A Business Model for Reliability

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SUMMARY & CONCLUSION

The ASPIRE Business Model incorporates the essential business features that will enable and foster exceptional reliability as a market differentiator. The key features are:

- Create a win-win scenario from the outset, fostering success in both manufacturer and customer objectives whilst simultaneously working within technical, business and legislative limitations.
- Focus reliability on maximising achievement of customer objectives and, though judicious choice of technical and customer metrics, create market leading opportunities.
- Ensure that methods and processes used during design and manufacturing gain maximum efficiency — speed of reliability achievement, effectiveness and cost.

These together provide the basis, but exceptional reliability remains dependent on design and manufacturing effort.

The Model is best implemented during design concept and pre-contractual discussions, using white-board 'brainstorming' techniques to identify new design opportunities and to avoid unnecessary business restrictions.

1. INTRODUCTION

Exceptional product reliability is usually an advantage to a customer and user but designer and manufacturer motivation for enhancement is not universal. Indeed, enhanced reliability may degrade manufacturer profits, at least in the short term.

As part of a UK collaborative project with major aerospace companies, a business model has been developed that clearly identifies the necessary conditions to motivate the seeking of optimum (higher) levels for reliability. The ASPIRE Business Model for Reliability separates design-oriented technical measures of reliability from customer (user) measures and goals. Designer and manufacturer performance measures and goals are included and show the need for balance between customer and supplier, and of the importance for innovative business relationships. Long-term goals of repeat-business and brand loyalty would be pertinent factors. However, technical, business and legislative restrictions may limit possibilities. Indeed, the ASPIRE Business Model may cause these limitations to be challenged once their influence is identified.

Overall, the goal of the ASPIRE Business Model for Reliability is Win-Win motivation of customer and manufacturer alike, to foster achievement of enhanced reliability to the benefit of both. This paper describes in detail the model which has been mentioned in a previous RAMS conference. (Ref. 1)

1.1 Acronyms

ASPIRE: AeroSpace Project for the Insertion of Reliability— a collaborative project sponsored by the UK Department of Trade and Industry.

mtbf: Mean time between failure.

mttf: Mean time to repair

M/F-FOP: Maintenance/Failure – Free Operating Period

2. BACKGROUND

Experience from several design & development projects indicates that business pressures may restrict motivation to enhance reliability or maintenance features.

- Enhanced reliability and maintenance features may often require additional time and expense, and lead to reduced supplier profits.
- Enhanced reliability may be seen as reducing opportunities for sale of 'profitable' modifications or repair services.

Even where a contract may impose financial penalties for failure to meet technical requirements (or offer incentives for exceedance), monopoly suppliers may believe that further work on reliability or maintainability is not profitable, even though such work would significantly advantage the customer.

The situation just described is considered unacceptable. If reliability and maintenance are to be promoted, they must be promoted in a context that is advantageous to both the design/manufacturing company and the customer/user.

The ASPIRE Business Model for Reliability was developed in order to allow identification of the specific conditions limiting or promoting reliability enhancement, and to facilitate improvement and opening of new business opportunities.

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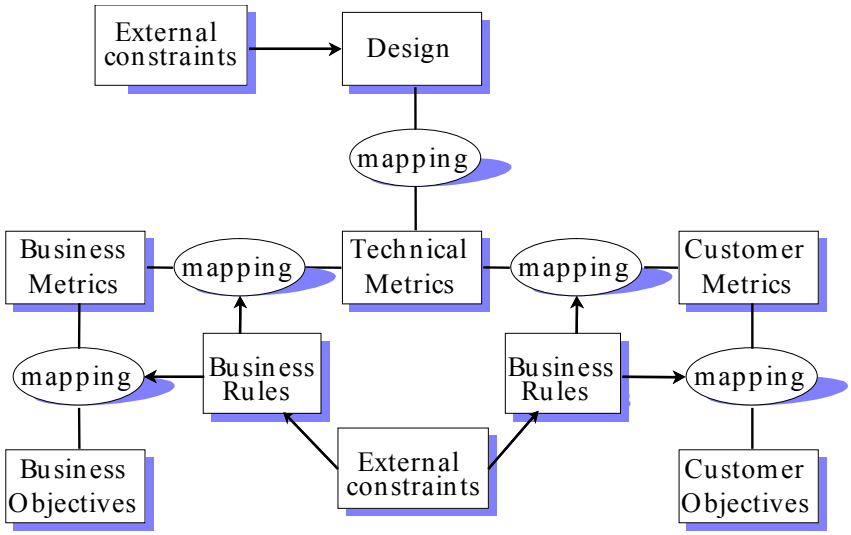

Figure 1: ASPIRE Business Model - Objectives. Metrics and Mappings

3. OVERVIEW

Figure 1 shows the ASPIRE Business Model for Reliability as has been developed by Warwick University and agreed by the ASPIRE project partners. It identifies objectives, metrics, rules and constraints.

The model separates the technical and business aspects of a project into 3 viewpoints:

- *Technical design viewpoint*, which includes all the features and systems of a product – hardware, software, manufacturing, at all levels of the supply chain, and all measurements of its technical capability.
- *Customer/User viewpoint,* which includes operations, maintenance and all other business activities of the parties making use of the product after delivery, being focused on achieving whatever goals or objectives are appropriate.
- *Design/Manufacturing viewpoint*, which involves all companies involved with providing the *Design*, throughout all levels of the supply chain, being focused on achieving whatever goals or objectives are appropriate.

Each of these viewpoints measure reliability performance differently and have what are often conflicting objectives.

4. TECHNICAL VIEWPOINT

4.1 Design

Design indicates those physical features that are directly discernible and visible from the design process. They include:

- Material
- Layout
- Dimensions
- Components

External Constraints to ***Design*** will include technology and manufacturing limitations, as well as interface requirements and international standards. Where the product needs to match existing systems, these too would impose ***External Constraints*** to ***Design***.

4.2 Technical Metrics

Design is the physical nature of the product. However, product performance attributes require a context. In the case of reliability, they require at least an environment. In addition, they may only be measurable indirectly through an analysis process and may be expressed in several alternate ways. The translation process, taking into account context and any analysis process, is indicated by ***Mapping***.

The chosen means of performance expression and the associated quantitative values are ***Technical Metrics***. For reliability, ***Technical Metrics*** would include, for example, failure rate, mtbf, life, and probability of individual mission success.

The ASPIRE Business Model can equally be applied to maintenance and maintainability. Technical maintainability metrics could be mttr, maximum repair time and % fault isolation.

Reliability is particularly badly served with analyses to predict reliability during the design process. There is poor correlation between individual analysis tools, resources expended, and

reliability achieved for many products. (Ref. 2) Testing of prototypes is often necessary and may offer somewhat better correlatoin, provided the testing reflects future operation and environment — in other words, reliability performance of a design cannot be divorced from customer usage. The metrics used to quantify reliability performance have usually used some variation of the international definition of reliability, namely "the ability of an item to perform a given function in a stated environment for a defined period of time." This is a technical description of reliability and as such, when quantified against such a measure, is a ***Technical Metric***.

5. CUSTOMER VIEWPOINT

5.1 Customer Metrics

Technical Metrics are not synonymous with ***Customer Metrics***. Customer perception of reliability is influenced by factors that he considers important. In other words, not all product failures are equal. Some will cost the Customer considerably more than others, in reputation as well as financially. For example, random failures that would disrupt missions or machine operation will likely be more critical than those preventable by scheduled or prognostic anticipation.

Small differences in reliability, in ***Technical Metric*** value or character, can be the catalyst for major changes in the Customer's operating scenario and achievement of ***Customer Metric***. Thus, a technical definition of reliability is inadequate to measure ***Value*** (— totality of a product's contribution to the Customer and his Objectives, relative to the cost of that contribution). ***Customer Metrics***, on the other hand, are tailored to directly assess that ***Value***.

Example ***Customer Metrics*** are:

- Airline operating delays
- Production line operating ratio
- Military deployment efficiency using M/F-FOP capability
- Maintenance resource requirements.

Customer Metrics will also include financial measures such as profit and cashflow. What is of ***Value*** to the Customer is influenced by the ***Customer Objectives***.

Mapping from ***Technical Metrics*** to ***Customer Metrics*** requires a detailed operating and logistic scenario. Alternate scenarios will result in differing ***Customer Metric*** values from identical ***Technical Metrics***.

Mapping from ***Technical Metrics*** to ***Customer Metrics*** may be as simple as an arithmetic calculation but where there is strong scenario dependency, more complex analysis will be required, for example using a discrete event simulation.

5.2 Customer Objectives

Objectives are an important feature of the ASPIRE Business Model. They identify the customer motivation for purchasing the product in question. There will usually be several objectives, with associated priorities or ranking.

Objectives will usually include words such as *maximise* and *minimise*. They should not include specific values or words such as *optimise*. *Optimise* is part of a process to identify the ***Design*** that provides the balance of *maximise* and *minimise* of several objectives that, according to priorities or ranking, gives the best overall result.

Example ***Customer Objectives*** are:

- Maximise number of race-car wins during a season
- Maximise effective maritime aircraft patrol coverage
- Maximise return on investment
- Minimise financial risk

Customer Objectives may be qualitative, such as being better than the competition. However, in such cases, specific features would need to be identified to be used as metrics.

5.3 (Customer) Business Rules

Customer ***Business Rules*** are a set of operational and financial guidelines that the customer follows. They include such as:

- Maximum development timescale, beyond which the business opportunity would be lost.
- Maximum purchase cost as limited by cash-flow or credit.
- Current organisation within which the new product must fit: skills, existing resources, etc.
- Risk exposure limits.

These Business Rules affect potential opportunities as well as the Mapping process. One of the goals of the ASPIRE Business Model is to promote opportunities for synergy between ***Customer Objectives*** and ***Design***. Therefore, existing ***Business Rules*** should not be taken necessarily to be unalterable. Rather, the role of the ASPIRE Business Model is firstly, to identify factors influencing the achievement of objectives and, secondly, to challenge them, to create new opportunities.

6. DESIGN/MANUFACTURING COMPANY VIEWPONT

6.1 Business Metrics

Business Metrics are performance measures important to the design/manufacturing company. Cash-flow, profit and

liquidity are lifeblood to a company. These must be predicted and controlled, by forecasting and budgeting. The Design process will consume resources, both current and future. In return, committed and potential sales will provide income, as would leasing but with different cash-flow.

6.2 (Design) Business Rules

The business relationship between the design/manufacturing company and the customer/user will significantly influence the ***Mapping*** link between ***Technical Metrics*** and ***Business Metrics***. Sales with in-service support costed separately would, in the short term, result in improved reliability reducing in-service support and hence potentially profit. Any sale or lease which included in-service support at the manufacturer's expense, the opposite would be true.

It may be argued that sale of any product with poor reliability, offering a worse package that by competitors would not provide long-term profit. Sales and reputation would be lost. However, in monopoly situations, customers do not have choice except not to purchase at all.

Contract incentives and penalties have been used frequently as a means to control reliability achievement. However, these provide motivation to improve product reliability only whilst the incentive/penalty is greater than the cost of further development. The greater the cost of development, the less would be any improvement, notwithstanding the effectiveness of any change on ***Customer Objectives***.

(Design) Business Rules are particularly important within the ASPIRE Business Model. They will significantly alter the synergy between maximisation of ***Customer Objectives*** and ***Business Objectives***.

6.3 Business Objectives

In addition to financial objectives such as maximising profit, Business Objectives should include Strategic Development and Benchmarks such as being Best-in-Sector. The Business Objectives will identify those factors that look beyond short-term profit. If short-term profit is indeed an objective, the Business Objective should give the reason why.

Any company that seeks short-term profit at the expense of maximation of Customer Objectives is not likely to seek improved reliability. Therefore, such companies are also unlikely to use the ASPIRE Business Model.

6.4 External Constraints to Business Rules

External Constraints will include government policy, legislation, competition rules, etc. They are limitations on the potential ***Business Rules***.

7. APPLICATION

7.1 Usage

The ASPIRE Business Model has several uses:

- Identify and correlate reliability and maintenance parameters with customer requirements and promoting synergy: Customer focus
- Identify and promote opportunities for reliability and maintenance synergy between design/manufacturer and customer objectives: Win-win scenario

In practice, these will be conducted using white-boards and brainstorming to identify and link features to each Business Model box, seeking synergy, minimising conflict of interest and maximising achievement of both design/manufacturer and customer/user objectives. This will be done early in a project, during requirements definition and contractual discussions. Once requirements or contract have been finalised, opportunity for synergy may have been lost and customer objectives compromised. The ASPIRE Business Model, being applicable particularly early within a project, offers maximum efficiency for the effort expended.

7.2 Win-Win Scenario

Implementation of features and performance (***Design & Technical Metrics***) costs resource and time. It may be argued that enhanced performance could command a price-premium and a leading market-share, thus leading to delighted customers and enhanced corporate profit. Within restricted bounds, this is the case. However, other circumstance lead to the opposite, where enhancement of reliability above a minimum level leads to reduced achievement of design/manufacturer corporate objectives (***Business Objectives***). In these cases, the market differentiator of enhanced reliability will be prevented — it would not be desirable for the supplier. However, where a positive link can be introduced, whereby enhancement leads simultaneously to improved achievement of ***Customer Objectives*** and ***Business Objectives***, enhanced reliability becomes a worthwhile goal.

Thus, it is concluded that a Customer-Supplire relationship that supports simultaneous benefit, is a pre-condition to the attainment of enhanced reliability. This is described succinctly by the phrase "win-win scenario." Such a win-win scenario must extend throughout the supply chain.

Existing contracts frequently focus on non-achievement, particularly declaring actions for the event of 'non-achievement.' However, win-win scenarios are best described by co-operative, positive descriptions that utilise trust. These relationships remain competitive, with 'value for money' being an important feature, as well as long-term development. They are consistent with the aims of the UK government's 'smart procurement' philosophy.

7.3 Customer Focus

Exceptional reliability does not necessarily produce maximum achievement of customer objectives. The reason for this is clear. A particular technical metric does not necessarily enhance customer satisfaction, if that metric is not used by the

customer. For example, a reduced maintenance manhour content required to operate an aircraft does not necessarily reduce the number of technicians required for a small fleet. On the other hand, a reduced number of failures combined with improved system resilience may remove the need for technicians to be always immediately on-hand. Revised management of the technicians may then allow reductions in numbers and an improvement in their efficiency.

The important factor is to assess the contribution of technical reliability improvement in increasing customer satisfaction (achievement of his objectives), and to identifying those technical metrics that have the strongest relationship or potential to deliver customer-focused improvements.

7.4 Efficiency

Value is an important feature of any product. For every feature or level of performance, there is a price to pay. However, value is introduced when that feature or level of performance is introduced efficiently — quickly, effectively and at minimum cost. The choice and capability of processes used in the design and manufacture of the product, all contribute to its overall efficiency and hence value.

Within the exceptional-reliability context, all reliability methods must contribute to the core design process, to managing project risk, and to minimising costs. As a general rule, the earlier a method can be used effectively, the greater will be its chance being proactive in improving the product, or of aiding management decisions, or of reducing costs. Methods that directly support a designer or manager, rather than being indirect through a 'reliability specialist,' are more efficient.

Processes and methods that make the Mapping processes more transparent and that highlight the links between design and the Customer or Business, are important. They highlight the benefits to be gained.

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