

The Strategy of using DFMA as part of the Value Analysis / Value Engineering Process

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DFA Implementation at a Medical Device Company

Introduction

The purpose of this paper is to explore the use of a Value Analysis/ Value Engineering Event to be considered periodically for key product lines. The approach used here is a Value Analysis / Value Engineering effort using a structured, cross functional team to improve the value of your product and the process. Although cost reduction is a major focus, these studies can also produce incremental improvements to the product helping to drive up or maintain a higher price point. The result of this effort will be a vetted and prioritized list of ideas that should reduce cost, improve quality and/or increase revenue. As our product go through their lifecycle it is important t that we periodically evaluate that product for value to better manage our current and future profit.

The paper will address the following process as we explore this application of VA/VE and the DFA Tool.

- Project Selections - Aligning and prioritize your efforts with the Business Strategy
- Getting started – what is needed prior to a VA/VE event?
 - Effective and efficient VOC
 - DFA for structure and common understanding of the current situation
- The VA/VE event
 - Gemba Walks and why this is important
 - Structured Brainstorming using the DFA output
 - Prioritizing your output

This paper will not get into a specific example but will draw from experience using different development and operational excellent tools to give what the author considers to be the best approach. We will explore the rational and strategies for conducting a VA/VE analysis, we will look at the use of the DFA and other tools and their use in a VA/VE analysis and we will discuss a methodology for vetting and prioritizing your ideas

Project Selections - Aligning efforts with the Business Strategy

Why is alignment with the business so important? This is so critical to being successful when deploying Six Sigma or Lean in an organization. When we get focused on the methodology of DFA, Lean or Six Sigma, we can easily find ourselves fighting to show how effective and efficient the tools can be. We may want to apply the methodology to everything. What we forget is that we are paid to be useful to the business. I.e. if we don't support the business decisions and directions, all the efficiency and effectiveness means nothing. As an example. A few years ago, my manager was working with the R&D group trying to help a ventilator project get to market faster. Because they had seen evidence that the DFA approach could help us get there faster, they asked me to lead a DFA exercise. We conducted a DFA workshop, came up with several suggestions and ideas to reduce the part count, improve quality and lower the cost. But nothing was implemented, some of the group complained that it was a waste of time, and the reputation of the DFA tool took a hit. What happened? Because we did not take a hard look at the timing of the project, we conducted our analysis too late in the project. Since most of the drawings were released and tooling kicked off, changes would have delayed the project. Although we could save money and improve quality in production, we would also delay launch. Early market release on innovative technology has great value to our company and is supported by healthy margins where our technology outperforms similar products. To save on timing – we needed to conduct this analysis earlier before tooling was kicked off and we could change the design with only positive affects to the schedule. In this example DFA was considered an overall solution without and clear understanding of the current situation and the strategy to get to market quickly. In reality Tools such as DFA are enablers that allow us to meet a plan or strategy only when that are fully understood and integrated in the proper place. Some other examples of what can happen, when we don't fully match the tools to our strategy.

A VAVE analysis is conducted on a supplier with good results yield many potential cost savings that could be implemented. However, our company is not a major customer to this supplier i.e. we are only 3% of their total business and they do not want to spend man hours to support the changes.

Several cost reduction ideas are completed and the overall cost for a particular component is reduced, however 3 months later a replacement component is launched to include several new features the customer is waiting for and the old component volumes are reduced to min numbers.

We need to take a strong look at what the business is doing to make sure we have a solid plan. This means that we are aligned with the strategy of our leaders, we have a plan that will support the overall strategy and we are using the right tool to enable us to meet our goals. We do this so that we are both effective and add value to the business. We may want to consider the following questions to ASK

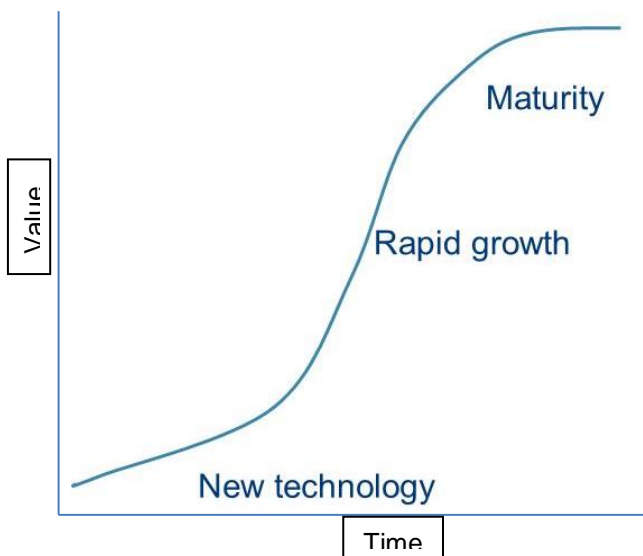
1. Where is your product at for Maturity – see below pattern of Evolution?
2. Has your product recently been evaluated for VA/VE
3. Will your product go through Design Changes in the near Future
4. What is the marketing Strategy/Forecast for this Product?
5. Is the Timing right for this type of project?
6. Do you have the resources and culture to pursue this change?
7. What are your profit profile look like and how will a VA/VE affect this?
8. Is there an Alternate plan that makes more sense?

We will not go through all of these questions in detail as their importance and priority will vary between businesses. But I would like to discuss a few items that will help us evaluate when a product is ready for a VATF. First let's look at patterns of evolution for a product life cycles This concept was 1st proposed by Genrich Altshuller who is known as the father of TRIZ. He had proposed (Mann, 2002, 2007, p. 17) "that technology evolution trends are highly predictable". Altshuller had proposed what is known as an S curve to describe this pattern.

Darrell Mann added focus areas based on where a product was in the s curve evolution in his book "Hands On Systematic Innovation" where he stated (Mann, 2002, 2007, p. 129) "the simplest way of identifying where a system is on its current s-curve is to examine the general focus of the intellectual property". Others had also grasped this idea and modified and elaborated on the concept of what to focus during a product life cycle. A modified version is attached here with suggestions on focus areas of the DFA tool application to better enable the core focus.

This is a repeating pattern
As new technology emerges

As products progress.
What should we focus on ?



Location	Focus	DFMA Focus
Maturity	Cost	Cost Reduction
	Reliability	Look for Poka Yoke/ reduce parts
Rapid growth	New Features	All
	Works better - Quality	Look for Poka Yoke/ reduce parts
New tech.	1 st to market	Deploy Early

Innovative companies who are focused on “best product” in the market place will be in the New Technology, Rapid growth area’s focusing on innovation with quick time to market, then better quality followed by new features. These along would not be ideal for a VA/VE analysis in the traditional way that will be presented here. If a VA/VE is conducted in this space, it would be more likely that the feedback would go into the next R&D project as the product was evolving. It would also take a back seat to the functionality and performance factors that would help keep the product in a high margin area.

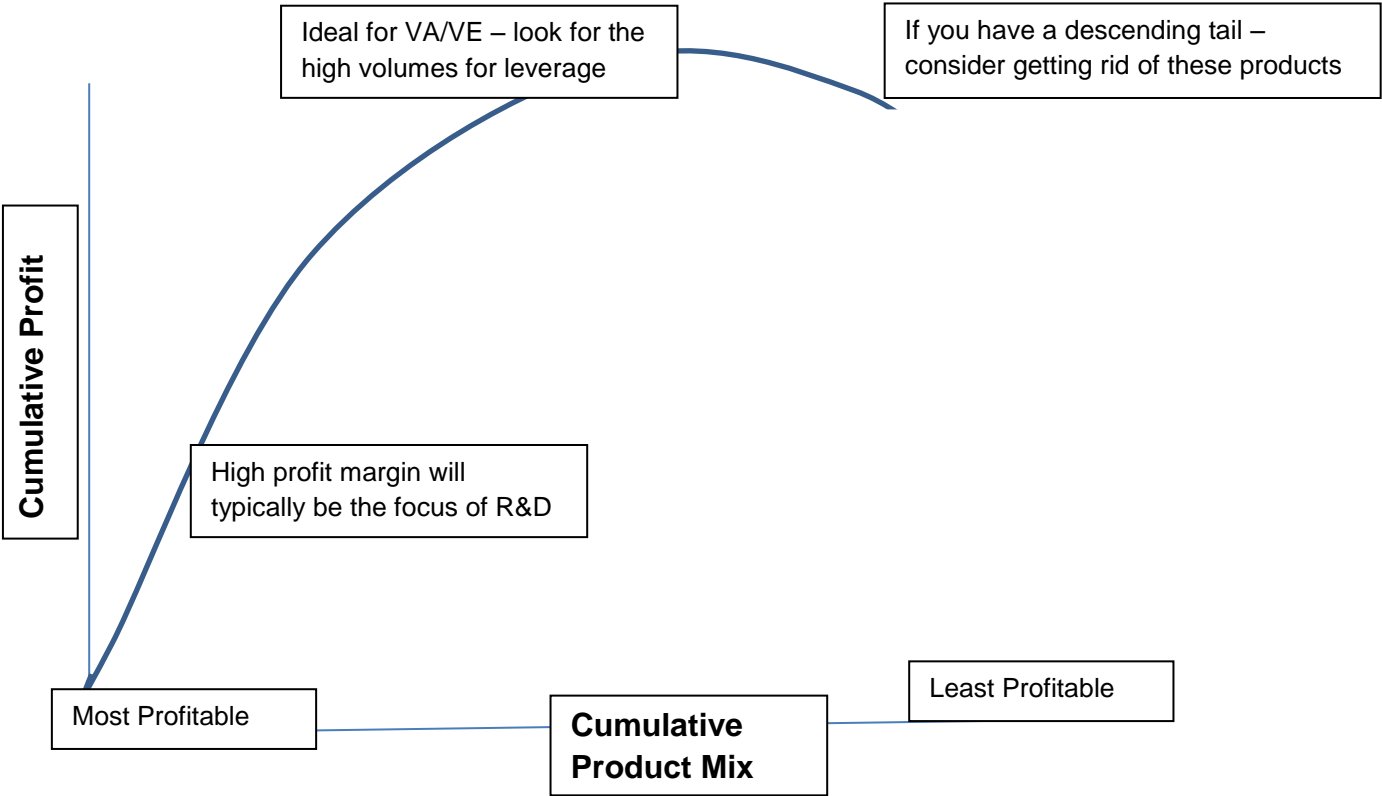
Companies that are focused on Operational excellence and compete more on cost, are typically those in the Maturity area. These products have been in the market for a while and have exhausted most if not all of the new technology with additional features added. Reliability and total cost of ownership is important here where in the end these parts have become commodities until the next evolutionary pattern emerges to expose new technology. These products are ideal for a VA/VE analysis. This type of activity will help reduce cost or could help push incremental innovation causing the rapid growth to be extended. In some cases it may even spark a new evolutionary curve with brand new technology.

In some cases a company may operate across the span of evolution from products for new technology to mature products. In these cases we just need to understand our particular product and what is most important to maintain or improve our margins for that product. It

should be noted that in general new technology will have the highest margins based on the levels of innovation

And as we move up the curve, margins will typically shrink and the Cost of Production will be more and more important. It should also be noted that the sustaining mature products can be creating the profit centers that feed new innovation; in this case, it can be very important to maintain and improve these margins to continue to fund new innovations.

Another consideration to look at, especially for mature products is the Customer, Product/Process Rationalization or CPR. This model is explained as (Luftig, 2012, p. 92) “the result of the merger of three contributory models: the total asset utilization (TAU) model: an allocated cost accounting (ACA) model: and a strategic product/market capability model”. The results can help show us a true profit per product. We sometimes miss this big picture by focusing on cost in the plants and sales revenue in the market. Managing these separately does not guarantee healthy profits. But if we measure properly, we can get our true profit per product code. And by comparing these we can make rational decision on what products would best benefits from a VAVE analysis and what product make need another tool (say an axe) to take them out of our portfolio. In many businesses it is not uncommon to find some product codes that are sold at a loss and in some cases this may be desirable. In grocery stores they are called loss leaders to help support the overall sales. If the business demands these product codes, then we should manage them to minimize the loss or even turn them around to a profit, but if cost is too high for the benefit, we may be better off eliminating these product codes to focus on more profitable product codes. The chart below shows a cumulative profit vs Product codes with some notes/suggestions



Getting started – Preparing for a VAVE Eventy

Now that we have a focus on business alignment and what products/projects we want to address in a VA/VE event, let discuss what we are trying to accomplish. We want to improve the value of our product. From the customer perspective value is equal to qualities relative to price. Where Qualities includes all non-price attributes – Product and Customer service.

David Garvin has Qualities broken down into 8 areas as such:

- .1. Performance - primary operating characteristic of a product or service
2. Features - secondary characteristics of a product or service
3. Reliability - frequency with which a product or service fails
4. Conformance or consistency - match with specifications or standards
5. Durability - product life
6. Serviceability - speed, courtesy, and competence of repair
7. Aesthetics - fits and finishes
8. Perceived Qualities - reputation

Qualities are defined from the *customer's* point of view. We need to keep this in mind as we look for way to improve our value.

Another way to look at this from the Business point of view - what is our profit margin. It is said that a customer may appreciate something but when they value a feature, product or service, they are willing to spend money for the same. If we break profit margin down it is simply the selling price – our true cost of production. So we are looking at two possibilities here 1- reducing our cost or 2 – adding qualities that will increase sales and or help maintain or increase the price. For both of these we need to be creative, we need to come up with incremental improvements and maybe a few big ideas. And we need to do this in about 2 days.

In preparing for creativity to add value, we will need to gather a lot of information about the market, the product and the manufacturing process. As a minimum the following is needed:

- Marketing data preferably in a VOC or Value Innovation format
- Product information including design and BOM with cost
- Manufacturing and quality information including Process map (VSM if available), control plans, FMEA's

We gather his information because we are trying to define the system of the manufacturing process, the product and the marketing use. We need this information to help define issues and potential solutions while conducting the VA/VE analysis. A lot of these documents and information would be familiar to most engineers. But I do want to take a little time to discuss the VOC and the Value curve.

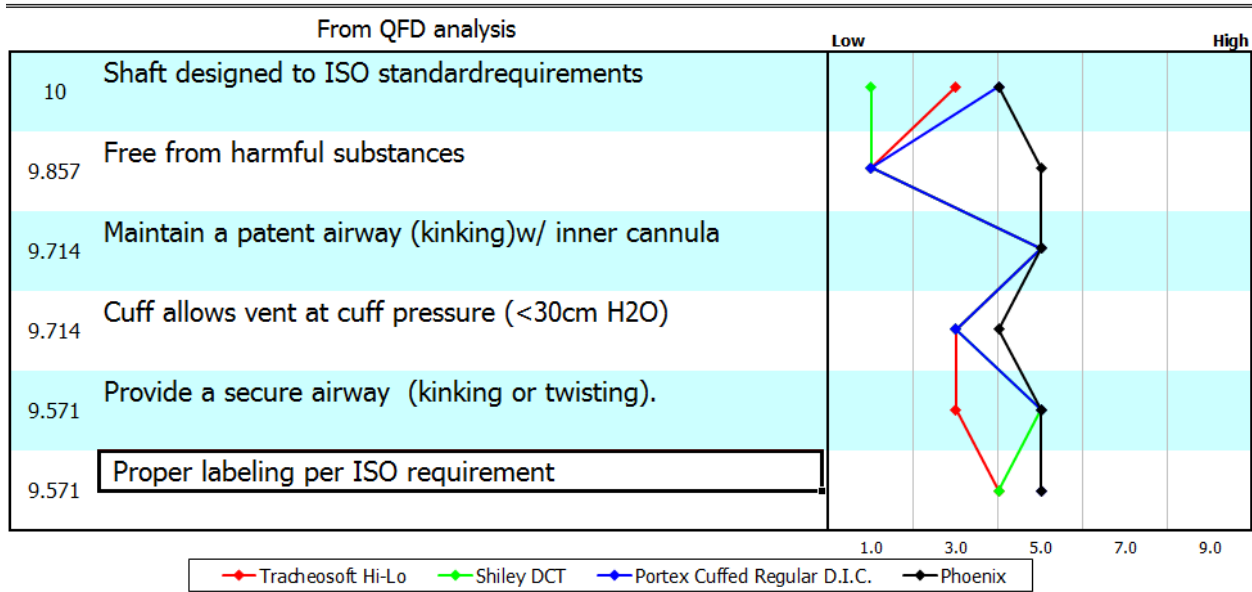
The VOC or Voice of the Customer a process to gather information about what the customer really wants and needs. This type of approach is taught in Design for Six Sigma using market segmentation, Kano analysis, Interviews, Language processing or Affinity diagrams, translation of customer requirements and Quality Function Deployment or House of Quality. The problem is that we don't have time to conduct such an in depth study for a VAVE exercise. If we have a recent VOC, we can use that information. Sometimes we have just used Marketing feedback, but I would recommend using some of the tools defined in the Value Innovation process as defined by the Boom (Lee, 2012, p. 2) "Value Innovation Works" this is a (Lee, 2012, p. 2) "10 step process" that will "uncover What and How you will deliver exceptional Value to the Most important Customer in your value chain"

My recommendation for a quick and fairly good VOC feedback is to complete steps 2-5 in the Value Innovation process to create a valid "Value Curve". These 4 steps are.

1. Define the Value Chain and the Most Important Customer (MIC)
 - Value Chain - identifies each company/entity that is involved in a buying/selling/using transaction between the original provider or manufacturer and the end user
 - MIC - Most Important Customer in the Value Chain. MIC can be found by asking three questions.
 1. Who is responsible for taking action required to rectify a problem or issue that may occur?
 2. Who stands to lose the most financially if there's a problem or issue with your offering?
 3. Who is the most likely to recognize the value provided by your offering?
2. Develop an "As Is " and best in class Value Curve
3. Conduct Contextual interviews with your MIC – Note this can be done by phone 2 at a time.
4. Develop To Be Value Curve
 1. Value Curve – A graph that shows the priorities of the top Elements of Performance with a competitive analysis based on the MICs -

If time allows there are other steps to confirm the value curve but these are the basic minimum required to get a good Value Curve. More information is available at <https://valueinnovations.com/>

Phoenix Traceal tube



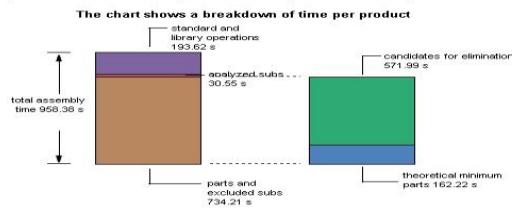
DFA - The initial DFA Analysis can be created at the VA/VE event (Typically at the plant) or travel time is limited – can be started with R&D and Manufacturing by Web Ex prior to the event. This will typically be the last step you complete prior to the event. This will allow us to combine data sets from the plant and give us a good template to run a structured brainstorming session. A few pointers that I would recommend.

1. Capture the component cost from the BOM as the DFA analysis is completed.
2. Use Manufacturing cycle times for special operations as needed
3. Make sure to include packaging – this cost can be examined later
4. Add Poke Yoka or mistake proof options to your Analysis

Executive Summary - DFA
Boothroyd Dewhurst, Inc.

Friday, January 28, 2011 2:37 PM P2.0 1-28-11.dfa
P2.0 DFA baseline Product: Baseline

Per Product data	Entries (including repeats)	Labor Time, s	Labor Cost, \$
Component parts	93	686.60	4.74
Subassemblies partially or fully analyzed	8	30.55	0.23
Subassemblies not to be analyzed (excluded)	10	67.61	0.47
Standard and library operations	28	193.62	1.39
Totals	139	958.38	6.84



Conducting a VA/VE Event

The VA/VE Event will typically be a 1-3 day event depending on the product and opportunities. The event is a structured cross functional working meeting that should include R&D or Sustaining Engineering, Sourcing, Quality, Manufacturing, Marketing and is facilitated by Operational Excellence personnel. The meeting will be held at the plant and the agenda will include the following

- Introduction and a plant overview
- A review of the materials gathered
- A Gemba Walk to the production line in the area of focus
- A DFA analysis or DFA review
- Structured Brainstorming using the DFA output
- Review(scrub) and prioritization of ideas
- A report out to management

The key here is to get a mutual understanding of the entire product / process / Market system in preparation for the Brainstorming event, An then running the Brainstorming event in a structures way to ensure everything is looked at and key areas are looked at a bit more. The way we approach this is to go through the assembly process as the parts are being used. IE we use the DFA worksheet (after filtering out information that is not relevant) to go line by line through the part/process looking for ideas to improve our Value. When we used DFA for an R&D project our focus would be on the following

- Reduce part count & type **Part Count Efficiency**
- Ease of handling **Handling Index**
- Ease of insertion **Insertion Index**
- Eliminate secondary ops. **2nd Op. Index**

What we have to add for a VA/VE is the following

- Reduce Part cost through sourcing / alternate materials – DFM could be considered on expensive parts
- Add Value – Can we improve the quality or features to satisfy a customer need -
- Lean process Opportunities – Can we reduce waste in the manufacturing process

An example of the worksheet is given here (not spectacular but effective)

Name	Type	Repeat count	Minimum items	Handling problems	Insertion problems	Labor cost, \$	Total item cost, \$	Total cost, \$	Notes	PY Wrong Way	PY wrong / no part
CapnoLine Plus	Main									0	0
2M CO2 line orange	Sub	1				0.03	0	0.03		0	0
quicl seal sub assy	Sub	1				0.03	0	0.03		0	0
QUICK SEAL FLL - ORANGE GOLDEN	Part	1	1			0.03	0.06	0.09		0	0
FILTER ASSEMBLY FOR QUICK SEAL FLL	XSub	1	0			0.03	0.17	0.2		1	0
Apply adhesive drops	Lib Op	2				0.02		0.02	Acquire and replace adhesive applicator, load applicator with adhesive and apply drops of adhesive in a single location. Allowance is made for the time to move the applicator from one location to another when the application is to be repeated in another location.	1	1
Totals for quicl seal sub assy			1			0.08	0.23	0.31		2	1
Apply adhesive bead	Lib Op	1				0.02		0.02	Acquire and replace adhesive applicator, load applicator with adhesive and apply an adhesive bead. Allowance is made for the time to move the applicator from one location to another when the application is to be repeated in another location.	0	1
Reel Tube Assy	Sub	1				0.05	0	0.05		1	0

Couple of recommendations here

- If your BOM or DFA analysis is too large – break it up and separate your team to work on sub systems separately.
- Use written suggestions as well as verbal – this allows some people to write their ideas down as we go through it.
- Pause or circle back on expensive components or key improvement areas
- Review the Value Curve before and after the DFA brainstorming - allow some additional time to brainstorm these areas
- Add risk levels to the ideas as you go

All ideas are collected. We employ basic brainstorming rules as follows

- Defer judgment
- Criticism is discouraged at this time
- Strive for quantity
- The more options the better
- Suggest bizarre options
- These can lead to unique solutions
- Build on other ideas

- Build, combine or improve options
-

However once the Brainstorming and idea generation is over we switch to divergent rule to eliminate those ideas that don't make sense and gather the ideas the team feels are worth vetting further. These ideas are put in a Pugh Matrix (transposed) where we replace requirements with items such as, cost savings, Risk, Effect on Quality, Timing, cost to implement etc.. And give initial ratings from the team. This is actually the 1st step of screening and prioritizing of the ideas. It should be noted that most ideas have been historically about cost reduction. So Value Add ideas, have been treated separately and vetted with marketing and R&D. From these basic tables, a weighted score is created in the Pugh matrix and initial priorities are set. This list is then used as the basis for further vetting outside the meeting.

Item Order	Opportunity	Type	Flow Chart #	Option 1 Est. Saving	Option 2 Est. Saving	Cost	Confidence (1-Risk)	Regulatory/Marketing	Project Time	Priority	Responsibility	Comments
1	Compressed diapers to reduce cost of packaging, shipping unit and shipping cost - Diapers only	Process	31	\$12,000.00		Consumer testing for performance (\$25K) and stage gate testing	80.00%	no issues	6 months	2.00		Need clarity on this - would want to keep count the same. Mainly medtronic ship savings and 3K packaging and Valor shipping cost. Good opportunity to include other packaging issues.
2	Soft Strip to Medtronic Crystal Lake facility - Awaiting equipment to separate Materials	Process	EOL	TBD		No test	95.00%	no issues	12 months	Hold		
3	Reduce the content of the fluff in pants (5%) (in progress)	Design	3-Jan	\$10,000.00		Consumer testing for performance (\$25K) and stage gate testing	70.00%	some concern - performance	12 months	3.00		
4												

The final step is now here, the team takes an hour or so to prepare a report out to Management. This is a summary report showing a few details and the prioritization list of the Team. This presentation will also have the plan vetting process and is a welcome conclusion to a 1-3 day event.

Works Cited

Lee, R. a. (2012). *Value Innovation Works*. Denver: Richard K. Lee.

Luftig, J. a. (2012). *Business Performance Excellence*. London: Bloomsbury Information Ltd.

Mann, D. (2002, 2007). *Hands On Systematic Innovation*. England: Lazarus Press.