimating.

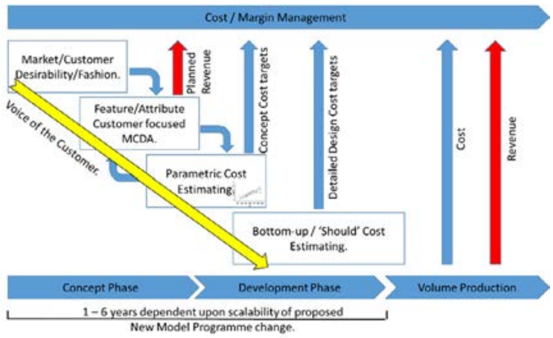

Fig. 2: Proposed CLNMP Business Model for the Automotive Industry

The primary objective of these key elements working in concert is to achieve a profitable outcome, even against a changing operating environment and to support the overarching management of the expected contribution margin that will be realized by the NMP and driven as far as is possible by the voice of the customer. In the following section the key elements shown in figure 2 will be described in greater detail.

4. An overview of the key elements within the proposed Business Model.

4.1. Cost / Margin Management

Cost includes variable cost, the cost incurred on a strict per unit product basis and fixed cost, cost incurred irrespective of one or more product being produced.

To be considered within a margin management concept the potential and/or actual revenue per unit needs to be considered. Contribution Margin is revenue minus marketing costs, after market support costs and externally purchased material costs, [6]. The resulting margin needs to cover all fixed costs and a profit.

'Margin Engineering' or the study of margin management, has significant implication to the overall concept 'Balancing global customer needs and Profitability'. The decision to source a part/assembly with a specific supplier may provide the lowest cost but revenue is achieved through sales within specific markets, where each market has their own trading rules. Some trading rules might 'prohibit', others might apply tariffs or import duties upon the importing business. Still more tariffs might be levied upon the customer/owner of your product.

Aftermarket support might additionally impact the potential revenue available from the original sale of your product. Aftermarket spares pricing is controlled by 'market forces'. However, they are also covered by European 'Competition Law' and US 'Antitrust Law'. The net effect being that aftermarket pricing of parts cannot be achieved at a loss – all costs must be covered. This has a direct impact on the maximum cost of parts even whilst in mainstream production. However, high aftermarket costs drive down the residual value of the customer's asset and the insurance cost and ratings up. In short, this makes the car less desirable other than to a small dedicated subset of the potential market population.

An example, of how this might impact the design strategy would be a simple front light structure, the position on the vehicle is constrained by each markets vehicle licensing rules; the lights have to be within a specific space envelope relative to the outer edges of the vehicle. If brand 'A' designs these vulnerable items in such a way that they are fully exposed even in minor accidents the cost of ownership, through the insurance company can be several hundreds of pounds in the case of modern laser headlights. Brand 'B' might add to the costs by including a low cost cosmetic sacrificial component. The outcome may be that this additional OEM cost might actually increase revenue through additional sales volume as a result of the reduced insurance rating resulting in an increased margin.

There are several other areas of margin engineering that need to be considered in this space; customs commodity classifications of the imported parts; non-recoverable VAT; offering complexity; production space constraints; infrastructure; and break-even markets to create the volume.

Within margin engineering there is a need to absorb methods from other industry sectors. The catering industry developed 'Menu Engineering' [7], which as the given name implies was developed to look at the psychology of the way that menus are constructed.

4.2. Market/Customer Desirability/Fashion.

Customers and their perception of desirability are different by market. They will subdivide into groups that may be differentiated by geographic, social or physical usage, this view is reflected in [8]. Customers within markets can be influenced by local factors. [9, 10, 11] cite situations where the material evolution of the customer base has been 'steered' by governments through tax breaks.

4.3. Feature/Attribute Customer focused MCDA.

The weighting behind the customer desirability may not be ridged and before a decision is taken there is a need to explore the impact or revision in the customer desirability thus necessitating a novel framework for 'Multi Criteria Decision Analysis' (MCDA). It is proposed that this potential variation in outcome is undertaken using Monte Carlo based method as shown in figure 3.

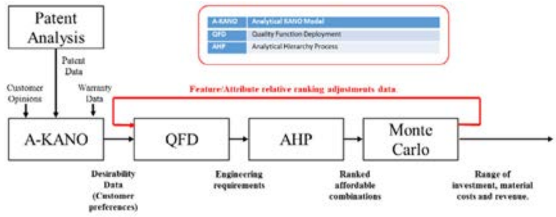

Fig. 3: High level view of the proposed overall MCDA.

Using such a framework would be necessary as customer interest driven fashion and or local factors can be short lived, this can be explored by building into the MCDA, breakeven analysis and Monte Carlo.

For example, at the time of writing a typical Jaguar Land Rover vehicle will be made up of 226 Feature families which results in 781 individual features that can be offered to the customer. These deliver a complete vehicle definition but also deliver the qualities required in the 17 Attributes which cover weight through to speed, acceleration and miles per gallon (MPG). The MCDA, also needs to consider that the requirements of the customers across the 170 supported countries each have different feature profiles, volume and revenue potential. The technology and manufacturing readiness levels, TRL and MRL, behind the delivery of the features need to be at a high if not the highest levels available before the volume production date.

Because it is intended to reflect customer needs it is proposed that several pre-existing analytical techniques need to be brought together in this MCDA space. As shown in figure 3 this is currently thought to be constructed from; A-KANO, 'Quality Function Deployment', (QFD), 'Analytical Hierarchy Process', (AHP). It might be possible to under-pin some customer needs using pre-existing company data such as warranty data. [12, 13, 14]. Where new technology might be involved 'Patent Analysis' and 'Patent Co-citation Analysis' could provide some answers. [15, 16, 17] Proposes that 'Social Media Analysis' may provide answers.

The weighting behind the customer desirability may not be rigid and before a decision is taken there is a need to explore the impact of revision in the customer desirability. It is proposed that this potential variation in outcome is undertaken using a Monte Carlo based method. Customer interest driven by fashion and or local factors can be short lived, this should also be explored by building into the MCDA breakeven analysis and Monte Carlo. Whilst this approach to joining such tools as AHP, QFD and Monte Carlo has been documented in use within 'Supplier selection' [18], it is not in general use in product creation and/or starting so early in the Concept phase.

4.3.1. A-KANO

The classical KANO model shown in Figure 4 shows how a potential customer ranks an offering through Dissatisfaction vs. Satisfaction against 'does not work' vs. 'works well'.

A-KANO extends this from a visual indication to a model that produces ranking between different offerings. A customer might rank two items both as must haves but offering 'A' is higher ranked than offering 'B'. This provides a statistically quantifiable output that can feed into a QFD model.

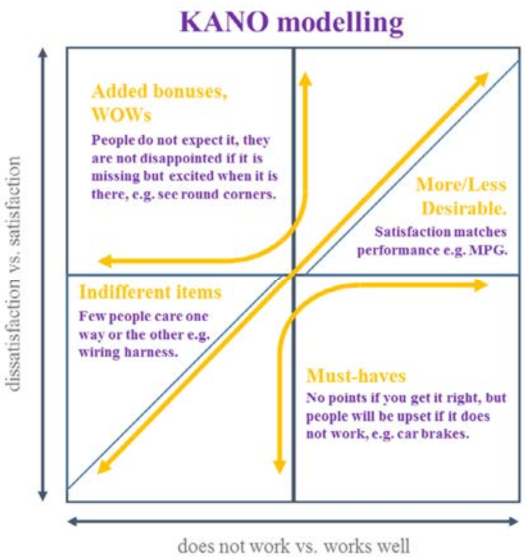

Fig. 4: Simple classic KANO Model.

The quantitative axes in figure 5 show the numerical values that would be assigned with the A-KANO model to supplement the qualitative assessment of KANO.

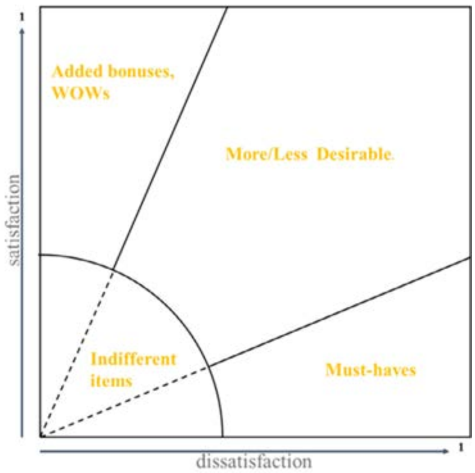

Fig. 5: Equivalent A-KANO model to figure 4

4.3.2. QFD

QFD, as shown in figure 6, is a structured method to turn customer preferences into engineering requirements. It is normally presented as a matrix and hence is often known as the 'House of Quality'. When applied in isolation of real world controls or large sample, the ranking given to the 'importance' down the left side form an 'opinion' that can be used to justify anything. The features and the ranking as an output from the A-KANO form the inputs to 'What' and 'Importance' in the QFD model in figure 6.

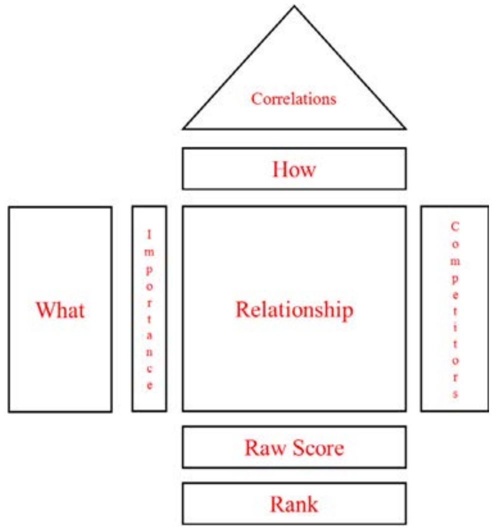

Fig. 6: Quality Function Deployment Structure.

4.3.3. AHP

AHP is used to establish 'pairwise' rankings within data when simple weighting is not possible or available. Within the framework being proposed here it is used to assess the degree of difficulty and cost it the delivery of the respective VoC driven desires.

4.3.4. Monte Carlo.

More correctly this should be referenced as 'Monte Carlo Simulation'. The technique is used to simulate the probability of outcomes for changes in input data. In the case of CLNMP development it is used to determine the distribution of outcomes should any of the input variables be flexed. This provides robustness to the indicated levels of success.

4.4. Parametric Cost Estimating.

The results from the MCDA are fed into parametric cost models. This provides an estimation of the potential costs of the selected features against historically incurred cost data using regression analysis. [19, 20, 21].

Figure 7 shows a simplistic view of 'Parametric Cost Estimating' (PCE). In this view the historical source data is shown as blue dots; these are used to establish the regression line, while the yellow dot represents the estimated output. Whilst it is unusual to find PCE and the Automotive Industry joined together, JLR has proved in a POC that PCE can be applied to great effect delivering early cost targets at system level for each Feature, [22]. Within the framework the use of PCE is a conformational action.

4.5. Bottom-up / 'Should' Cost Estimating

This approach to cost estimating starts with the process and material to establish what a designed 'something' should cost.

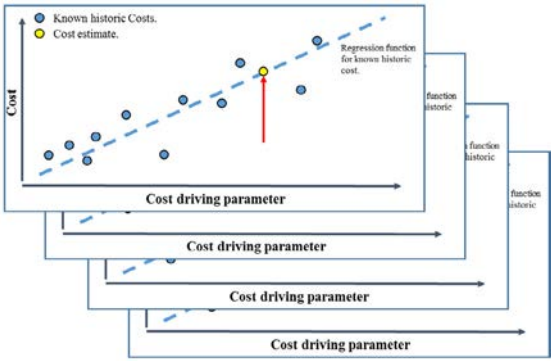

Fig. 7: Simplistic view of Parametric Cost Estimating

It can be used to confirm that the design is too complex to achieve the required target, that the target is easily achieved with the design or that the supplier is over charging. It can also be used to establish a baseline against which Value Analysis/Value Engineering can be performed.

Bottom-up cost estimating has been the cornerstone of the automotive industries structured part cost evaluation for approximately 30 years. Unlike PCE, which only requires a concept relative to a prior version, Bottom-up cost estimating requires a design to exist. [23, 24, 25, 26].

CLNMP would use 'Should Cost' methodology in conjunction with PCE to attain a higher level of understanding of the costs. Figure 8 shows three potential states that could exist when PCE and 'Should Cost' derived data are compared. If both the Parametric derived targets and the 'Should Cost' targets are below the programme target achieving or improving upon the programme target should not present a problem. If the parametric target driven from the historic business purchase data is above the programme target but the 'Should Cost' is below then there is an historic cost challenge to be achieved/delivered. If both PCE and 'Should Cost' are above the programme target, then the design is potentially over engineered for the Customer/Feature/Attribute requirements.

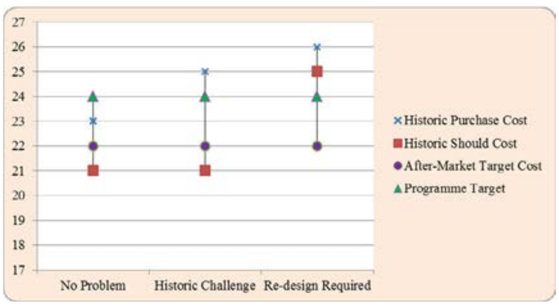

Fig. 8: Relative information that will from a comparative study of Parametric derived targets sourced from historic data and Should Cost derived Target data

Figure 9 is based upon an illustration prosed by Dale Shermon [27]. In Shermon's earlier version as shown by the dotted line labelled 1, 'Should Cost' starts at the same time as Parametric Cost Estimating. In reality PCE has an early data quality and a time-line advantage as shown by the dotted line labelled 2. This is because 'Should Cost' requires a design to exist whilst PCE can start with just a concept. Where PCE is weaker than 'Should Cost' is in the detail that can be derived.

5. Discussion

Measuring new model profitability from its potential at the earliest consideration during concept through to its end of life is not new. Being able to establish a baseline for the sum of the new model programme parts, in terms of Feature and Attribute compromises, design and market forces, driven by Customer needs and desires is new. The proposed novel business model has the capability to be flexible enough to respond to the shifting activity of external forces, vital in a 'Fashion Industry' environment but also vital as Governments respond to various lobby groups.

Many of the proposed sub-processes are well known and documented throughout academic literature and industrial applications, although few are cited as being applied within the Automotive Industry. Examples from literature include AHP, QFD and Monte Carlo [18], KANO and AHP [28], QFD and AHP [29], AHP and QFD [30].

If the potential difficulty is not embodied within the techniques then it might be in the combination of the techniques and/or the multi criteria's themselves.

The analysis of the multi criteria combinations is seen as a significant activity; 261 Features, the interactions between features, the interactions between Features and Attributes and the preferences expressed by 170 Market and their sub-groups. Some interactions are obvious Features such as 'sun roof' and 'soft top' cannot be combined together and must be eliminated using Boolean logic. Others are less obvious such as everything that contributes to the Attribute 'Weight' co-contribute to the attributes of 'Engine Power', 'MPG', 'CO_2', 'Acceleration' and 'Handling'.

Technology and manufacturing readiness levels, ease of development of a new Feature offering are all continuously changing. If the CLNMP is going to be useful a means of maintenance has to be achieved that can be maintained and relied upon.

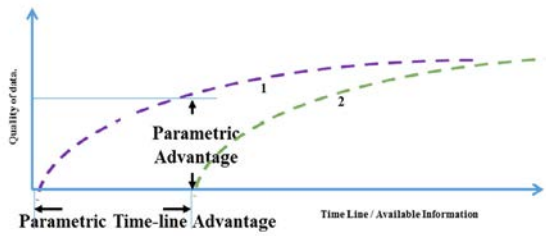

Fig. 9: Illustration of 'Parametric Advantage', (Adapted from [27])

6. Conclusions

At present this CLNMP, which can respond to external and internal forces including the customer needs, is largely theoretical. Parts have been tried in isolation but never together in a joined up end-to-end process and never initiated at the earliest phase of the concept discussions. Having a data driven baseline rather than just an aspirational expected profit target moves NMP into data driven rather than judgmental. By establishing an initial baseline, the steps can be 'tuned' and tested for their outcomes against real world events.

7. Next steps/further work.

The next steps for this customer needs based novel business model will be to physically trial the key data input elements; 'A-KANO', 'Warranty data' and 'Patent Analysis' to ensure that these key stages are understood. Customer data inputs drawn from real vehicle history will be extracted from historical records of actual data. In parallel, take the individual elements along with their existing standalone models and create an over-all joined model that can go into trials alongside existing NMP developments.

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