Using the SCOR Model to Assess the Potential Impact on Business Metrics of an IT Solution

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SCOR, supply chain management, business metrics

We report on preliminary work towards developing a model-based method for assessing the impact of an IT solution implementation on business metrics in the supply chain domain. We use the supply chain operations model (SCOR) and extend it with metric interdependencies and solution and best practice relationships. We then estimate the likely improvement in a SCOR performance attribute or level I metric given that a set of best practices is implemented with a specific HP IT solution. The estimates can be used to qualify business performance indicators and metrics likely to improve upon the successful introduction of the HP solution into the enterprise.

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Abstract. We report on preliminary work towards developing a model-based method for assessing the impact of an IT solution implementation on business metrics in the supply chain domain. We use the supply chain operations model (SCOR) and extend it with metric interdependencies and solution and best practice relationships. We then estimate the likely improvement in a SCOR performance attribute or level I metric given that a set of best practices is implemented with a specific HP IT solution. The estimates can be used to qualify business performance indicators and metrics likely to improve upon the successful introduction of the HP solution into the enterprise.

1. Introduction

For a number of enterprises, past investments in IT infrastructure have failed to deliver on promised business benefits and have resulted instead in increased integration costs of point technologies. Consequently, the CIOs demand [BEA 2003] that any future IT investment should be aligned with the business objectives of an enterprise, and the operational efficiencies gained should be measurable against the business metrics of interest.

The shift from pure technology consulting to a combination of business and technology consulting requires a change in the consulting engagement processes as well as development of suitable tools to support it. These tools should provide a link between the established operational business models and the IT solutions components.

This paper reports on the results of extending the industry standard, supply chain operations reference model (SCOR) and the application of a scorecard procedure that computes the likely impact of supply chain solution components on the SCOR business metrics.

First, we introduce the original SCOR model and discuss existing associations between the elements of the model relevant to the problem. We then discuss minimal extension to the model required to relate an IT solution to business performance indicators. In the following section a plausible method for the calculation of business impact of a given IT solution is given and the assumptions made are outlined. Finally, we discuss the results and make recommendations for further work in the area.

2. Original SCOR Model

The Supply Chain Operations Reference-model (SCOR) has been developed by the Supply-Chain Council (SCC) as the cross-industry standard for the supply-chain management. The model prescribes a set of processes templates and their decomposition into more detailed set of tasks. The main model elements and the relationships of interest are shown in Figure 1, for further information see the SCOR guide [SCOR 2001].

On the first level of detail, processes within the supply chain domain are classified into Source, Make, Deliver, Return as well as Plan and Enable process types. The later two process types are meta-processes and specify planning or enabling activities for the former four process types. The second level gives a list of configurable process templates (e.g. "Make-to Stock" or "Make-to-Order") that can be chosen when modelling a specific supply chain instance. Level three processes specify task inputs and outputs (process interdependencies), business metrics that can be collected for a given task as well as best practices for task implementation that should result in the improvement of business performance indicators.

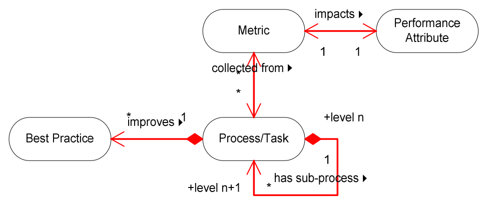

Figure 1 Original SCOR Model schema subset.

Each metric is associated with exactly one out of five performance attributes (Assets, Costs, Responsiveness, Flexibility and Reliability). Like processes, metrics are classified into a number of levels but these do not necessarily correspond to the process levels. The thirteen level I metrics, (e.g."Perfect Order Fulfillment") are high level business measures that are of interest to the supply chain managers. It should be noted that a given metric can have multiple associations with processes on various levels depending on whether the metric calculation requires data carried by the process.

Calculation of a metric may be dependent not only on the process data items but on the calculation of more detailed, lower level metrics as well (e.g. level I metric "Delivery Performance" depends on finer grained metrics "Delivery Performance to Customer Commit Date" and "Delivery Performance to Customer Request Date"). The SCOR model does not prescribe a method for rolling up the metrics.

3. Extended SCOR Model

We are interested in extending the SCOR model so that we can qualify the impact that the introduction of an IT solution is likely to have on SCOR business metrics. Because the original model does not support it, we introduce an association between the IT solution and the SCOR best practice.

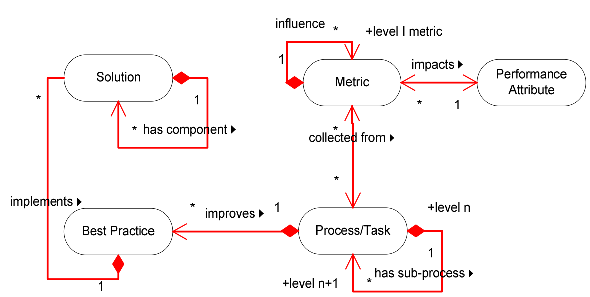

Figure 2 Extended SCOR Model schema.

Given best practice can be realized with different solutions. Any one IT solution can consist of a number of sub-components that may fulfil the best practice requirements. It may also be the case that the sub-components originate from different vendors although such composition introduces an additional software integration cost. For example, the HP KeyChain Solution for the supply chain management can be decomposed into the following components:

Solution Component	Functionality
HP Key Chain IC	Supplier managed inventory: collaboration, automated replenishment of inventory, inventory levels visibility
HP Key Chain PO&FC	Purchase Order and Forecast Collaboration: managed purchase order change at the level of single line item, order forecast sharing
HP Key Chain SPM	Spend and Price Monitoring: part number matching, Bill of Material analysis, compare suppliers for cost competitiveness.

For each process in the SCOR model the corresponding best practice implementation is looked-up and compared against the solution functionality. Where the functionality of a component fulfils the best practice implementation requirement, an association between the best practice and the component is created. Consequently, SCOR best practices and features can be viewed as solution requirements. An example of associations for process template "ES2. Assess Supplier Performance" is shown in Figure 3.

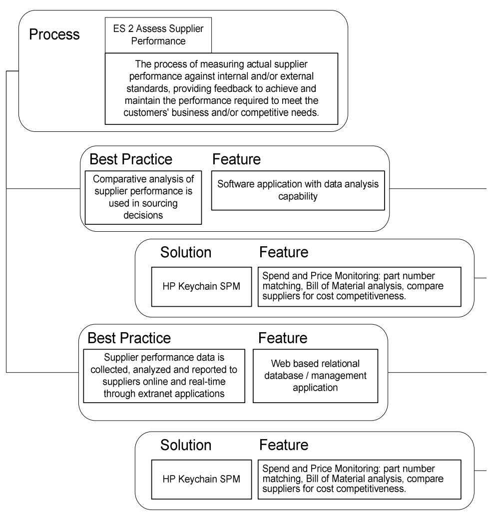

Figure 3 Example associations between the best practice implementation for process "ES2. Assess Supplier Performance" and the solution component in the extended SCOR schema.

As shown in Figure 2, we have also included in the extended model schema, the metric influence strength, using work carried out [Metric 2003] by the HP-IT Business Process Modelling Group. The metric influence indicates the strength of the inter-metric relationship which can one of multiplicative, additive, some or none and thus better qualifies the impact that a change in one metric will have on the related one.

4. Calculation of the Impact on Business Metrics

A generic, more abstract description of the extended SCOR model is shown in Figure 4. For a given solution, we can obtain a list of all processes and tasks that are likely to improve as a result of the best practice implementation. As an example, consider that solution s_2 is deployed in the enterprise. As a consequence, best practices b_1, b_2 and b_3 will result in likely improvement of tasks/processes $\alpha_{1,3}$, $\alpha_{2,1}$ and $\alpha_{4,1}$. Process improvement is likely to have also a positive impact on the metrics m_1^{II}, m_j^{II} and m_n^{II} associated with these processes. The impact on level I metrics is due to the improved processes as well as dependent sub-metrics. Consequently, metric m_1^I is likely to improve (due to improvement in sub-metrics m_1^{II}, m_j^{II} and process $\alpha_{2,1}$) as is the metric m_{13}^I (due to improvement in process $\alpha_{4,1}$) . Furthermore, because each metric has an association with a unique performance attribute a_i improvement in the performance attributes' space can be estimated.

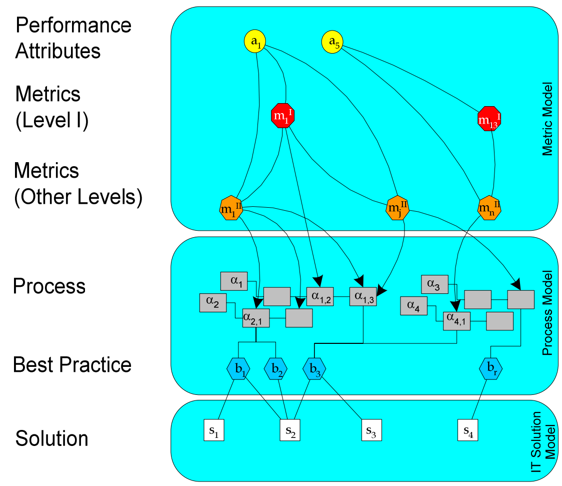

Figure 4 Example associations between some elements of the extended SCOR model that introduces solutions.

More formally, let the binary matrix **A** encode the solution-best practice association with elements $a_{s,b}=1$ if the best practice *b* can be realized with the solution *s* and $a_{s,b}=0$ otherwise.

Let the binary matrix **P** denote the best practice-process association with elements $p_{b,\alpha}=1$ if the process α can be improved as a result of the best-practice *p* and $p_{b,\alpha}=0$ otherwise.

Let the binary matrix **R** denote the business metric-process association with elements $r_{\alpha,m}=1$ if the metric m collects data from the process/task α and $r_{\alpha,m}=0$ otherwise.

Let the binary, square matrix **T** denote the intra-metric relationship with elements $t_{m,n}=1$ for all $m=n$ and if the *m*-th business metrics has a multiplicative impact on the *n*-th business metrics.

Let the binary vector $\mathbf{s}^*$ denote the solution component space with non-zero elements of the vector corresponding to the solution component(s) for which we want to calculate the impact on the business metrics.

The absolute score vector $\mathbf{u}(\mathbf{s}^*)=\mathbf{s}^*\mathbf{APRT}$ contains scores for all business metrics. The relative score for the *i*-th level I metrics can be obtained by normalizing across all metrics within the relevant metric set

$$v^I_i(\mathbf{s}^*)= u_i(\mathbf{s}^*)/\Sigma_k\, u_k(\mathbf{s}^*),$$

for all *k*, such that the metric m_k belongs to a level one metric set M^I. Lower level *i*-th metric is computed analogously

$$v^{II}_i(\mathbf{s}^*)= u_i(\mathbf{s}^*)/\Sigma_l\, u_l(\mathbf{s}^*),$$

for all *l*, such that the metric m_l belongs to the lower level metric set M^{II}.

Let the binary matrix **Q** denote the classification of the metric into a performance attribute, with element $q_{m,a}=1$ if the metric *m* is associated with the performance attribute *a* and $q_{m,a}=1$ otherwise.

The absolute score vector $\mathbf{w(s^*)=s^*APRTQ}$ contains scores for all performance attributes. The relative score for the *j*-th performance attribute can be obtained by normalizing across all performance attributes

$$v^A_j(\mathbf{s}^*) = w_j(\mathbf{s}^*)/\Sigma_k\, w_k(\mathbf{s}^*).$$

The calculation described above can obtain, for a given solution (or combination of solution components), a set of metrics and performance attributes that are likely to improve as a result of solution implementation.

In addition, semi-qualitative analysis is also available through the relative scoring of metrics and performance attributes. The rationale behind the calculation is that the amount of an improvement in any one metric is likely to be proportional to the number of improved processes from which the metric collects the data. The amount of the improvement in any one process can also be thought to be proportional the number of best practices implemented for that process by the solution of interest. Under these assumptions the relative metric improvement is proportional to the number of best practices implemented by a solution in the processes from which the metric collects the data directly as well in the processes associated with its sub-metrics. For simplicity (i.e. to first order), in our approach we have considered just multiplicative metric relationships.

5. Experimental Results

We have developed a simple software tool that implements the ideas outlined above. It can be used to load extended SCOR models, edit solution-process best-practice associations and compute the impact on business metrics and performance attributes. Results can be viewed in the graphical form as shown in Figure 5 or in a form of a detailed report (see Appendix).

The outlined approach allows us to plot likely relative metric and performance attribute improvement as well as to obtain a detailed report listing all factors contributing to the likely improvement. Figure 5 shows these plots for HP KeyChain IC and HP KeyChain PO&F components. The metric plots are colour-coded according to their performance attribute classification.

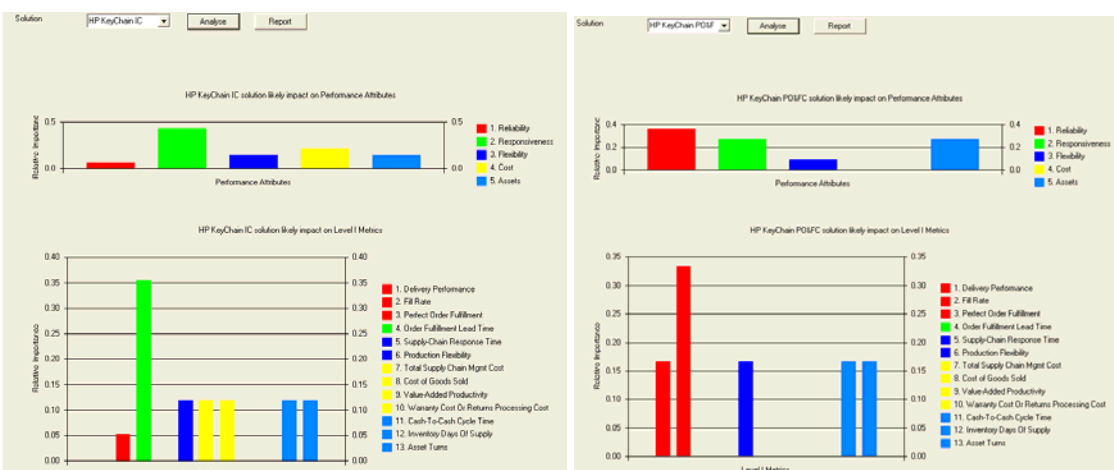

Figure 5 Likely, relative impact on SCOR performance attributes and metrics. The left panel shows the impact of HP Key Chain IC component; the right panel shows the results for the HP KeyChain PO&F.

For HP KeyChain IC component, "Responsiveness" is the most impacted performance attribute. This is due to a high relative improvement in the Order Fulfilment Lead Time level I metric. Informally, shortened order fulfilment lead times are plausible because the main functionality of this solution component is inventory collaboration (VMI) and forecasting that enables the enterprise to shorten the replenishment cycles.

These results can be contrasted with those for the HP KeyChain PO&F solution component that provides purchase order collaboration and electronic messaging functionality. The highest relative impact can be observed for "Reliability" performance attribute due to the increased Fill Rates[1] and Perfect Order Fulfilment[2] metrics that is consistent with the reduced need for manual data re-keying, and increased data accuracy.

6. Discussion and Observations

We have outlined a method for projecting solution components onto the SCOR model by matching the solution functionality with the process best practice requirements. A series of linear transformations is then applied to the best practice vector to project it into the business metrics space.

The results look plausible (especially the qualitative ones) but should be treated with caution. The reason for this is that the SCOR metrics are associated with the process/task and not the best practice directly. Consequently, the benefits of best practice implementation may in reality be limited to a subset of metrics associated with a given process rather than with all of them, as it is currently assumed. It is likely that more accurate results can be obtained at a cost of modelling metric-best practice relationship. This is recommended as an area of further work.

It should be noted also that our results relate to the SCOR model schema and not the SCOR model instances generated from specific customer engagements. Because SCOR processes are configurable, for a given customer some processes would not be chosen and would not therefore make a contribution to the overall score.

This approach also assumes that we are dealing with HP solution architectures with a high specificity to the domain in question, in this case supply chain and CBI.Net and KeyChain. Solution architectures with a broad, horizontal scope, will impact a large number of best practises in the SCOR model and will thus not have a distinctive metric 'signal'.

In general, it would be desirable to obtain SCOR instance data from a number of customer engagements E, that would allow us to compute the process likelihood $p(\alpha|E)$ and use it in the transformation from the process to the metric space.

Of course, in a normal customer engagement [Perf 2003] the consulting process would lead *from* the performance attributes and metrics, not the other way round as is presented here. The customer would supply actual business metric values that would be compared against the best in class competitor data identifying the metrics where improvement is required. Then a solution component or their combination would be suggested for which the salient business metrics improvement is maximized. This paper has taken the contrary approach as a tool to investigate HP solution architecture assets in the space of supply chain management in order to assist HPS in a metric driven, rather than technology driven, customer engagement.

[1] The percentage of ship-from-stock orders shipped within 24 hours of order receipt. For services, this metric is the proportion for services that are filled so that the service is completed within 24 hours.

[2] A 'perfect order' is defined as an order that meets all of the following standards: delivered complete; delivered on time, documentation is complete and accurate, perfect condition, correct configuration, customer-ready, no damage

As a final note, this method can be extended into other verticals where an operations reference model[3] exists or can be constructed

7. References

[SCOR 2001] "Supply Chain Operations Reference Model Overview", version 5.0, www.supply-chain.org, Supply-Chain Council, Inc., 303 Freeport Road, Pittsburgh, PA 15215.

[ProScor 2003] "ProSCOR: ProVision Suply-Chain Operations Reference Models", white-paper, web-site: www.proformacorp.com, Proforma Corporation, 26261 Evergreen Road, Suite 200, Southfield, MI 48076.

[Metric 2003] "SCOR Model Metric Interdependencies v2.2", SCOR Model 5.0, web-site: HP-IT Business Process Modelling Group.

[BEA 2003] "Aligning IT with Business Goals", BEA Business White Paper, BEA Systems Inc., http://www.bea.com

[Perf 2003] "Supply Chain Performance Score Card Data Table for Electronic Equipement", Performance Measurement Group, 1050 Winter Street, Waltham, MA 02451, http://www.pmgbenchmarking.com/.

[3] i.e. one which links process elements with a metric framework and identified best practice.

Appendix A

Below we show fragment of the report for the impact of the HP KeyChain IC solution on level II and level I metrics. Below all factors that contributed to the improvement in level I metric "Order Fulfilment Lead Time" can be found. The report details for a given process all best practices implemented with the IT solution, level II metric that collects data from this process. Level I metric with which the level II metric has a multiplicative relationship is also printed.

FOR PROCESS:S1.1

Schedule Product Deliveries

IMPLEMENTATION OF THE FOLLOWING BEST PRACTICES

1) Utilize EDI transactions to reduce cycle time and costs

WITH SOLUTION: HP KeyChain IC

2) VMI agreements allow suppliers to manage (replenish) inventory

WITH SOLUTION: HP KeyChain IC

3) Mechanical (Kanban) pull signals are used to notify suppliers of the need to deliver product

WITH SOLUTION: HP KeyChain IC

HAS A LIKELY IMPACT ON: % Of EDI Transactions

THAT IN TURN MAY IMPROVE: Order Fulfillment Lead Time

FOR PROCESS:S2.1

Schedule Product Deliveries

IMPLEMENTATION OF THE FOLLOWING BEST PRACTICES

1) Utilize EDI transactions to reduce cycle time and costs

WITH SOLUTION: HP KeyChain IC

2) VMI agreements allow suppliers to manage (replenish) inventory

WITH SOLUTION: HP KeyChain IC

3) Mechanical (Kanban) pull signals are used to notify suppliers of the need to deliver product

WITH SOLUTION: HP KeyChain IC

HAS A LIKELY IMPACT ON: % Of EDI Transactions

THAT IN TURN MAY IMPROVE: Order Fulfillment Lead Time

FOR PROCESS:S3.3

Schedule Product Deliveries

IMPLEMENTATION OF THE FOLLOWING BEST PRACTICES

1) Utilize EDI transactions to reduce cycle time and costs

WITH SOLUTION: HP KeyChain IC

2) VMI agreements allow suppliers to manage (replenish) inventory

WITH SOLUTION: HP KeyChain IC

3) Mechanical (Kanban) pull signals are used to notify suppliers of the need to deliver product

WITH SOLUTION: HP KeyChain IC

HAS A LIKELY IMPACT ON: % Of EDI Transactions

THAT IN TURN MAY IMPROVE: Order Fulfillment Lead Time

FOR PROCESS:S1.1

Schedule Product Deliveries

IMPLEMENTATION OF THE FOLLOWING BEST PRACTICES

1) Utilize EDI transactions to reduce cycle time and costs

WITH SOLUTION: HP KeyChain IC

2) VMI agreements allow suppliers to manage (replenish) inventory

WITH SOLUTION: HP KeyChain IC

3) Mechanical (Kanban) pull signals are used to notify suppliers of the need to deliver product

WITH SOLUTION: HP KeyChain IC

HAS A LIKELY IMPACT ON: % Schedules changed within Supplier's Lead Time

THAT IN TURN MAY IMPROVE: Order Fulfillment Lead Time

FOR PROCESS:S2.1

Schedule Product Deliveries

IMPLEMENTATION OF THE FOLLOWING BEST PRACTICES

1) Utilize EDI transactions to reduce cycle time and costs

WITH SOLUTION: HP KeyChain IC

2) VMI agreements allow suppliers to manage (replenish) inventory

WITH SOLUTION: HP KeyChain IC

3) Mechanical (Kanban) pull signals are used to notify suppliers of the need to deliver product

WITH SOLUTION: HP KeyChain IC

HAS A LIKELY IMPACT ON: % Schedules changed within Supplier's Lead Time

THAT IN TURN MAY IMPROVE: Order Fulfillment Lead Time

FOR PROCESS:S3.3

Schedule Product Deliveries

IMPLEMENTATION OF THE FOLLOWING BEST PRACTICES

1) Utilize EDI transactions to reduce cycle time and costs

WITH SOLUTION: HP KeyChain IC

2) VMI agreements allow suppliers to manage (replenish) inventory

WITH SOLUTION: HP KeyChain IC

3) Mechanical (Kanban) pull signals are used to notify suppliers of the need to deliver product

WITH SOLUTION: HP KeyChain IC

HAS A LIKELY IMPACT ON: % Schedules changed within Supplier's Lead Time

THAT IN TURN MAY IMPROVE: Order Fulfillment Lead Time

FOR PROCESS:S1.1

Schedule Product Deliveries

IMPLEMENTATION OF THE FOLLOWING BEST PRACTICES

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2) VMI agreements allow suppliers to manage (replenish) inventory

WITH SOLUTION: HP KeyChain IC

3) Mechanical (Kanban) pull signals are used to notify suppliers of the need to deliver product

WITH SOLUTION: HP KeyChain IC

HAS A LIKELY IMPACT ON: % Schedules generated within Supplier's Lead Time

THAT IN TURN MAY IMPROVE: Order Fulfillment Lead Time

FOR PROCESS:S2.1

Schedule Product Deliveries

IMPLEMENTATION OF THE FOLLOWING BEST PRACTICES

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WITH SOLUTION: HP KeyChain IC

2) VMI agreements allow suppliers to manage (replenish) inventory

WITH SOLUTION: HP KeyChain IC

3) Mechanical (Kanban) pull signals are used to notify suppliers of the need to deliver product

WITH SOLUTION: HP KeyChain IC

HAS A LIKELY IMPACT ON: % Schedules generated within Supplier's Lead Time

THAT IN TURN MAY IMPROVE: Order Fulfillment Lead Time

FOR PROCESS:S3.3

Schedule Product Deliveries

IMPLEMENTATION OF THE FOLLOWING BEST PRACTICES

1) Utilize EDI transactions to reduce cycle time and costs

WITH SOLUTION: HP KeyChain IC

2) VMI agreements allow suppliers to manage (replenish) inventory

WITH SOLUTION: HP KeyChain IC

3) Mechanical (Kanban) pull signals are used to notify suppliers of the need to deliver product

WITH SOLUTION: HP KeyChain IC

HAS A LIKELY IMPACT ON: % Schedules generated within Supplier's Lead Time

THAT IN TURN MAY IMPROVE: Order Fulfillment Lead Time