ORGANISATION STREAM

Measuring Cost and Performance -
A Review of Concepts for Design and Deployment
of Process-Oriented Measurement Systems

by
Matthias Holweg
Lean Enterprise Research Centre
Cardiff Business School
August 2000
## INDEX

1 INTRODUCTION .................................................................................................................. 3

1.1 Objectives ......................................................................................................................... 4

1.2 Definitions .......................................................................................................................... 4

2 MEASURING COST .............................................................................................................. 6

2.1 Direct Costing and Contribution Analysis .......................................................................... 6

2.2 Activity Based Costing Systems ........................................................................................ 6

2.3 Kaizen Costing, Pseudo Profit Centres and Target Costing ............................................. 9

2.4 Value Analysis – Value Engineering .................................................................................. 10

2.5 Lean Accounting ............................................................................................................... 13

2.6 Throughput Accounting .................................................................................................... 14

2.7 Life Cycle Costing ............................................................................................................. 14

3 MEASURING PERFORMANCE ............................................................................................ 16

3.1 Alignment of Measures – ‘Hoshin Kanri’ ........................................................................... 16

3.2 Process Performance Measurement Systems (PPMS) ....................................................... 18

3.3 Time Relevant Measurement Schemes ............................................................................... 20

3.4 Balancing Financial and Operational Measures – The Balanced Scorecard ................... 22

3.5 Customer-Focused Measurement ..................................................................................... 23

3.6 The Role of IT Systems in Cost and Performance Measurement ....................................... 24

3.7 Failure of Performance Measurement Scheme Implementations – Empirical Evidence 24

4 CASES .................................................................................................................................. 25

5 CONCLUSIONS .................................................................................................................. 26

5.1 Summary ............................................................................................................................ 26

5.2 Principles for Design and Deployment of Measurement Schemes ..................................... 26

6 Four Steps How to Review Cost and Performance Measurement Systems 28
‘What you get is what you measure!’

1 Introduction

Current cost accounting and management control systems are often obsolete or obstructing new process-driven business models. Major criticisms include:

- the distortion of product cost due to the allocation of indirect cost,
- the failure to produce key non-financial data required for efficient operations, and
- the provision of production of data that reflects external reporting requirements (i.e. stakeholders) far more than the reality of the new manufacturing environment.

It is generally acknowledged that efforts to improve production will be successful and permanent only when management accounting systems are brought into line with the new competitive environment. To improve management control systems, fundamental changes are needed (Kaplan, 1984).

Also, traditional performance measures, developed from costing and accounting systems, have been heavily criticised in the literature for encouraging ‘short termism’ (Banks and Wheelwright, 1979; Hayes and Garvin, 1982), lacking strategic focus (Skinner, 1974), encouraging local optimisation (Hall, 1983; Fry and Cox, 1989), encouraging minimisation of variance rather than continuous improvement (Johnson and Kaplan, 1987; Lynch and Cross, 1991) and not being externally focussed (Kaplan and Norton, 1992).

In an attempt to overcome these and other criticisms, performance measurement frameworks have been developed which provide a more balanced view, between the internal and external focus (Keegan et al, 1989), between levels in the organisation (Cross and Lynch, 1988 and 1989), between results and their determinants (Fitzgerald et al, 1991) and between four perspectives of the balanced scorecard (Kaplan and Norton, 1992).

This short report will review some of these theoretical approaches taken to performance and cost measurement systems – in the light in how these could be used to support a customer focused and process-oriented business model – and conclude with a conceptual approach to analyse and improve current systems.
1.1 Objectives

The objective of the report is to support the development of a new measurement system specifically for a customer-driven order fulfilment process in the car industry. The specific questions this report seeks to address are:

- How to devise measures to support a process optimum, as opposed to fostering the creation of departmental sub-optima, i.e. enabling the visibility of deciding whether ‘spending more at one stage in the supply chain saves cost / increases profit in the overall process’?

- How to introduce a customer and process focus into the measurement scheme, i.e. turn the attention away from functional / departmental issues to a ‘process thinking’?

- How to achieve a balance between financial and operational measures, as any imbalance might lead to a distorted performance picture and result in in-adequate action?

1.2 Definitions

**Activity**

The series of related tasks that are part of work performed in an organisation. It represents what is done - such as the several things needed to load a truck with goods to be shipped, or responding to a customer complaint.

**Activity Based Costing (ABC)**

A method of costing in which activities are the primary cost objects. ABC measures cost and performance of activities, and assigns the costs of those activities to other objects, such as products or customers, based on their use of activities.

**Allocation**

The appointment or distribution of a common cost between two or more cost objects. In accounting, allocation is usually a way of assigning a cost between cost objects (products, departments or processes) that share that common cost. An allocation involves dividing the cost needed to allocate by some physical quantity (ideally a cost driver).

**Cost Driver**

An event or factor that has a systematic relationship to a particular type of cost and causes that cost to be incurred.

**Fixed Cost**

A cost element that does not vary with changes in production volume in the short run.

**Incremental Cost**

The cost associated with increasing the output of an activity above some base level – or: the additional cost associated with selecting one economic or business alternative over another, such as difference between working overtime or subcontracting the work.

**Indirect Cost**

Costs that are not directly assignable or traceable to a cost object.
Life Cycle Cost
Accumulation of costs for activities that occur over the entire life cycle of a product from inception to abandonment.

Process
A series of linked activities that perform a specific objective. A process has a beginning, an end, and clearly identified inputs and outputs.

Variable Cost
A cost element that varies directly and proportionately with changes in production volume.
The following sections 2 and 3 review some of the recent ideas being discussed in the literature in relation to cost and performance measurement in general, and to process-oriented measurement in specific.

2 Measuring Cost

2.1 Direct Costing and Contribution Analysis

The direct costing concept tries to avoid the pitfalls of allocating any indirect cost to the products by only focussing on the direct cost of the product. The idea is to achieve the best possible view of the ‘real’ product cost, and then to analyse the profitability of the product, rather than debating the allocation of indirect cost.

In direct costing terms, activities that can be legitimately costed to products and services are ‘direct’, and the other cost objects are ‘fixed’. Of course, in the long term no costs are fixed but in the short to medium term contribution analysis provides a very powerful technique for exploring profitability at the product, channel, market segment and customer level.

Direct costing and contribution analysis are often used in conjunction with Activity Based Costing (ABC) or Attribute Based Costing (ABCII), as the major benefit from introducing ABC is often to accurately identify direct costs and undertake contribution analysis. ABCII uses ABC techniques to accurately cost ‘direct’ activities to products. Other activities that tend to be fixed in the short term are not charged to products and instead contribution must be sufficient to cover these costs plus profits. Contribution analysis provides a powerful technique for exploring profitability at the product, channel, market segment and customer level. In many industries, limited factor contribution analysis provides an even more powerful means of analysing profitability - which can reveal insights and dramatically influence business strategy. (Walker, 1998).

2.2 Activity Based Costing Systems

One reason why conventional costing systems have run into trouble with modern manufacturing approaches is that overhead cost are allocated in sometimes inappropriate ways, resulting in misleading product costs.

Conventional cost accounting allocates overhead to products by a two stage process: overhead costs are allocated to cost centres and departments, and then are re-allocated from cost centres to products on the basis of typically labour hours or machine hours consumed by the product.

This made sense when direct cost made up for the majority for the cost, yet nowadays direct labour and machining accounts for relatively little cost. Hence, major distortions due to the allocation of fixed costs are likely, if not inevitable.
Concept of Activity Based Costing (ABC)

Under ABC, the concept is that **cost elements are allocated to activities**, which are in turn allocated to products via ‘cost drivers’.

An activity traceable cost is the most basic grouping in ABC. Examples are salaries, rent, office machines, and power. A primary activity is a defined, repetitive operation that is undertaken in the company – such as planning, storage, materials handling, inspections, etc – which are directly linked to the value streams.

Secondary activities, such as training, should be accounted to the primary activities they serve.
Cost drivers are measures relating to the volume of an activity – for instance the number of set-ups made, or the area of floor space used in storage. Minor cost categories are non-traceable costs such as library and postage, which are difficult to trace to particular activities, yet could be assigned via traditional rules, such as direct machine hours.

The unit cost per activity is determined by dividing the total cost of the activity by the volume of the activity (for example the cost per inspection). These are the cost drivers that are ‘consumed’ by the products. Since activities are not costed in conventional systems, ABC yields valuable insights into the underlying cost structure of the business even before product costs are calculated.

For more detail see: Bicheno, J (2000).

Criticism of ABC

ABC is more likely to yield accurate costs than conventional costing, because there is greater traceability. However, even with ABC there is still considerable amount of judgement involved, so costs are never certain.

Also, ABC is criticised for failing to support strategic orientation and not enabling continuous improvement (Bittici et al, 1997).

However, ABC is most often criticised for its complexity, and hence to expensive to support. Bicheno (2000) states that if ABC is not set up properly, it can even be wasteful. Bicheno suggests that there is a trade-off between complexity and accuracy: ‘...one could have a complex system with scores of drivers but is all this worth it?..’, and suggests periodic audits to assess to benefits gained from ABC.

According to Cooper and Slagmulder (1999) however, this can be avoided - the reason for this complexity is seen in the fact that many costing systems went out to provide both product costing and support organisational improvement. Hence the systems had to cope with additional complexity, which was redundant is many perspectives.

Cooper and Slagmulder (1999) suggest using an ‘intelligent’ system, whereby systems would be distinguished according to their purposes: to support strategic product costing or to support operational improvement and learning. For product costing purposes, relatively simple SBC systems will suffice, Cooper and Slagmulder suggest.

Operational improvement systems require more detailed task analysis and real-time direct cost assignment, which make them more expensive to design and maintain as strategic product costing systems.

Cooper and Slagmulder hence suggest a two-system approach, one for strategic product costing (10 – 100 max activities) and one for operational improvement, with greater detail and a few hundred activities. The strategic system is to encompass the whole company, whereas the detailed system would only cover those areas where an ABC system is effective. Thus, the detailed system for improvement would not be ‘complete’. This twofold approach is described as ‘Intelligent System Design’.
Attribute Based Costing Systems (ABCII)

‘Attribute Based Costing (ABCII) is a quoted as a development of Activity Based Costing that supports management decision making for improved performance effectiveness. The major fallacy about ABC is that it provides a more accurate method of costing all overheads to products and services. Fully recovering all overheads still involves arbitrary allocations that can only provide dubious information. ABC should be an attention-directing system for management, rather than merely an accounting technique to value stocks and calculate profits.

ABCII uses ABC techniques to accurately cost direct activities to products. Comparing actual and target costs for major attributes reveals where effort and costs could be increased to provide more value, and where cost savings can be made without noticeably impacting customer value.’

…there are no major references for this, so I presume it is fairly irrelevant.

2.3 Kaizen Costing, Pseudo Profit Centres and Target Costing

Kaizen costing (Kaplan and Cooper, 1998) is an approach to develop a costing system to support continuous improvement activities in a company. It aims to motivate operators to drive costs down, rather than to record historic costs and variances for middle manager accountability.

Kaizen costing is less concerned with accuracy and more concerned with putting information necessary for good decision making in the hands of the people doing the work.

Kaizen costing is generally carried out by the team itself, who are provided with the basic hourly rates and other cost accounting data. The team will then be asked to produce weekly product costs against target (which could be decreased over time). Kaizen costing is usually related only to operational measures, such as changeover times, power used, inventory levels, etc.

‘Kaizen costing is about beating the current cost levels, not matching standards and explaining variances.’ (Bicheno, 2000)

<table>
<thead>
<tr>
<th>Standard Costing</th>
<th>Kaizen Costing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Concepts</strong></td>
<td><strong>Concepts</strong></td>
</tr>
<tr>
<td>Cost control system concept</td>
<td>Cost reduction control system</td>
</tr>
<tr>
<td>Assume the current manufacturing conditions</td>
<td>Assume continuous improvement in manufacturing</td>
</tr>
<tr>
<td>Meet cost performance standards</td>
<td>Achieve cost reduction targets</td>
</tr>
<tr>
<td><strong>Techniques</strong></td>
<td><strong>Techniques</strong></td>
</tr>
<tr>
<td>Standards are set annually or monthly</td>
<td>Cost reduction targets are set and applied monthly</td>
</tr>
<tr>
<td>Cost variance analysis involving standard costs and actual costs</td>
<td>Continuous improvement (Kaizen) is implemented during the year to attain target profit or to reduce the gap between target profit and estimated profit</td>
</tr>
<tr>
<td>Investigate and respond when standards are not met</td>
<td>Cost variance analysis involving target kaizen costs and actual cost reduction amounts</td>
</tr>
</tbody>
</table>
| Investigate and respond when target kaizen amounts are not attained.
‘Pseudo Profit Centres’ (Cooper and Slagmulder, 1997) takes this idea further, whereby each group or work centre is made a separate business. Then, each of these profit centres will be given the ‘transfer price’ for its products and hence has to manage its own cost. The work centre then is able to calculate profits, prioritise improvement activities and take decisions in case of shortages or other constraints.

Target Costing (e.g. Monden, 1992, Horvath, 1993) is another closely related approach, whereby the idea is to use target costing in the development phase, and kaizen costing post product launch.

Target costing essentially ‘works backwards’ from a given sales or target price, and then defines the allowable cost as: allowable cost = target price – target profit. Any gaps emerging should be attacked using the Value Analysis or Value Engineering tool.

2.4 Value Analysis – Value Engineering

Although not directly a costing approach, VA/VE is a most powerful tool to analyse and evaluate the cost structure and customer value of a product. It can be used to support any of the standard costing systems, and is widely being used by major companies world-wide since the 1940s.

Value Analysis (VA) is considered to be a process, as opposed to a simple technique, because it is both an organized approach to improving the profitability of product applications and it utilizes many different techniques in order to achieve this objective.

The VA approach is almost universal and can be used to analyze existing products or services offered by manufacturing companies and service providers alike. For new products, the Value Engineering (VE) approach, which applies the same principles and many of the VA techniques to pre-manufacturing stages such as concept development, design and prototyping.

At the very heart of the VA process review is a concern to identify and eliminate product and service features that add no true value to the customer or the product but incur cost to the process of manufacturing or provision of the service. As such, the VA process is used to offer a higher performing product or service to the customer at a minimal cost as opposed to substituting an existing product with an inferior solution. This basic principle, of offering value at the lowest optimal cost of production, is never compromised. It is the principle that guides all actions within the VA process and allows any improvement ideas to be translated into commercial gains for the company and its customers. The VA process is therefore one of the key features of a business that understands and seeks to achieve Total Quality Management (TQM) in all that it does to satisfy customers. For many of the worlds leading companies, including names like Hewlett Packard, Sony, Panasonic, Toyota, Nissan, and Ford, the VA process of design review has provided major business returns. The key to realizing these returns is knowledge, of the customer requirements, the costs of the product, and an in-depth knowledge of manufacturing process and the costs associated with failures due to poor or inadequate product design. All these inputs to the VA process are vital if decisions regarding product and process re-design are to yield lower costs and enhanced customer value.

The Value Analysis technique was developed after the Second World War in America at General Electric during the late 1940s. Since this time the basic VA approach has evolved and been supplemented with new techniques that have become available and have been integrated with the formal VA process. Today, VA is enjoying a renewed popularity as competitive pressures are forcing companies to re-examine their product ranges in an
attempt to offer higher levels of customization without incurring high cost penalties. In parallel, many major corporations are using the VA process with their suppliers to extend the benefits of the approach throughout the supply chain. Businesses, big and small, will therefore benefit from understanding and applying the VA process. It is likely that those companies that do not take the time to develop this capability will face an uncertain future as the lessons and problems of the past are redesigned into the products of the future.

Definition of Value Analysis

Value Analysis can be defined as a process of systematic review that is applied to existing product designs in order to compare the function of the product required by a customer to meet their requirements at the lowest cost consistent with the specified performance and reliability needed.

This is a rather complicated definition and it is worth reducing the definition to key points and elements:

1. Value Analysis (and Value Engineering) is a systematic, formal and organized process of analysis and evaluation. It is not haphazard or informal and it is a management activity that requires planning, control and co-ordination.
2. The analysis concerns the function of a product to meet the demands or application needed by a customer. To meet this functional requirement the review process must include an understanding of the purpose to which the product is used.
3. Understanding the use of a product implies that specifications can be established to assess the level of fit between the product and the value derived by the customer or consumer.
4. To succeed, the formal management process must meet these functional specification and performance criteria consistently in order to give value to the customer.
5. In order to yield a benefit to the company, the formal review process must result in a process of design improvements that serve to lower the production costs of that product whilst maintaining this level of value through function.

Defining Cost and Value

Any attempt to improve the value of a product must consider two elements, the first concerns the use of the product (known as Use value) and the second source of value comes from ownership (Esteem value). This can be shown as the difference between a luxury car and a basic small car that each has the same engine. From a use point of view both cars conduct the same function – they both offer safe economical travel (Use value) – but the luxury car has a greater esteem value. The difference between a gold-plated ball pen and a disposable pen is another example. However, use value and the price paid for a product are rarely the same, the difference is actually the esteem value, so even though the disposable pen is priced at X the use value may be far less.

It is important for all managers to understand the nature of costs in the factory and for any given product. Whilst there is no direct relationship between ‘Cost’ (for the factory) and customer ‘Value’ in use and esteem, this education process is important. A shocking figure, that is often used as a general measure, is that typically 80% of the manufacturing costs of a product will be determined once the design drawing has been released for manufacturing. The costs of production are therefore ‘frozen’ and determined at this point. These costs include the materials used, the technology employed, the time required to manufacture the product and such like. Therefore, the design process creates many constraints for the
business and fixes a high degree of the total product cost. It is therefore a process that demands periodic review in order to recover any ‘avoidable’ costs that can be removed throughout the life of the product (by correcting weaknesses or exploiting new processes, materials or methods) and lowering the costs of production whilst maintaining its Use value to the customer.

![Diagram of Recoverable Losses]

<table>
<thead>
<tr>
<th>Product Cost £/unit</th>
<th>TOTAL</th>
<th>Transformation costs</th>
<th>NEW COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Costs</td>
<td></td>
<td></td>
<td>Reduced Costs</td>
</tr>
<tr>
<td>Excess Costs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recoverable Material Costs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recoverable Transformation Costs</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Basically, there are three key costs of a product:

- **Cost of the parts purchased**: These are costs associated with the supply of parts and materials.
- **Cost of direct labour** used to convert products.
- **Cost of factory overheads** that recover the expenses of production.

Although there are three elements of total cost accumulation it is traditionally the case that cost reduction activities have focused on the labour element of a product. Activities such as work-study, incentive payments and automation have compressed labour costs and as a result there is little to be gained, for most companies, in attempting to reduce this further. Instead, comparatively greater gains and opportunities lie in the redesign and review of the products themselves to remove unnecessary materials and overhead costs. This approach to the ‘total costs’ of a product involves taking a much broader look at the way costs in the factory accumulate and the relationship between costs and value generation. These new sources of costs and evaluations would therefore include such sources as:

- **Cost of manufacture**
- **Cost of assembly**
- **Cost of poor quality**
- **Cost of warranty**

A detailed understanding of how costs are rapidly accumulated throughout the process of design to the despatch of the product is key to exploiting the process of VA. All VA activities are aimed at the reduction of avoidable and unnecessary costs, without compromising customer value, and therefore the VA process should target the largest sources of potential
cost reduction rather being and indiscriminate or unsystematic process (such as focusing on labour alone). It is therefore preferable to take the holistic approach to understanding costs and losses in the ‘entire system’ of design and conversion of value in order to determine how to achieve customer service ‘functionality’ at a minimal cost per unit.

2.5 Lean Accounting

With the advent of the ‘lean production’ paradigm in the Western manufacturing companies, it soon became apparent that the standard accounting systems were insufficient to support the new manufacturing system.

The traditional ‘mass’ producers used simple, volume based decision-making models. They assume that costs either vary with output (variable cost), or that costs are relatively constant (fixed) over a certain period of time (Ansari et al, 1997).

Lean producers know that volume is not the major factor affecting cost – they search for the ‘drivers’ of cost by analysing the tasks performed and the resources consumed by those tasks.

The following table sums up key differences between ‘Mass’ and ‘Lean’ accounting systems:

<table>
<thead>
<tr>
<th>Mass Production</th>
<th>Lean Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume based decision making models, relating volume to cost</td>
<td>Cost driver decision making models, relating drivers to cost</td>
</tr>
<tr>
<td>Responsibility accounting - Individual or departmental responsibility and targets</td>
<td>Process Accounting - Value stream focus</td>
</tr>
<tr>
<td>Inventory tracking and controlling is central task due to high capital employed</td>
<td>No inventory, hence not major focus</td>
</tr>
<tr>
<td>Labour efficiency is key area</td>
<td>Focus on indirect cost / efficiency of cell, not individual</td>
</tr>
</tbody>
</table>

Inventory is not accounted for properly in standard cost management systems, as double-handling and quality defects generally are assigned to overhead or other fixed cost, whereas the only variable cost are interested and warehouse space. Hence stocking products or materials appears far more favourable than it should be – in fact, the best spread of the fixed warehouse and stocking cost is achieved at a maximum fill of the warehouse!!

A study of JIT implementations in manufacturing companies in the USA (Durden et al, 1999) indicated that that those companies operating a JIT production system also change their accounting systems and place greater reliance on non-financial performance indicators. Empirical evidence is provided suggesting that JIT manufacturing companies which have modified their cost accounting systems demonstrate higher performance then JIT companies that have not done any changes.

The results suggest that greater use of non-financial measures is associated with higher performance, irrespective of the production management system operated.
2.6 Throughput Accounting

Throughput accounting is a part of the Theory of Constraints, promoted by Dr Eliyahu Goldratt (1990). Goldratt heavily attacked standard accounting measures of distortion manufacturing information and opposing real improvements by providing false interpretations of the data.

Goldratt states that there are only three relevant measures for a business: throughput, operating expense and inventory. Profit is calculated as throughput minus operating expense and inventory, whereby inventory accounts for all machinery and materials. Operating expense is all expenditure needed to turn inventory into throughput, whereby throughput only refers to the actual products sold, i.e. converted into cash.

Goldratt also states that any work in progress should only be accounted for at the value of its raw materials, as in fact no ‘value’ has been added to the material, unless it is sold to a customer. Hence all value added accounting is obsolete, and only operating expense and inventory are accounted for.

All improvement activities within the company should focus on improving profit by increasing throughput or reducing operating expense and inventory, and should be accounted against these.

Whilst very radical in his views, Goldratt earned a lot of supporters amongst the manufacturing community, and TOC is seen as one of the standard manufacturing approaches.

2.7 Life Cycle Costing

Physical assets form success. It has thus become essential to plan and monitor assets throughout their entire life cycle, from the development/procurement stage through to eventual disposal. Life cycle costing is concerned with optimizing value for money in the ownership of physical assets by taking into consideration all the cost factors relating to the asset during its operational life. Optimizing the trade-off between those cost factors will give the minimum life cycle cost of the asset. This process involves estimation of costs on a whole life basis before making a choice to purchase an asset from the various alternatives available. It is suggested project managers should familiarize themselves with what the approach involves, to better appreciate how they might then contribute to the enhanced quality decision making which it makes possible. (Woodward, 1997)

Example: Energy Generation

Life-cycle cost analysis represents a paradigm shift in energy system cost analysis, which had its roots in the energy crisis of the early seventies. Even in the year 2000, there is still much discussion, in terms of quantifying "all" costs of procurement, operation, maintenance, and even disposal of systems for cost comparison purposes. A typical case for life cycle cost comparison is any rural or remote solar photovoltaic installation compared to a remote diesel system for critical use electrification.

Costs are calculated separately for any specific case, though the basic principles underlying life cycle cost calculations are the same in all instances. The actual comparison values will vary from site to site.
In general, total costs are calculated at the discounted present value of the cost of components, measured in constant dollars, for providing the end-use service to a customer for 15 to 30 years. Such time horizon and discount rate are commonly used in any planning for the supply of electricity.

The focus of analysis is on the total costs of providing the end-use service that customers want, rather than the cost of electricity alone. This approach is particularly important in a comparison of the costs of solar PV and diesel systems because of the dissimilar cost structures and energy efficiencies for appliances and power needs that customers use with solar electric systems (i.e. DC, direct current power plus AC power) vs diesel systems (generally AC power only). DC appliances are often relatively more energy-efficient, and also cost more than comparable AC appliances. For the purpose of analysis, it is assumed that the both solar PV and diesel systems are properly designed, installed, and maintained.

Three broad categories of costs apply:

1) **Customer appliance costs**. These reflect the costs of the appliances used by customers. For simplicity, a linear depreciation schedule is assumed, so that the residual value at the end of 15 years is based on the fractional remaining life of the equipment.

2) **Generation equipment costs** reflect the costs of the hardware needed to provide a reliable supply of electricity to the customer. Both initial and replacement costs are taken into account, and a linear depreciation schedule is used to calculate residual values at the end of the useful life of the equipment. Included are engine and generator overhauls, which are assumed to take place every five years for diesel systems but are not needed for solar PV systems.

3) **Operational and maintenance costs** reflect ongoing, daily, monthly, and annual costs the generation equipment installed at the customer’s site. These costs are generally based on the wages and travel costs of the installing contractor’s agents who must periodically visit the customer’s site, the costs of outside system operators and maintenance personnel, and the associated costs of stocking parts and equipment. Site visit-team overhead costs are also included.

On a 15-20 year basis, the future costs of generation equipment, end-use appliances, and operations and maintenance over such time periods come into play, though for simplicity it is often mistakenly assumed that these costs will remain unchanged in constant dollars over time.
3 Measuring Performance

3.1 Alignment of Measures – ‘Hoshin Kanri’

Hoshin Kanri (Akao, 1991) is the Japanese term for ‘policy deployment’ and has also been translated as ‘a methodology for setting strategic direction’. And has become an well-accepted way of planning and communicating quality and productivity goals throughout an organisation. It is the emerging method of strategic quality and productivity planning and is used by the leading Japanese and Western companies (Toyota, Sony, HP, TI, P&G).

It is, in essence, very simple but requires high levels of commitment and time. The objective is to communicate common objectives and gain commitment throughout the organisation.

It refers to a methodology used in Japanese Management systems on how to deploy measures by translating the mission statement / business strategy down into the lower level measures, up to the final measures for each individual.

Translated literally, ‘hoshin kanri’ means ‘the captain steers the ship’. What is meant is that the captain of a ship only gives top level commands, which then are translated into the individual tasks for the subordinate crews, as the command feeds down the hierarchy. On the feedback flow, the captain only needs to get the top-level feedback, whereas the detailed feedback is only required at lower level.

The main focus of Hoshin is to keep the measures ‘aligned’ with the top level strategy, as it is argued that any misalignment causes sub-optimal behaviour in certain departments and ultimately conflicts between departments – as they are not ‘pulling the same string’.

This alignment is also seen as critical by McNair and Mosconi (1987), Drucker (1990) and Russel (1992), who see the need for alignment of financial and non-financial measures that fit within a strategic framework.

The following table show potential conflicts inflicted by internally misaligned measures. In the same manner, this misalignment can affect players in the supply chain as well; we would call this phenomenon external misalignment.
### Functional Measures

<table>
<thead>
<tr>
<th>Bulk Purchase</th>
<th>Purchasing</th>
<th>Production</th>
<th>Marketing</th>
<th>Finance</th>
<th>Logistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td>❌</td>
<td>❌</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Longer Production Runs</th>
<th>Purchasing</th>
<th>Production</th>
<th>Marketing</th>
<th>Finance</th>
<th>Logistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Broad Product Range</th>
<th>Purchasing</th>
<th>Production</th>
<th>Marketing</th>
<th>Finance</th>
<th>Logistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>❌</td>
<td>✔</td>
<td></td>
<td></td>
<td>❌</td>
<td>❌</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tight Fiscal Control</th>
<th>Purchasing</th>
<th>Production</th>
<th>Marketing</th>
<th>Finance</th>
<th>Logistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>❌</td>
<td>❌</td>
<td></td>
<td></td>
<td>❌</td>
<td>❌</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Decreased Delivery Times</th>
<th>Purchasing</th>
<th>Production</th>
<th>Marketing</th>
<th>Finance</th>
<th>Logistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>❌</td>
<td>❌</td>
<td></td>
<td></td>
<td>❌</td>
<td>❌</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Full Truck Loads</th>
<th>Purchasing</th>
<th>Production</th>
<th>Marketing</th>
<th>Finance</th>
<th>Logistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Furthermore, Hoshin is a process-oriented deployment tool, as the measures are analysed on how they fit into (or contradict with) the key business processes. Key business processes regarded are:

- Order Fulfilment
- Sales Acquisition
- New Product Development
- New Product Introduction
- Sustainability
- Etc.

At the top level, there might only be 3 to 5 ‘hoshins’, generally developed by consultation. Hoshin objectives are customer-focused, based on company-wide information, and are measurable.

In essence, there are 5 stages, according to Juran:

1. Expand the business plan to include quality and productivity goals, not only ROI and profitability (.the BSC thought, basically)
2. These goals are deployed down the organisation to determine the required resources, to agree on the actions, and to fix responsibilities
3. Develop appropriate measure at each department and function
4. Review the progress regularly
5. Adjust the reward (performance) system to support the quality and productivity goals

Feedback goes the reverse direction – difficulties and constraints are identified and fed back to the level above who are required to act accordingly. Also, measures are taken and gaps identified. If a problem is identified, corrective action is taken in relation to the process, not the person. This ‘blame free’ culture is critical.
3.2 Process Performance Measurement Systems (PPMS)

Similar to the Hoshin approach to deploying measures throughout the organisation, Kueng (2000) proposes a step model on how to identify and deploy process oriented measures.

Business processes and their activities have to make a contribution to the enterprise-wide goals and the process goals, respectively. Since process improvement should be aligned with the process goals and improvement takes place where measurement is carried out, it is self-evident that process performance indicators derive from process goals.

Step 1: Define high-level process goals. The identification of performance indicators begins with the definition of business process goals. In order to develop more than a unilateral view it is useful to state at least one primary, high-level goal for each of the five aspects. An example of a primary goal is 'satisfied customers'. As such a goal is very general it has to be specified by the subsequent steps. It is important that each process goal-high-level goal as well as subgoal-be congruent with enterprisewide goals, take into account the behaviour of the competitors and, last but not least, be in line with process stakeholders' interests.

Step 2: Derive performance indicators. In order to find possible indicators for a certain goal, the following question can be asked: What is measurable and reflects the extent to which a certain goal has been fulfilled? For example, in order to measure the goal 'satisfied customers' an overall customer satisfaction index (proposed by Kristensen et al. (1992) or Kaplan and Norton (1996), p. 82) could be used; However, it is not always possible to find indicators which are clearly related to the goal stated. For instance, the high-level goal 'societal responsibility' can hardly be measured directly. In this case, a further refinement (cf. step 3) will solve the problem.

Step 3: Derive subgoals. Since goals and their associated performance indicators may be rather general (especially during the first iteration), it is necessary to decompose them. However, a simple goal decomposition carried out by someone without specific domain knowledge is not sufficient as it does not take into account that different organizations follow different achievement strategies. Therefore, the question to be asked is: Which means or actions can be taken by the organization to fulfil a certain goal? The answer normally received has the form of a subgoal. For example, in order to raise overall customer satisfaction, on-time delivery is critical and can serve as a subgoal. And what if no means can be applied (within the process team) to accomplish a certain process goal? There are two choices: either the goal has to be moved to a higher organizational level or the process team has to be empowered in order to apply certain means.

Step 4: Refine and modify goal tree. Continuous measurement of selected performance indicators often leads to the effect that process actors emphasize the aspects measured at the expense of unstated or implicit goals (Austin, 1996). To anticipate this effect we have to ask whether measurement of the elicited indicator(s) produces unintended side-effects. If this is very likely, the goal tree has to be completed and performance indicators added if possible. For example, stressing the goal 'on-time delivery' could lead to increased stocks. In order to prevent such an unintended migration, an additional indicator, e.g. 'profit on working capital', should be added. (Go back to step 2 and iterate as often as needed.)

There is a debate whether performance indicators should be focused on procedures (activities) or on results (output). The procedure-oriented community, e.g. the ISO 9000
community, argues that procedures (processes in a narrow sense) determine the result. In other words, good results are achieved through good procedures. The result-oriented community, on the other hand, argues that there is no 'one best way'. The best procedures have to be chosen according to the resources available. This may lead, for instance, to a situation whereby process team A chooses procedures g, h and j, while process team B selects procedures g, k and p to achieve an equivalent result. What may be concluded? The more precisely the ideal procedures are known and the more uniform and predictable the resources are in their behaviour, the better performance measurement can be focused on procedures. In contrast, the more potential approaches, techniques and tools exist to achieve stakeholders' satisfaction the more the emphasis should be placed on results.

Requirements on process Performance Indicators

In the preceding section it was shown how performance indicators can be elicited. The aim of this section is to list the requirements which performance indicators should fulfil. According to Kitchenham (1996, p. 103) and Winchell (1996, p. 108), the main requirements are:

* **Quantifiability**: If performance indicators are not quantitative by nature, they have to be transformed. For instance, the performance indicator customer payment attitude could be transformed into number of days between 'invoice sent' and 'invoice paid'.

* **Sensitivity**: Sensitivity expresses how much the performance must change before the change can be detected. Therefore, a sensitive indicator is able to detect even minor changes in performance.

* **Linearity**: Linearity indicates the extent to which process performance changes are congruent with the value of a certain indicator. Or, conversely, a small change in the business process performance should lead to a small change in the value of a corresponding performance indicator, whereas an ample performance rise should also lead to strong change in the level of the performance indicator.

* **Reliability**: A reliable performance indicator is free of measurement errors. To illustrate, if a certain business process has to be rated through a given performance indicator by different experts, the results should not depend on the subjective evaluation of an individual.

* **Efficiency**: Since the measurement itself requires human, financial and physical resources it must be worth the effort from a cost/benefit point of view.

* **Improvement-oriented**: Performance indicators should emphasize improvement rather than conformity with instructions. Therefore, measuring billing errors, number of safety violations, data entry errors and the like do not create an atmosphere where feedback sessions are viewed in a positive, constructive light.

Although performance indicators may possess the attributes listed, this does not guarantee that the indicators will be used in order to improve process performance. A requirement of primary importance is acceptability. It is evident that process teams who are measured by certain indicators on one hand and have to improve process performance according to the level of certain indicators on the other hand, must perceive the selected indicators as a fair and accurate assessment instrument. If the indicators are not well received it will be unpromising to establish a process performance measurement system to improve long-term performance and competitiveness. To check whether process participants consider the 'given' indicators as useful or not, a questionnaire can be very helpful.
A PPMS is designed and implemented with substantial involvement on the part of senior management. For a project such as the implementation of a PPMS the endorsement and personal support of senior management must be given. Commitment of senior management without empowered process managers will not lead to success. Cross-departmental communication (e.g. human resources department with process managers) and a cooperative approach are absolutely necessary. Even then, it is very difficult to institutionalize process performance management into management thinking and into the daily operating practices of an organization.

Kueng concludes in relation how to use a PPMS:

* Data collection must be made as easy as possible. The more effort process actors must put into non-original activities the more difficult it is to convince them that performance measurement is essential. One approach is 'automating data collection'; even more effective is 'minimizing the amount of required data'.

* One of the crucial requirements for effective use of a PPMS is the acceptance of the chosen indicators. Hence, it is essential to ensure that process participants can express themselves as to whether they consider the 'given' goals and indicators useful or not. The application of a questionnaire (in a first round) and face-to-face communication (in a second round) have proved useful. Based on an empirical study, Sinclair and Zairi came to the conclusion that personal involvement was vital for effective performance measurement (Sinclair & Zairi, 1996, p. 378).

* Measurement dysfunctions (aspects measured are improved at the expense of aspects not measured, though they may be relevant) exist and cannot be fully excluded--even if one tries to implement a balanced set of indicators. In order to anticipate an unintended shift, a more fruitful but demanding approach may be for the process team to establish a common understanding, an understanding where goals, objectives and values are shared as far as possible among the individuals.

* PPMSs in themselves do not have the ability to improve competitiveness per se. If, however, PPMS are used in conjunction with social transformation such as team orientation, a changed attitude towards openness, etc. the potential seems to be significant.

To summarize the approach described, Kueng believes that process performance measurement is a necessity for a modern process-oriented organization. Based on our experience with several enterprises, it seems very unlikely that a universal set of performance indicators can be applied successfully to all business processes. Thus, performance indicators must be process-specific and have to be derived from both the strategic enterprise-wide goals and the process goals. Performance measurement, by itself, does not show which actions are to be taken in order to improve a process. However, it is a means to give the process a clear direction, to identify areas of weakness, to evaluate process performance comprehensively and to assess the impact of previous process changes.

### 3.3 Time Relevant Measurement Schemes

Schonberger (1999) criticises existing measurement schemes on two factors, the level of aggregation and the time lag. Schonberger argues that in many cases the level of aggregation of the measures is too high to point out the right corrective action.
Furthermore, he argues that the time lag – until the results are fed back – is a major downfall of current measurement schemes.

He acknowledges the Balanced Scorecard (BSC) as a partial solution for these problems, as the BSC is able ‘to raise the key business factors to prominence alongside the financial numbers, with the same degree of systematic measurement against goals’. He sees the BSC as a valid tool to measure competitive factors (such as throughput times, time to market or quality), yet argues that mixing these measures with middle-management or executive level measures creates and ‘unbalanced scorecard’.

The outcome of doing so, he argues, is to distance causes from effects, hence making it more difficult to deploy the right corrective action.

He therefore suggest to group all measures according to their ‘time relevance’. The three groups he suggests are:

- **Direct Effect**, or the results of ‘process management’, as e.g. throughput-time reductions, value-added rations, space reductions, etc. This category is a useful indicator for good or bad practices.

- **Short and Medium Lag** performance measures conventionally monitored at functional or middle-management level. These are not used as management targets, as the time lag is too great, and there is little indication of the causes. This category is a rough indicator of effective or ineffective programmes, if the trends continue for several periods. Beware of reacting to short-term (i.e. month to month) variability!

- **Long Lag** measures, generally reviewed by the top management, such as cash-flow, market share, etc. This category is a rough indicator of effective or ineffective strategies, if the trend continues for several business periods.

Schonberger states that with the advent of process management, current measurement is a futile exercise, and may even prove to be harmful (by pushing costs on a short term basis out into other subsystems).

He suggest to cure these ills by taking the top measures of each category – direct-effect, lag and long-lag – and let senior management set goals for these, which would be reviewed on a monthly basis.

The ideal measurement system in Schonberger’s view only focuses on data-based management of processes. Direct effect measures would be reviewed on a weekly, daily or even hourly basis. These metrics would be made known to all employees and departments. The second and third column metrics would not enter the scorecard at all, yet might be watched and measured, but would not be managed! Schonberger sees these measures as ‘score records in sports’, They give the vital score and are cause for cheer, yet are not being managed.
### 3.4 Balancing Financial and Operational Measures – The Balanced Scorecard

Johnson and Kaplan (1987) heavily criticised corporate measurement systems as heavily biased towards ‘stockholder requirements’, i.e. unbalanced towards backwards looking financial metrics. They claim that this is one of the root causes for Western companies falling behind Japanese manufacturers.

This situation has been described as:

‘.. like a one-eyed person driving a car by looking through the rear view mirror.’

The Balanced Scorecard (Kaplan and Norton, 1996) is now widely recognised as being a significant improvement to performance measurement schemes. Kaplan and Norton developed a methodology for a balanced set of measures. The objective is to achieve a balance between financial and non-financial (operational) measures, and a balance between backwards and future oriented measures.

According to Kaplan and Norton, there are four aspects that any performance measurement system needs to cover:

- Financial aspects
- Customer or externally focussed measures
- Business process or internally focussed measures
- ‘Learning and Growth’ measures

Moreover, Kaplan and Norton maintain that measures should be capable of ‘telling the story’, that is they should form a logical sequence showing how learning and growth lead to
operational growth, which are both assisted by customer or market orientation, which finally result in financial return for shareholders. Such a framework can be both top-down and bottom-up, with participation at all levels in much the same way as the Hoshin framework.

As a variation to the balanced scorecard, a Cambridge version of it, based on an input-output model, is shown below.

3.5 Customer-Focused Measurement

The Cambridge research group on performance measure believes that before going into any detail, products should be grouped into product families and a simple question should be asked: *What makes a customer buy from you?* Only once this question has been answered, more detailed measures should be deployed.

According to Veitch et al (1999) there are two major categories of customer-focused performance measures:

1. Those which seek to identify the relationship between key elements of the customer/supplier interaction and the organisation’s overall business performance – Service Profit Chain, Loyalty Based Management, and SERVQUAL (references omitted).
2. Those which seek to redress the balance between the use of financial and business process measures, to assess business performance, e.g. the Business Excellence Model, The Balanced Scorecard and Customer Value Management (references omitted).

Although distinct in structure and scope, Veitch et al see these schemes as predominantly focussing on the strategic side of customer service, and neglecting the operational level of it. They see a gap of literature in the area of the operational side of customer service.

Veitch et al propose a three-step approach for the development of customer-focused measures – a customer service audit, an in-depth study of internal service support systems and processes, and a customer survey for the collection of primary data within the organisation’s customer network *(for details see full paper).*

→ This approach has been tested and geared at Small and Medium Size Enterprises (SMEs), yet the systems approach as such might prove as valid for larger organisations.
SERVQUAL

‘Managers cannot know how good their service is until they ask their customers’ (St. Clair, 1997). Though this perception is not entirely new, in practice customer aspects are rarely systematically evaluated. This observation not only holds for enterprise-external customers, but also for enterprise-internal process customers, as they are often less visible than the former (Kueng, 2000).

To evaluate process performance from the customer’s point of view, the SERVQUAL approach is frequently used (Parasuraman et al., 1988). This instrument consists of two sections of questions: section one addresses customer expectations, section two is dedicated to gathering customer perceptions regarding a certain service they ‘consume’.

A second approach proposes to abstain from an explicit inquiry of customer expectations. Instead, quality criteria are defined and customers have to rate both the degree of fulfilment and the importance of each criterion (Kristensen et al., 1992).

3.6 The Role of IT Systems in Cost and Performance Measurement

Whilst the enabling role of today’s IT systems and their ability to provide real-time and encompassing global is widely being acknowledged, there are some more differentiated views.

Several studies showed that higher levels of investments in IT did not lead to productivity gain; a phenomenon called the ‘productivity paradox’ by Brynjolfsson (1993).

Today there is some consensus that IT systems cannot be assessed at an enterprise level; instead it must be evaluated in terms of its support of the process goals (Mooney et al., 1996). Since the performance measures of a measurement scheme are linked to the process goals, the deployment of a scheme can effectively help to assess the impact of IT investments.

3.7 Failure of Performance Measurement Scheme Implementations – Empirical Evidence

Bourne et al (1999) conducted an empirical study of manufacturing companies and their implementation of performance measurement schemes. The reasons for failure or not implementing the new schemes were firstly the loss of interest by the managing director who was not sure of the benefits he would get out of the project and, secondly, the conflict between the new locally deployed performance measures and those used by the parent company.

Also, the research showed that the implementation process itself was not perceived as a key problem – it was the waning of senior management commitment that caused the failure.

The conclusion Bourne et al reach is that successful implementations of performance measurement schemes take time and effort over a considerable time period, nearly 12 to 18 months in the cases analysed in their study. Given this length of time, Bourne et al conclude that it was no surprise that the project was overtaken by other events.
Bittici et al (1997) furthermore identified two critical factors when deploying new measurement schemes: integrity of the scheme, and the deployment approach itself.

4 Cases

Overall there are an infinite number of successful implementations reported on redesigned performance and cost measurement systems. In many cases, Japanese approaches and techniques have been fully or partially adopted to introduce a value and customer focus into the business.

In regards to Auto, it should be stated here that techniques such as ABC and Value Analysis have been very successfully implemented in Western Auto manufacturers. Chrysler for example introduced ABC in 1991 and found that the cost for some components made in house was 30 times higher than their accounting systems made them believe, hence ABC enabled them to outsource specifically and reduce component cost drastically.

Japanese accounting and performance systems have been widely described as superior to standard approaches in the Western world. To a great extent this is a result of the focus on continuous improvement, which drives not only the manufacturing bit but the whole enterprise, and the Hoshin Kanri technique in how to deploy measures within a company that are in line with the overall business strategy.

Those two factors, I believe, created a competitive advantage for the Japanese companies – as everyone was pulling the same rope, and everyone was continuously trying to pull more efficiently.

One particular case however should be mentioned here, whereby one European car manufacturer set out to deploy a process-oriented measurement scheme in conjunction with a new lean supply and distribution system. The idea was to evade a particular problem current accounting systems had: the time lag effect. In today’s systems, we are looking at the beginning of June at ‘May’s numbers’, that is May’s production, distribution cost and May sales. This however, is highly inaccurate, as the sales made in May are hardly produced in May, if have passed through the distribution channel at the most. Hence due to the enormous time lag from manufacture to the point of sales.

The new scheme proposed hence relied on a very simple concept: the cost of vehicle is accounted as before, using direct and indirect costing systems. The customer service measures however are analysed backwards from the customer perspective. All lead time measures relate back from the time of order entry to the point of handover. The detailed cost associated with this particular sale are only accounted for in detail from the point of the vehicle being identified with the order.

The performance measures used are:

- Cost of vehicle up to point of allocation to customer order
- Cost of vehicle from this point onwards, specifically
  - Direct marketing cost, including discounts and other benefits
  - Indirect marketing cost
- Operational measures
  - Lead time from order entry
  - Delivery date reliability
  - Correct specification
  - Vehicle quality
Using this approach, a very powerful and accurate (customer focused) picture of the order fulfilment performance could be established. The data for the measures is being extracted from the vehicle tracking system, the vehicle history file and the various accounting systems along the supply chain.

→ For cases on ABC see: Kaplan and Cooper, 1998. For cases on Hoshin see: Akao, 1991. For cases on VA see Bicheno, 2000. Furthermore, a huge variety of cases are available on the internet.

5 Conclusions

5.1 Summary

The literature and case study review has found a range of approaches towards customer-focused or process-oriented cost and performance measurement. The discussion surfaced a wide variety of opinions in relation to these approaches, yet in general it is agreed upon that

- **Performance Measures drive behaviour** – hence the design of a cost and performance measurement scheme is critical to business success. With the advent of modern IT technology, the support of more appropriate measurement systems is now seen as feasible.

- **Current Accounting Systems do not support process orientation.** Standard accounting systems have frequently been criticised on this issue, as they foster a departmental focus and tend to produce ‘local optima, at the expense of a global optimum’. Strategic costing systems can rely heavily on indirect cost assignment, for operational improvements such estimates are worthless. The individuals or departments measured will simply argue that the estimates are incorrect and insufficient for performance evaluation, and they’ll be right! Performance evaluation requires real-time direct cost assignment.

- **Cost Management / Performance Measurement requires a holistic perspective.** Cost and operational performance are in a cause and effect relation – hence need to be jointly. Hence, when devising a new approach to Cost management and performance indicators, the two cannot be separated. In fact, in most cases the performance measures are a variety of financial indicators, such as ‘Return On Investment’ or ‘Cost of X’, and operational indicators, such as customer service indices. The main contribution here was the Balanced Scorecard, which is generally seen as a valid approach.

- **Cost as such is a poor measure.** Cost as a stand-alone measure is very poor for various reasons; first of all, cost can too easily be altered on a short-term basis to ‘look good’ for the measurement period, and the long term effect of this behaviour is not covered by the cost measure. Hence, measuring cost fosters ‘short termism’. Also, a cost saving action in one department can induce extra cost in other parts of the supply chain, which will is completely undetectable with departmental or non-process oriented measures.

5.2 Principles for Design and Deployment of Measurement Schemes

The objective of process performance measurement scheme is to provide comprehensive and timely information on the performance of business processes. This information can be
used to communicate goals and current performance of a business process directly to the process team, to improve resource allocation and process output regarding quantity and quality, to give early warning signals, to make a diagnosis of the weaknesses of a business process, to decide whether corrective actions are needed and to assess the impact of actions taken (Kueng, 2000).

In relation to how to deploy a process-oriented set of measurements to avoid the problems mentioned above, the following principles could be extracted from the existing body of knowledge:

1. **A balance** is needed between financial and operational measures, with greater focus on non-financial measures, as studies show that this shift in focus increases performance levels. **Cost as such is perceived as dangerous measure**, as it leads to ‘short-termism’ and opposes process thinking.

2. **Time relevance** is seen as another key, whereby the focus of attention should be on the measures that can be directly affected, not on those measures that have a time-lagged feedback loop. It is argued to **measure** time-lag metrics, but not to **manage** them. As an interim solution, a portfolio of all three categories might be used and reviewed monthly.

3. **Alignment** of metrics critical to support the key business processes, as conflicting between measures will lead to sub-optimisation.

4. **Time focus.** Measurements need to be compared using the correct time, otherwise the causal link is distorted and corrective action is mislead.

**Activity-based costing** might prove to be an alternative, but attention is needed to keep it simple for product costing. The level of detail depends on objective of measurement schemes - different levels of ABC detail needed for product costing and support of organisational improvement.

Regarding the frequency of data collection and feedback of results, Grant and Higgins (1996) show that employees are most likely to believe that feedback is accurate if it is provided frequently. On the other hand, if data collection and feedback takes place often, the sense of being controlled is also increased.

**How to introduce a customer focus into the measurement scheme?**

This assumes that customer focus is a critical success factor for the company or is a key strategy. In either case the way here seems to use the policy deployment methodology, whereby the current measures should be evaluated in how far they support the key business success factors and/or cause internal conflicts. Then, a revised set of measures should be deployed by starting off from the critical success factors, which then are deployed down into the hierarchical levels.

**How to prove that spending more in one part of the supply chain can increase profit or customer service?**

This proof is almost impossible to provide on an holistic basis (other than using the 3DayCar simulation), yet might be achieved using limited pilot studies.
In general it has to be insured that all performance measures are in line with the overall objectives of the key processes. If then all departments work towards improving these measures, sub-optimisation should not occur at all – the more one department tries to improve on a measure, the more the overall objective is supported.

6 Four Steps How to Review Cost and Performance Measurement Systems

This section proposes a five-step process to analyse existing costing and performance measurement systems in terms of its effectiveness and support of the process goals. In the last steps, a new set of measures will be deployed, if the existing ones are to be found insufficient.

1. Current Cost Structure Analysis

A: In a Process Activity Mapping exercise, the direct cost structure of a product should be mapped out and displayed across the supply chain. This map should then be expanded into a Cost Analysis Time Profile, and subsequently into a Value Analysis Time Profile.

B: A similar approach should be taken to the overhead cost, which should be mapped out over the supply chain.

C: Then, a Value Analysis exercise for the total cost should evaluate value and relevance to the customer and surface the waste in the system.

As a result of the Value Analysis exercise, improvement projects should be brainstormed.

In case the overhead allocation content exceeds a significant part of the total cost, and ABC approach could help to convert more overhead into direct cost. A simple ABC system should be sufficient here.

2. Improve Costing Systems

If Activity Based Costing seems appropriate, this is definitely worth considering. To foster the process improvement, a Kaizen costing might also be installed to monitor the improvement of the system.

The improvement activities here should address the root causes endeavoured in step 1.

3. Analysis of Current Measurement Schemes

Much in the same as the costing systems, the performance measures should be evaluated under the following considerations:

- **Conflict Analysis**: do the measures support my overall process goals? This analysis should be conducted using a table for each of the key processes. Do these measures foster continuous improvement?

- **Time Relevance Analysis**: are current measure time relevant, or is the focus balanced on non-direct, i.e. time lagging measures?

- **Time Synchronisation Analysis**: are the measures relating to the correct time horizons, or are the results simply accounted when the feedback is recorded?
- **Balance Analysis**: are current measures balanced in terms of financial and operational measures, and are these balanced in terms backwards / forward looking?

4. Deployment of Process-oriented Measurement

In case of a misalignment or unbalance of the current measurement scheme with the process goals, a policy deployment / Hoshin Kanri or a PPMS exercise should be conducted to devise a new set of measures.

These four steps should be run for a pilot product first, before being deployed into the whole system, yet the pilot study should provide for an extrapolation or estimate of the full impact of the changes.
References


Ansari, S, Bell, J, Klammer, T, and Lawrence, C, (1997), ‘Management Accounting in the Age of Lean Production’, Management Accounting Series, McGraw Hill,


Fry, T D, and Cox, J F, (1989), 'Manufacturing Performance; Local versus Global Measures’, Production and Inventory Management Journal, 2nd Quarter


