UNIVERSITY OF VAASA
FACULTY OF TECHNOLOGY
DEPARTMENT OF PRODUCTION

Sanna-Mari Kaakinen

MEASURING THE DYNAMIC STOCK BUFFER MANAGEMENT APPROACH FIT TO THE CUSTOMER NEEDS BASED ON THE (BALANCED) CRITICAL FACTOR INDEX METHOD

Case: ABB Oy, Distribution Automation

Master's Thesis in
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SYMBOLS AND ABBREVIATIONS

BCFI	Balanced Critical Factor index
CFI	Critical Factor Index
DSBM	Dynamic Stock Buffer Management
FICON	Low Voltage Products Business Unit
FISUB	Distribution Automation Business Unit
MRP	Material Resource Planning
OTD	On-Time-Delivery
SD	Standard Deviation
TOC	Theory of Constraints
Z70TOC	The Dynamic Stock Buffer Management Transaction in SAP

UNIVERSITY OF VAASA
Faculty of Technology
Author: Sanna-Mari Kaakinen
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Instructor: Josu Takala
Degree: Master of Science in Economics and Business Administration
Department: Department of Production
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ABSTRACT

In this research, the fit between the Dynamic Stock Buffer Management (DSBM) approach, designed for inventory control and optimization, and the customers' needs under the current circumstances is studied. The customer is the purchasing department in ABB Oy, Distribution Automation Business unit in Vaasa, Finland. The purchasing function of another business unit, Low Voltage Products, is treated as a reference in the research.

The research goals encompass identifying both the critical factors and the DSBM factors, and the culmination of the research is to analyze and examine the reciprocal fit between these factors. The main goal is to analyze the suitability of the DSBM approach to the Distribution Automation purchasing function based on the fit between the critical factors and DSBM factors.

The research method used in this research is the (Balanced) Critical Factor Index method. It is chosen because of its applicability and flexibility and the wide practical and theoretical basis it lies on. In this research the method has been further developed to fit the research question and composition. The research data is gathered from a triangular basis: the Distribution Automation purchasers, the Low Voltage Products purchasers and an external consultant.

The core theoretical contribution deals with the applications of the research method; the research proved the method applicability to a new kind of research. The practical contribution lies in identification of the critical factors in both Distribution Automation and Low Voltage Products purchasing functions; the critical factor identification is derived to sensing customer needs. Also identification of the Dynamic Stock Buffer Management factors and comprehensive understanding of the approach enable the evaluation of the fit to the customer needs.

KEYWORDS: Balanced Critical Factor Index, Critical factor index, Customer Needs, Dynamic Stock Buffer Management.

VAASAN YLIOPISTO
Teknillinen tiedekunta
Tekijä: Sanna-Mari Kaakinen
Tutkielman nimi: Dynamic stock buffer management -lähestymistavan yhteensopivuuden asiakkaiden tarpeisiin mittaaminen Balanced critical factor index -metodin avulla.
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TIIVISTELMÄ

Tässä pro gradu -tutkielmassa käsitellään dynaaminen varastotasojen hallinta (DSBM) -työkalun yhteensopivuutta asiakkaiden tarpeisiin tiettyjen olosuhteiden vallitessa. Asiakkaana nähdään ABB Oy, Sähkönjakeluautomaatio Vaasan yksikön osto-osasto. Vertailukohteena käytetään toista yksikköä nimeltä Pienjännitekojeet.

Tutkimuksen alatavoitteet kattavat sekä kriittisten tekijöiden että DSBM-tekijöiden tunnistamisen sekä niiden keskinäisen yhteensopivuuden analysoimisen. Päätavoitteena on analysoida tämän yhteensopivuuden perusteella DSBM-lähestymistavan sopivuutta Sähkönjakeluautomaation ostofunktiolle.

Tutkimusmetodina käytetään tasapainotettua kriittisten tekijöiden indeksiä sekä kriittisten tekijöiden indeksiä. Metodin valinta perustuu sen sovellettavuuteen ja joustavuuteen, sekä metodin vahvaan teoreettiseen ja tutkimukselliseen taustaan. Tässä tutkimuksessa metodia käytetään sovelletussa muodossa; sitä on edelleen kehitetty, jotta se sopisi yhteen tutkimuskysymyksen ja -asetelman kanssa. Tutkimustulokset on kerätty kolmikantatutkimuksen muodossa: itse asiakkaan ohella referenssinä käytetään sekä pienjännitekojeiden osto-osastoa että ulkoista konsulttia.

Tutkimuksen teoreettinen kontribuutio liittyy tutkimusmetodin sovellettavuuden todistamiseen: tässä tutkimuksessa metodia on käytetty toimivasti uudella tavalla. Käytännön kontribuutio taas liittyy ensisijaisesti kriittisten tekijöiden tunnistamiseen ja niiden kautta asiakkaiden tarpeiden havaitsemiseen. Myös DSBM-tekijöiden tunnistaminen ja lähestymistavan kattava käsittely mahdollistaa DSBM-lähestymistavan ja asiakkaiden tarpeiden välisen yhteensopivuuden hahmottamisen.

AVAINSANAT: Tasapainotettu kriittisten tekijöiden indeksi, kriittisten tekijöiden indeksi, asiakkaiden tarpeet, dynaaminen varastotasojen hallinta.

1. INTRODUCTION

1.1. Introduction to the Business Unit and the Research Background

This research discusses the fit of the Dynamic Stock Buffer Management (DSBM) approach to the prevailing circumstances in the purchasing department in ABB Oy, Distribution Automation business unit in Vaasa, Finland. The business unit is referred to as FISUB for facility reasons in this research. Another business unit, Low Voltage Products, referred to as FICON, is treated as a reference as the DSBM approach has already been implemented there. Yet the focus is in adding value to the Distribution Automation purchasing department and hence less attention is paid to FICON issues. The first chapter will explain why the DSBM approach implementation is considered.

Distribution Automation belongs to the Power Products division and to Medium Voltage Products. The Vaasa Distribution Automation factory (FISUB) is a business unit in the global Distribution Automation network with two other main factories in China and India. According to the CEO of the business unit, the FISUB mission is: "-- to help customers' business processes by developing innovative, advanced and reliable solutions together with customers using our distribution automation technology leadership. We make grids smarter!" The business unit's role in the global ABB DA network is prominent: FISUB has global responsibility for the development, marketing, sales and production of protection and control IEDs, software tools and communication devices. The heaviest responsibility concerns research and development: the other DA factories around the world rely in large scale on FISUB in product development issues. In addition to this, FISUB has global operations, customer support and training responsibilities. (PPMV General Presentation 2011.)

The factory's core operations include final assembly and testing of protection relays. The production control method in use is TOC, theory of constraints, which has been combined with the dynamic stock buffer management approach discussed in further detail later on. The production planning method is ATO, assembly to order, which means that no final products are held in stock. The main reason behind not stocking end items is lucid: the number of available product variants is vast. This leaves heavy strain on supply management to ensure the uninterrupted flow of materials to guarantee the on-time-production of end products.

All companies basically compete on the basis of a combination of the following: cost, quality, speed, service and variety (Hopp 2008: 1). FISUB DA competes on a combination of the previously mentioned competitive factors explained in further detail below. The fixed EXW delivery time for FISUB is two weeks which allows the factory to compete on speed. The two weeks delivery time is something that is tightly held onto as it is considered a competitive advantage over competitors who might offer lower product prices. In global competition FISUB DA can't be the market leader in low costs due to many factors, and not least because of different variable expenses, such as labor and energy, are notably high in Finland. It is also remarkable that even if FISUB is sourcing roughly 70 per cent of all components from low cost countries, the costs of transportation are considerable because of the long geographical distances. Instead, FISUB DA is focusing heavily on product and service quality.

The previously mentioned competitive factors leave supply chain management in a tough spot: How to ensure material availability in the prevailing circumstances? The supply management strategy emphasizes high quality, economic growth and on-time-delivery performance (OTD) as the most important goals whereas quality, cost and OTD for the triangular basis for operations (FIPPMV Hankintastrategia 2015). So in summary quality, speed and product diversity are some of the FISUB core competences. Ensuring material sufficiency is crucial concerning especially the speed promise to customers – and customer satisfaction is a core element in the BU's strategy. The general view is that things are running quite smoothly in the purchasing department at the moment: there are no urgent issues to be fixed but rather a need for fine tuning of processes. There is always need to get rid of as much manual work as possible to be able to focus on the most important issues, instead of correcting errors caused by human errors etc. As continuous improvement is always aimed at, new solutions are needed. The question is how to find solutions or tools which fit to the prevailing circumstances; the purchasing process, the ERP system, the purchasing procedures and the supplier relations. A solution which manages to meet the most crucial elements in these areas will result in most overall benefit.

The idea behind finding the internal fit of the tools and the actual needs stems from the wider concepts of adjusting tactical level approaches to fit the strategy. The problem often is that companies fail in obtaining this fit (Hirvelä, Leskinen, Kekäle, Sivusuo & Takala 2006). It is very common in companies that different tools, approaches and solutions are implemented without checking the fit between the tool in question and

actual customer or end user needs. When neglecting the search of the fit, the solution might not serve the most urgent customer needs and fail to produce substantial benefit. In this research, the fit between the DSBM approach, a tool designed for inventory control and optimization which is based on theory of constraints principles, and the purchasing department's needs under the current circumstances is studied.

1.2. The Research Question, Goals and Research Composition

There are two sub goals which form the basis to the culmination, the final goal. These goals are identifying the critical factors in the field of operative purchasing defining and identifying the so called DSBM factors; factors which are affected by the DSBM approach positively. These critical factors and DSBM factors are sorted out from a comprehensive set of attributes covering the operative purchasing function by using the (B)CFI method. The main goal is to analyze the fit between the critical factors and DSBM factors to evaluate the suitability of the DSBM approach to the FISUB purchasing function. The research question can be defined as follows: Does the implementation of the DSBM approach allow substantial benefit in the field of operative purchasing, in other words does it fit to the purchasing department needs?

In this research, the customers are considered to be the operative purchasers to whom the DSBM-tool has been assigned to. This means that the original function of the CFI tool has been modified to suit the purposes of this study: the aim is not in external customer relations, but in enhancing the efficiency and fluency of the internal purchasing process, but also the supply chain linkage towards the suppliers.

The primary contribution of this study is based on the definition and comparison of the previously mentioned groups of factors; only after evaluating the convergence of the DSBM factors and critical factors one can evaluate the usefulness of the DSBM approach. On a technical level, the goal can be translated as evaluating whether the transaction functionalities meet the critical factors.

The research composition is presented in the next figure. The idea is to drive the research towards a culmination: the CFI and BCFI analysis act as a basis to analyze and map the current circumstances and to point out the critical factors as well as the DSBM factors. Then the factors are compared to examine their fit, which means the level to

which the DSBM and critical factors overlap, ergo are the same attributes. If this fit is comprehensive, the DSBM implementation can be justified as a suitable solution, but if not – then perhaps other more suitable solutions should be considered.

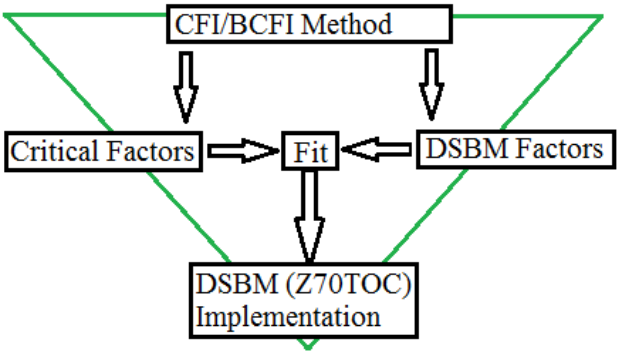

Figure 1. the research composition.

1.3. The Research Method

To be able to assess the fit between the customer needs in the current circumstances and the DSBM approach, a suitable research method is needed. CFI, critical factor index, was chosen because its applicability has been backed up by plenty of recent researches, such as that of Rautiainen and Takala (2003); Hirvelä, Kekäle, Leskinen, Sivusuo and Takala (2006); Ranta and Takala (2007); Nadler and Takala (2010), Grönholm and Takala (2011) and Belay and Takala (2011). For example Nadler (2010) stated in his study that "the usage of IMPL and CFI in over 50 different case studies, comprising a big variety of processes as well as business environments, showed that the method can be used to measure basically every business process, given that the attributes are well defined". The main reason for choosing the method is that it is highly flexible: a method was needed which would fit the research composition and goals. The CFI method can be applied to very different environments and organizations – and both to external and internal processes. The method relies on qualitative elements; expert perceptions on the experiences and expectations of the behavior of chosen attributes. These perceptions are gathered and analyzed in the form of a questionnaire, which has proven to be a reliable method for collecting data on customer satisfaction (Nadler & Takala 2010). Nadler also pointed out as a conclusion of his study the fastness, comprehensiveness and

reliability of the method to gather relevant information which applies as a basis to strategic decisions.

According to the definition, the CFI method is technically a measurement tool to identify the critical factors in a business process. The method comprises both qualitative and quantitative elements. The critical factors are based on respondent perception: experiences and expectations concerning the predefined attributes from among which the critical factors are searched. Also a central element of the method is the preceding interviews. Yet the respondents' responses are analyzed according to statistical formulas. The philosophy behind the tool relates to sensing and responding to customer satisfaction. The method is completed by using side to side the BCFI, balanced critical factor index. Nadler has already stated in 2010 that there is a problem with the CFI in cases of high standard deviation among the responses. In the BCFI index, the influence of the high standard deviation has been mitigated whereas the influence of experiences has been emphasized. (Nadler & Takala 2010.) The essence in CFI is to measure the resource sufficiency whereas in BCFI the focus is on the performance based on the resource in question (Takala 2011).

1.4. The Time Frame

This research was conducted as a cross study: the focus was on a certain point in time at which the development of the attributes over the past and coming three months was supposed to be evaluated. There are no actual longitudinal elements in the study. The time frame is presented in the picture below.

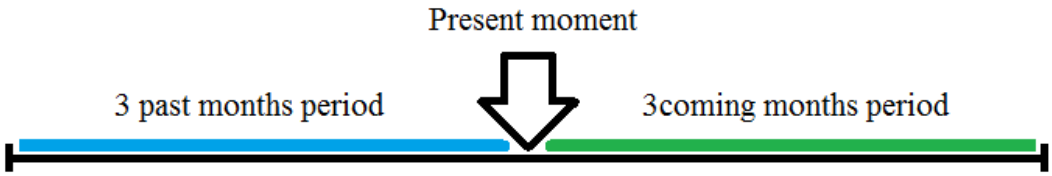

Figure 2. time frame of the research.

The time frame had to be only three months as FICON has implemented the tool in August 2011, so they didn't have experience from a longer time period. Yet, three months is a sufficient time frame as enough experience has been able to be gathered from using the transaction as the logic and functionalities are sufficiently simple. The future development expectations are quite difficult to evaluate on such a defined range but at least it clearly leaves out the long-range vision of the future. Like this, the respondents are guided to evaluate the short term future on the same baseline.

1.5. The Structure of the Thesis

The first chapter presents the research question, goals and the research composition. It also discusses the business unit and the research background to explain why DSBM is needed. The research restrictions are also presented. **The second chapter** deals with the theoretical background: the different theories this research is based on. The research is grounded on a trinity: the basic historical theory aspect, the internal aspect (the DSBM approach) and the modern aspect (the (B)CFI). All these aspects are reviewed in chapter two and a comprehensive theoretical background is formed to support the analysis. The DSBM tool is also discussed in further detail to provide internal value to any business unit potentially interested in the solution. **Chapter three** presents the research method and the research composition and the different elements of the research method, such as questionnaire and the formulas used. **Chapter four** presents, examines and combines the research results and introduces the new terms derived from the research results. **Chapter five** summaries the research results and reveals both the contribution and criticism of the research. Also the suggestions for future research are introduced.

1.6. Restrictions

The focus of the study is on strong signals detected from the research results. As this research has a multidimensional base: the views of three different interest groups are compared and the CFI method has been further developed to fit to the research purpose, the amount of outcome research material is vast and the analyzing opportunities numerous. Hence, the significant signals had to be extracted from the mass and refined into explicit and tangible research results. So the focus of the study is in practical implications: firstly in finding the critical factors and DSBM factors and secondly

examining the fit between the DSBM factors and critical factors. The indexes are examined to some extent but the processing has been left to minimum as the research background is already comprehensive and lies on a strong basis. Hence any un-value-adding examination of the indexes has been left out. This research can be considered as highly empirically focused and hence also the theoretical aspect has been left to less focus while still maintaining the theoretical validation of the research.

The focus of the study is on the critical attributes. The examination of the high-CFI-value attributes have been left out even if they are considered to be worth attention (Takala 2011). These definitions have been done to be able to maintain a specific focus in the research; the analysis possibilities are endless when it comes to the diversity of the possible implications of the research method. Identifying and examining the critical factors is crucial to be able to compare them to the DSBM factors.

Also the comparison between FICON and FISUB critical factors has been left to minimum as it is not relevant concerning the research: it is important which attributes are critical, but important is, whether these attributes are met by the DSBM factors and DSBM references factors. So the fit between the FICON and FISUB critical factors is not focused on.

2. THE THEORETICAL FRAMEWORK

2.1. Introduction to the Theoretical Background

The theoretical background in this research is roughly divided between three aspects: the internal view, traditional view and modern view. The internal view consists of the internal aspect of this research, it has to serve and fit the needs of the customer which is in this case the business unit itself – and more accurately the purchasing department. Widely expressed the DSBM view represents the internal view of the study. Even if the DSBM-tool in question is rather new and uncharted inside ABB, there is material available concerning the tool from the years 2007 – 2008 when it was first developed and implemented into SAP. Most of this material is project material: technical information and manuals. The internal view obviously has a huge importance in this research as the goal is to bring benefit and additional value to the company, but this aspect should not dominate the research, and even more importantly, it should not corrupt the results by dominating over the signals from other research aspects. The traditional view on the other hand deals with historic, profound theories on materials management and warehousing. These views usually act as a basis and starting point for all new research and hence should strengthen the groundwork of the research. The modern view in this research consists primarily of the CFI and BCFI methods and their advancements. There are quite a few interesting theories brought to publicity during the 21st century and as the topic is very actual, fresh and adjustable ideas are needed to support the research. As illustrated in the next figure, the three aspects are overlapping in this research: instead of the division being sharp, it's rather intertwined and the aspects are discussed hand in hand.

The views are bound together to form a suitable framework for the research. This three view approach has been chosen because even as the research is heavily focused on ABB interest, an objective and independent research background and a suitable research method had to be fitted with the internal view to allow research objectivity and comprehensiveness and consequently research validity and reliability. The triangular theoretical framework is presented in the figure below.

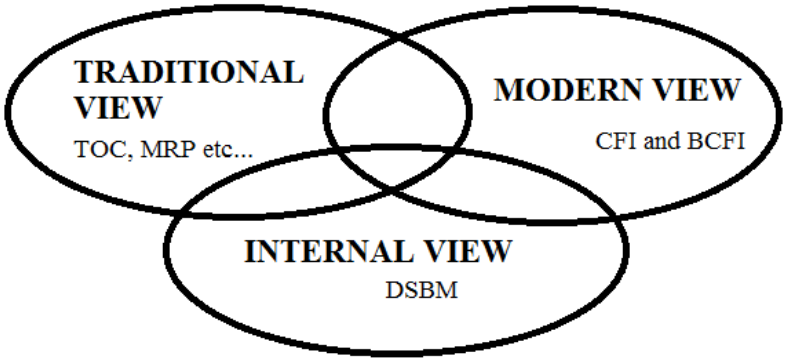

Figure 3. the three dimensional theoretical background of the study.

2.2. Theory of Constraints

One of the major so called background theories framing this research is the theory of constraints, TOC. According to the TOC view, an organization is a construction of different processes: a system. But these processes are not isolated, separate components of the system, but they are interdependent. The main issue is to ensure the interaction of the processes; here also an internal fit has to be achieved to maintain consistency and effectiveness. It's not enough to improve the performance of a system by improving the performance of some of its processes. Like a chain, a system's performance is limited by the performance of its weakest link (Dettmer 1997: 11–12). The process that constraints the capacity of a system is called the system bottleneck or in other words the bottleneck of a system is the process with the highest utilization. Thus, it's important to be able to recognize the weakest links in the system to achieve overall improvement and to understand the interactions between different components of the system. Sometimes the performance deteriorating issue is the fact that the process developers don't understand or misinterpret the interactions of processes; it's not so univocal to see what phenomena are causing others and vice versa. (Hopp 2008.)

In FISUB, the TOC view has been introduced in 2007. The core ideas of the TOC approach have been developed to fit the FISUB circumstances of the time to improve the overall performance in the operations function. The main TOC principles in FISUB were the following:

- to improve the production planned load with two weeks fixed delivery time
- To reduce the amount of manual work from production supervisors

- To implement a more constant and optimal workload on factory level

(Krupa 2007)

At that time, the factory's delivery time was set to the uncompromising two weeks, which still affects the nature of supply chain management. The two weeks delivery time was considered as a winning edge over competitors and this perception still applies. The second target was to reduce the amount of manual work by production supervisors to tie less resources to unnecessary work and to be able to focus on the essential areas. The implementing of a more constant and optimal work load refers to effective planning to be able to meet the two weeks delivery time and to clearing out the processes and balancing the production (TOC and Dynamic Buffer Management 2007).

2.3. Elementary inventory control

2.3.1. To Stock or Not

Inventories are defined as "stockpiles of raw materials, supplies, components, work in process, and finished goods that appear at numerous points throughout a firm's production and logistics channels --" (Ballou 2004: 326). One of the most crucial decisions when it comes to inventory management is to decide whether to stock an item or not (Niland 1970: 150). The decision of keeping stock of an item is basically a trade-off between costs and benefits discussed later on. The most obvious upsides and downsides of keeping stock are summarized in the table below.

Table 1. to stock or not – advantages and disadvantages.

To stock	**Not to stock**
Ensuring material availability	Obsolence risk
Protection against variation in demand	Masking of quality problems
Cost savings	Cost savings

The fundamental reasons for keeping stock relate to either customer satisfaction or cost savings, or both. These goals are usually indirect; reasons behind other more apparent

reasons. The main direct reason for stocking materials is usually to ensure material availability in all situations and hence maintain customer satisfaction (Ballou 2004: 328). Material availability is rather crucial when it comes to the FISUB mission: ensuring customer satisfaction. Customers expect to get what they have ordered exactly when it has been confirmed and if the good is not available to the customer at the agreed moment, there might be penalties and extra costs of for example fast delivery or even costs for lost sales.

Protection against variation in demand, and in more detail, covering for peaks in demand is relevant in FISUB's production as the consumption of materials is highly volatile. This means that there are unforeseeable, high peaks in end product demand which occur quite abruptly. This is mainly because of the nature of the business: the direct customers are usually other ABB units, especially switchgear manufacturers who leave the ordering of protection and control device to the last possible phase before delivery to the end customer. This leaves very little time for FISUB to react under the requirements of a two-week-delivery time.

Even if stock is an obvious expense in itself, there may be also cost savings related to it. These are for example the lowered order costs, item costs and setup costs. Order costs are related to placing the purchase order and receiving it, such as delivery and physical inspection costs. Item costs refer to economy of scale: larger batch sizes usually results in lower unit prices. Setup costs are caused when the process is modified when changing from producing one kind of product to another. All these three types of costs are lower per unit when the units are ordered in bigger batches, in other words when they are ordered to stock; the bigger the batch, the lower the unit costs. Another, sometimes fairly significant, cost is the cost of missed sales as having the demanded item in stock will shorten the lead time to customer and sometimes even result in a winning edge over a competitor when competing for sales. (Dilworth 1989; Ballou 2004: 328–330.) The main reason not to keep inventory is obvious: inventories tie working capital which could be invested elsewhere (Buffa & Sarin 1987: 100). The capital tied could be directed to other purposes contributing direct value to the company.

It is not common to have no stock level at all; mostly keeping a minimum, for example a stock level of a few pieces of a certain material, is necessary. Very low expected usage is one obvious reason for not stocking materials. Yet, there is a controversy; usually components, which are rarely consumed, also have a long lead time as the supplier

might not stock them either – the manufacturing might be started from scratch or the component ordered from a supplier's supplier with long lead times. This problem can be solved by setting longer lead times to customers when they order these kinds of components or end products which have these components in their bills of material. Still, some rarely sold items, such as spare parts, might be so important to the customer that the manufacturer has to keep a small stock to ensure quick delivery when they eventually are needed in order to maintain customer satisfaction. Another obvious downside of stocking is the inevitable risk of obsolescence and deficit. Even though the FISUB components are not spoiled easily, stocking always increases the possibility of breakage or even disappearing. (Niland 1970.)

Even if stocking materials ensures material availability, it is also important to notice that by having high stock levels, a problem somewhere in the supply chain can be hidden. Maybe managing the supply chain as a whole brings more advantage than just covering the weak points or bottlenecks by keeping a buffer somewhere along the chain.

2.3.2. Buffering

As mentioned earlier, inventory management is all about balancing between product availability, and indirectly customer service, and the costs of ensuring the wanted product availability (Ballou 2004). Buffers are needed to secure the continual, unbroken flow of materials throughout the production process so that the process wouldn't starve. The capacity of a process is wasted if utilization isn't on a sufficient level. Utilization can be calculated as rate into station divided by capacity of the station. By increasing buffers, production processes can be protected from starvation. Still, the fact has to be taken into consideration that the buffers can't be too high, otherwise for example excessive amounts of money will be tied to inventories and there will be deficit and spoilage of materials. This means that buffering of materials, or warehousing, is always a trade-off between costs and protection from variation, which has a disruptive effect on system performance. And regarding the theory of constraints view, high variability is most damaging in points in the process with high utilization – bottlenecks. (Hopp 2008: 80–89.)

2.3.3. Material Requirements Planning

MRP, material requirements planning, is a term comprising all activities related to creating a production schedule or purchasing plan for all consumable materials. The core idea of material requirements planning is simple: to make sure that all necessary materials are available when needed. The idea is to purchase no more and no less than what's needed. Material requirement planning can be either consumption-based or requirement based. Consumption based planning can be either reorder point planning or Forecast-based planning. Reorder point planning is consumption based: it does not consider the coming demand but the decrease in inventory levels, in other words material consumption. Reorder level on the other hand is a predefined stock level which, when penetrated, triggers a new purchase order. Requirement based planning on the other hand, refers to planning according to demand; open planned orders. (Blain, Boardman, Chapman & Dodd 1998: 118–121.)

Safety stock is defined as both a buffer against variation in demand and material delivery delays. Safety stock can be used together with reorder point, and worth noticing is that it should be used merely to cover for unexpected usage (Blain et al. 1998: 120). Dilworth (1989: 265–266) presents the safety stock as a means of protection against stock outages which shouldn't be penetrated on average, but it can happen when there is for example unexpectedly high sales. There are some factors affecting the safety stock level, which are the cost due to stock out, the cost of carrying the safety stock itself, the variability and uncertainty of demand and the frequency of risk of stock out.

2.4. Introduction to the (Balanced) Critical Factor Index and its Background

In this research, the (Balanced) Critical Factor Index ((B)CFI) method has been formulated with regard to balanced scorecard principles. The balanced scorecard is a well known and widely used method inside ABB and hereby a justifiable base element in the study. In its original form, the balanced scorecard has four different perspectives; the financial perspective, the customer perspective, the internal-business-process perspective and the learning and growth perspective. Out of these four perspectives a comprehensive framework can be formed by which the company's vision and strategy can be converted to a consistent and comprehensive set of performance measures (Kaplan & Norton 1996: 7–8). The balanced scorecard acts as a background theory for

the interpretation of the (B)CFI method applied to this study and the attributes are formed related to balanced scorecard logic.
The original core idea of (B)CFI, the (balanced) critical factor index, is to sense and respond to customer satisfaction. This can be achieved by measuring the criticality of different attributes of the business process based on the target group's experiences and expectations (Rautiainen & Takala, 2003; Nadler & Takala 2010). Grönholm & Takala (2011) on the other hand defined the CFI as a management tool to measure the performance of a business process. The goal is to form a comprehensive outlook on the state the business processes are in. In the sense and respond view presented by Bradley and Nolan (1998) sensing and responding to customer needs has been closely linked to the organization's strategy. So derived from this, the CFI method aims at quickly and easily gathering essential information to support strategic decisions (Nadler 2010).

2.5. The DSBM Approach

2.5.1. The Definition of the DSBM Approach

The DSBM, dynamic stock buffer management, is essentially a tool designed for handling the changes in demand and lead time. This means it is on a simple level a rather easy-to-use technical solution in SAP with no strategic levels, but as a wider approach the solution has also indirect, higher levels of applicability (Krupa 2008). SAP on the other hand, is a comprehensive enterprise resource planning system which is comprised of fully integrated modules covering all aspects of business management (Blain et al. 1998: 22–25). The DSBM transaction in SAP is Z70TOC, TOC Workbench. This transaction, or in other word command for executing a program, will be discussed in further detail later on.

2.5.2. The Essence of the DSBM Approach

In standard reorder point based replenishment behavior there are three strategic levels: safety stock, reorder point and maximum buffer. As indicated in the next figure, a new purchase order is created every time the stock level drops below the predefined reorder point level. This means that the order quantity and reorder point level itself have to be planned so that during the lead time, the stock wouldn't plummet below the safety stock level (Krupa 2007). In reality this is difficult to define, especially in case consumption

is volatile, but average consumption figures can be used to estimate the coming consumption.

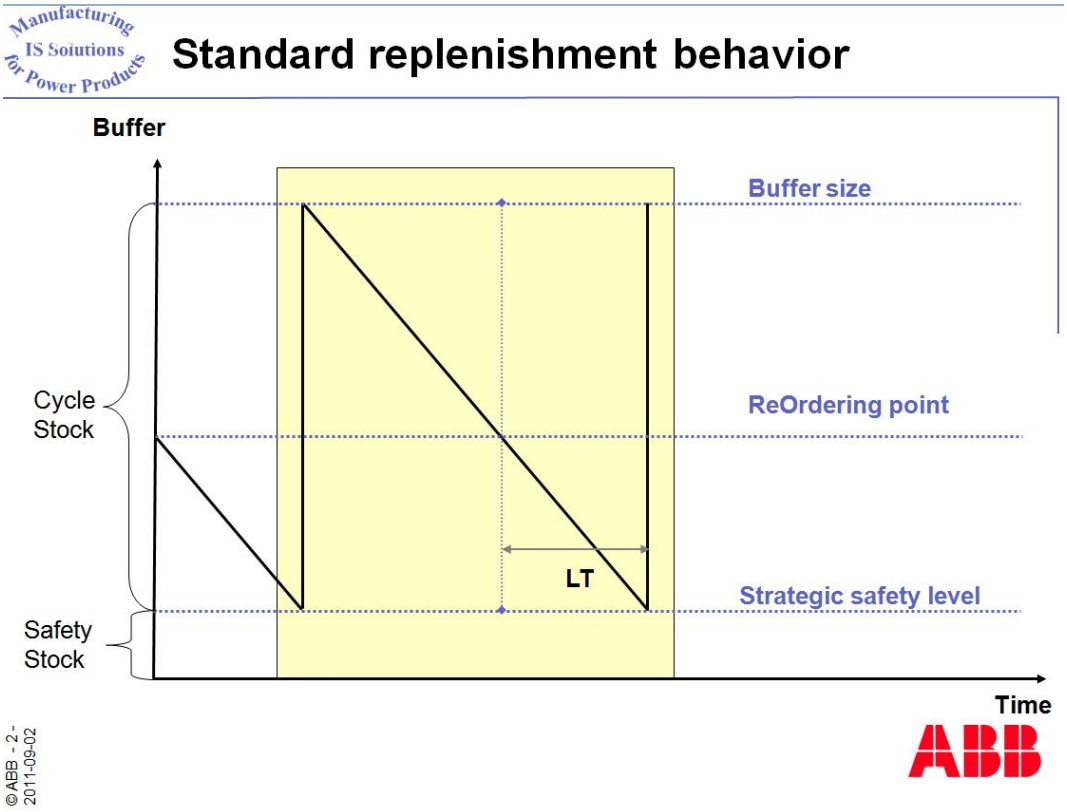

Figure 4. standard ROP replenishment bahavior (Krupa 2007).

The figure above presents the standard reorder point replenishment cycle. The material consumption starts at the maximum buffer size level; this is the maximum level the stock is supposed to reach. Usually there is a theoretical maximum which can also meet with a physical maximum, for example a limitation of storage space. The order is placed when the inventory level drops to the reorder point level and the order should be filled during the lead time (LT in the figure). The stock levels should never penetrate the safety stock level in normal conditions. The problem is that by following this standard replenishment method, the stock level constantly stays too high and there is no mechanism to adjust the stock level to the volatile demand nor the changes in suppliers' lead times. In the next figure, the DSBM approach is compared to the basic reorder point cycle.

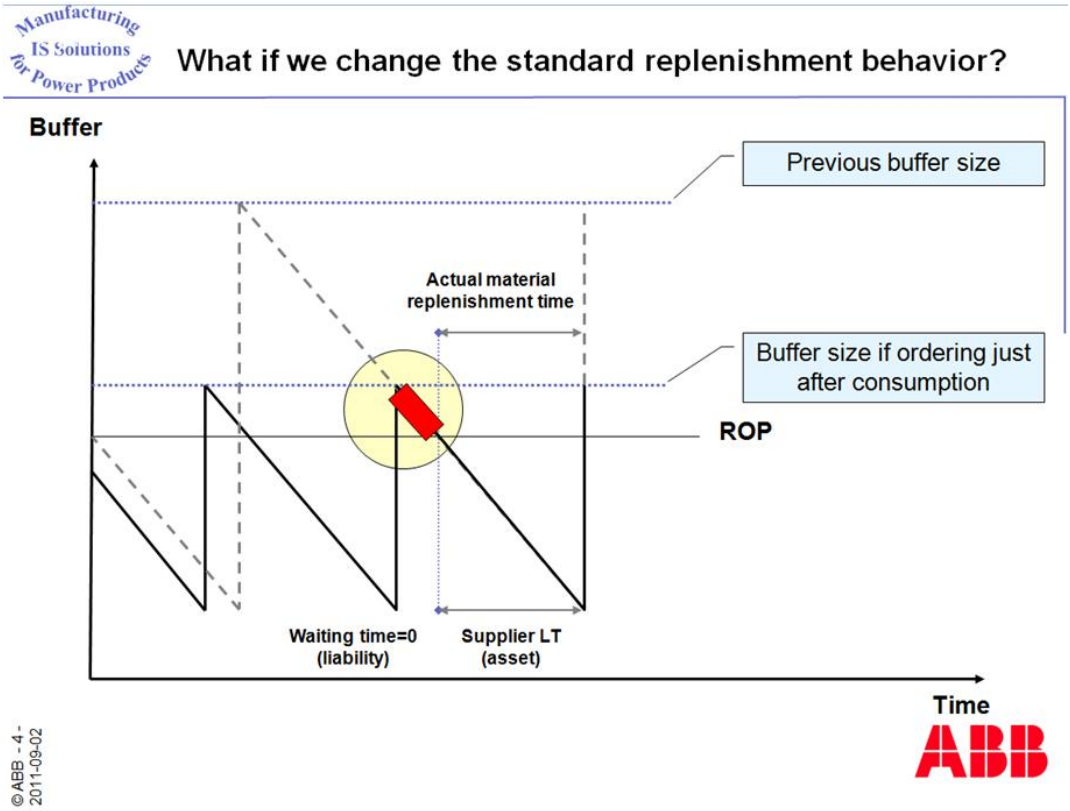

Figure 5. the DSBM approach in standard replenishment behavior (Krupa 2007).

The idea in original DSBM is to replenish more often and allow lower stock levels by ordering directly after consumption. Consequently the stock level will constantly remain on a lower level which will at least save space and lower the tied capital. Also a more fluent material flow can be attained. The downside is that as the order batches become smaller, the ordering interval becomes shorter and the ordering costs, such as transportation, grow higher. Yet, the main idea is to manage to keep the total costs lower than in the standard replenishment behavior.

The strategic levels of the DSBM stock are presented in the next figure. The green zone represents too high inventory level, the yellow zone adequate inventory level and the red too low inventory level. The stock level is allowed to penetrate all the levels mentioned above, but the black safety stock level is a critical, strategic level under which the stock levels should never plummet. The idea is to keep the stock level mainly in the yellow zone – if the stock level stays in the red zone for too long, there is a problem: the maximum buffer is too low. On the other hand, if the stock level stays in

the green zone for too long, the maximum buffer is too high. Basically these inefficiencies are usually caused by changes in demand or supplier lead times. The yellow zone is basically the optimal stock level. Based on the zones, it is possible to react to changing customer lead times and demand in a more accurate and dynamic way.

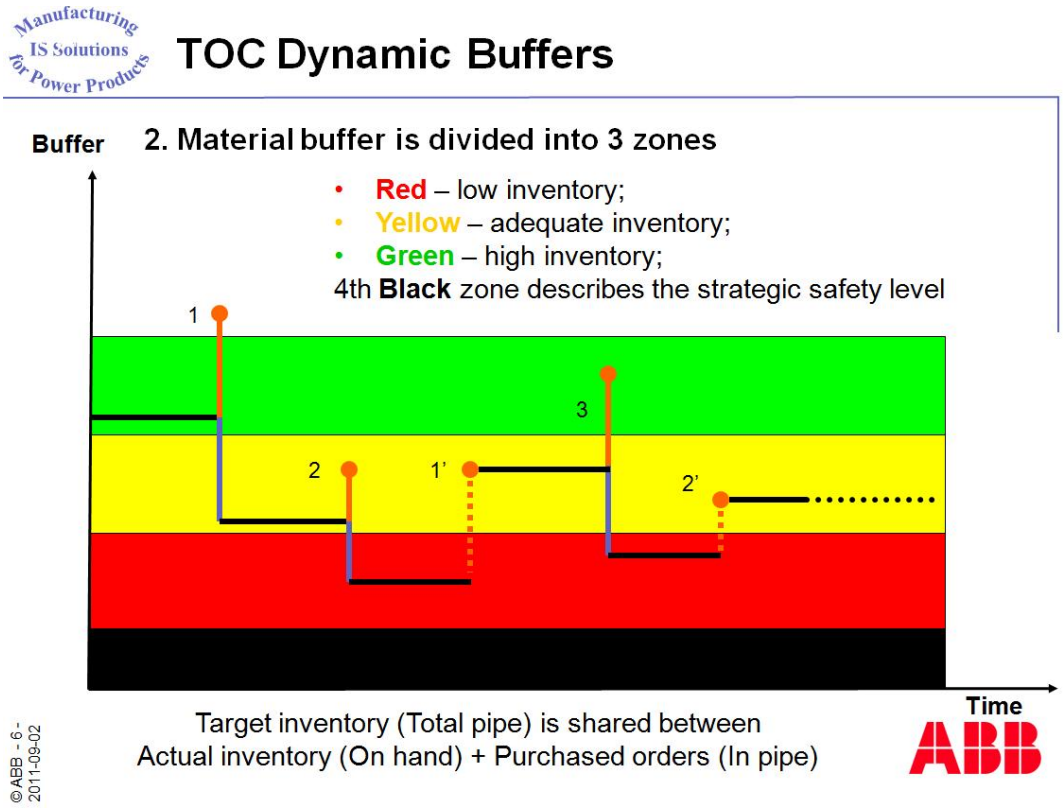

Figure 6. the DSBM zones (Krupa 2007).

The primary idea behind implementing DSBM in FISUB is to be able to follow stock levels more accurately and prevent stock outages from happening. The further applicability and benefit gained from the approach are based on this basic functionality.

The SAP DSBM transaction, Z70TOC, forms the core element of the approach. It covers the following functionalities presented in the figure below.

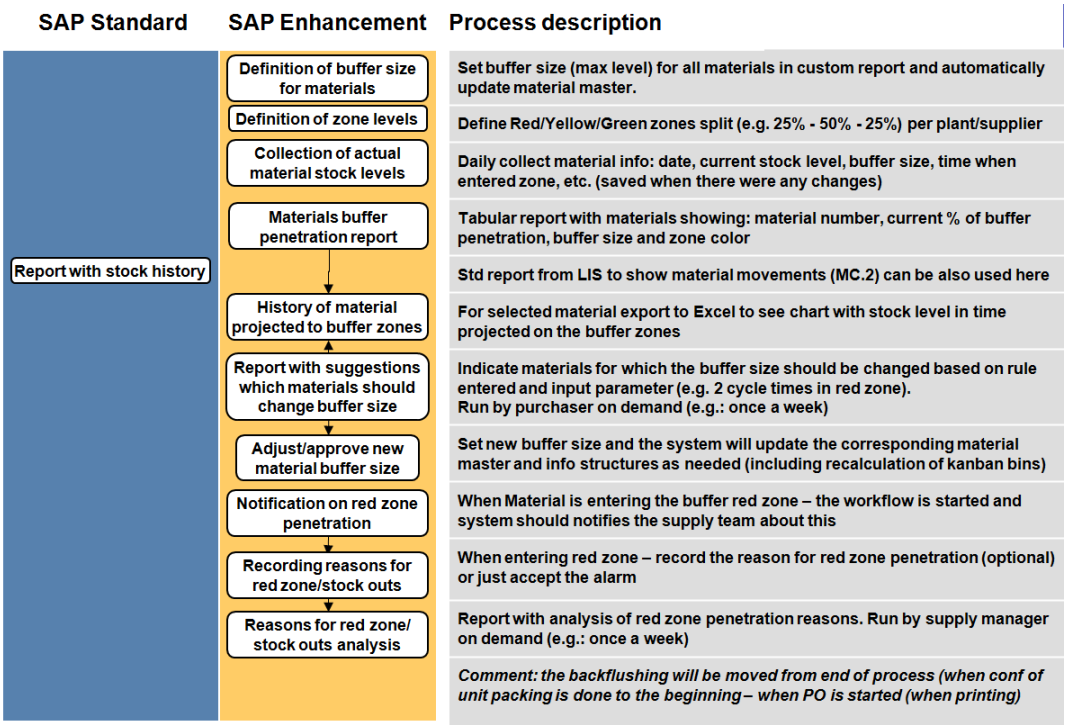

Figure 7. the DSBM functionalities.

The maximum buffer can be changed on the transaction which will automatically change the safety stock level to MRP type materials and reorder point to reorder point type materials. **The definition of zone levels** is divided as percentages of the maximum buffer (100%). The upper limit of the red zone is 25%, the upper limit of the yellow zone is 75% and obviously the upper limit of the green zone is 100%. There will be a change in the buffer split but it will be introduced later in this chapter. The essence of the transaction is **gathering of information on actual stock levels on daily basis**. This information can be seen on the transaction and even converted to an excel sheet which allows creation of different graphs. **The material buffer penetration report** is a functionality showing the actual stock level in comparison to the maximum buffer. **The history of materials** is also a rather useful functionality as one can view the past behavior of the stock level of a particular material. The past behavior is useful information when for example forecasting future consumption. **The report with stock suggestions** is an automatic report generated to suggest buffer changes where needed based on predefined parameters. The system automatically calculates these suggestions and the user only has to decide whether to act based on the suggestions or not. **Adjust/approve new material buffer size** functionality will automatically, when used

on the Z70TOC transaction, update the new safety stock on material master. This means that changing the maximum stock on Z70TOC has impacts on other SAP information and hence it has to be treated carefully to avoid confusions. **The notification on red zone penetration** is an automatic notification sent to the predefined recipient's SAP workflow to inform the responsive purchaser about the penetration. **Recording reasons for red zone/stock outs** is an optional feature actual when the stock level has penetrated the red zone; once the alarm has been received via SAP workflow a reason for the penetration can be inserted. This will allow future analysis, such as pareto analysis, on the reasons for stock outs and hence the most common reasons can be easily pointed out in the **reasons for red zone/stock outs analysis** functionality.

2.5.3. Changes to Be Made Prior to Potential Implementation

Even if the transaction has been configured already in the year 2008, some changes would have to be made before the potential implementation in order to achieve a fit between the transaction and the current purchasing procedures and to gain most benefit from the approach. The required changes are summarized in the list below.

- Adding a fourth buffer zone, the black zone
- Distinguishing the reorder point level from safety stock level
- Workflow has to be initiated
- New screen for reasons definition

(Doniec & Kaakinen 2011)

For the dynamic buffer management to work fluently and support purchasing on the best possible level, some changes in SAP have to be made. The most important change is adding an extra buffer zone to the transaction, the black zone. The black zone upper limit will be the safety stock level for each material not depending on the MRP type. The safety stock will be automatically updated to material master when the max buffer is changed. Currently the safety stock level is the upper limit of the red zone: 25 per cent of the maximum buffer.

Another change related to the safety stock issue is the distinguishing of safety stock and reorder point. The current configuration defines safety stock level for MRP materials and reorder point for reorder point controlled materials to 25 per cent of the buffer. This

means that reorder point is systematically used wrong. According to the new settings, the reorder point will be set somewhere close the limit between the yellow and green zone, which means that the replenishment signal will take place when the stock level is still close to the maximum buffer. The initialization of the workflow ensures that the crucial information concerning buffer change suggestions will automatically reach the recipients. The suggestions are generated when the stock level has been too long in either green or red zone, or immediately when it dips into the black zone, and there is a special inbox in SAP where this information will appear. When there are stock outages, the information will be automatically sent to the SAP inbox. At this point, a reason for the stock out has to be given. The predefined reason alternatives should cover for the most frequent cases, such as delayed shipments, quality problems and supplier material shortages, but there should be a possibility to add other reasons as they come up so that the reasons for stock outs could be analyzed later and the division between different causes could be visually seen.

2.5.4. The DSBM Project Goals

As mentioned previously, the DSBM principles date back to the years 2007 and 2008 when the project was first initiated in FISUB. These are the original goals of DSBM listed as the project was introduced:

- To reduce the amount of manual work from operative supply management
- To improve On-time-delivery performance
- To optimize inventory levels without risking OTD targets – to improve cash flow
- The solution itself – to be distributed within PPMV

(Bistron 2008).

So the initial target was to reduce the manual work caused by continuously checking the stock levels and trying to manually maintain the safety stocks, reorder points et cetera. In the year 2008, SAP was still quite new in FISUB as it had been implemented in 2007 and all master data and procedures were still, at least partly, on a crude level. This meant a lot of manual work, some of it rather unnecessary, while the employees were still trying to adapt and fit their working methods to the ERP system. This is why reducing manual labor was a high priority then. To improve OTD, on-time-delivery, figures seems like an eternity question in most factories: OTD is a key figure closely

monitored by top management. OTD is also the figure which quickly reflects problems in the supply chain: for example if there are some material availability problems, OTD will be soon affected negatively. Optimizing inventory levels is crucial in most companies; optimizing them means balancing between too low and too high inventories, which both have their downsides. On one hand too low inventories easily lead to stock outages and production stops but on the other hand too high stocks might for example overcrowd the warehouse and lead to excessive tied capital. The solution itself works as an asset in case it could be widely used in the medium voltage division in the future. (Bistron 2008.)

Now that the interest for the DSBM was woken again in 2011, new goals for the project were listed in June 2011, and they are the following:

- Increase the service level
    - Without inventory explosion
    - But by prevention of stock outs
- Improving OTD figures
- (focus on maintaining and updating buffer levels)
- Keeping material related data consistent
- Recording reasons for stock outs

(Doniec & Kaakinen 2011).

The goals defined in June 2011 are similar to the goals defined in 2008. Yet, the first priority was to increase the current service level. This means that FISUB has adopted a more customer oriented view in operations management. Basically the two border conditions “without inventory explosion” and “but by prevention of stock outs” refer to the point addressed already in 2008: the optimization of stock levels. But this time, the focus is not solely on optimizing the levels – but more on keeping them as high as possible yet considering the obvious limitations caused by maximum storage space, maximum tied capital etc. So the idea is not to keep the stock levels as high as possible, but to keep them as high as needed. The main goal is naturally to improve the on-time-delivery performance, which is a fundamental but indirect goal in this project. As mentioned previously, on-time-delivery performance is a measure closely monitored by different management levels and it is closely related to FISUB’s mission of ensuring customer satisfaction. The Z70TOC transaction is supposed to make maintaining and

updating of buffer levels easier and less time consuming and more automated. Like this, more time to the more essential and relevant tasks can be de-allocated. Keeping the material related data consistent refers to a parallel project of cleaning up SAP based master data and classifying of materials according to the ABC-analysis. This project is continuously ongoing and good results have been gained throughout 2011 for example in the form of deleting old materials from SAP and correction of bills of material. The last goal, recording reasons for stock outs, is related to the need to analyze the past reasons for stock running empty. Like this, the most frequent reasons can be identified and focus can be directed to the most prominent root causes.

2.5.5. Possible Risks and Obstacles for Implementation

The biggest risks and obstacles concerning the proper implementation and long term use of this transaction were defined in the beginning of the project in June 2011:

- Lack of commitment from employees
    - The purchasing department
    - Lack of understanding of the transaction (technical understanding and understanding of benefits)
    - Lack of a shared, mutual perspective
- Lack of integration from Material Master to Z70TOC
    - Changing of Safety Stock and Reorder Point
- Additional money to invest in a project which has failed previously
    - To analyse whether this is the right solution
        - Factors against/hindrances/problem points
            - Bin locations
            - DHL & kanban
            - Misuse of safety stock (especially DHL)

(Doniec & Kaakinen 2011).

Lack of commitment has been a problem before as purchasers' mutual procedures have been missing. This means that purchasers have been for example using different software for same operations, or they've been interpreting same data in different ways. One good example is extracting OTD figures from the master data: some purchasers use a tool named ReportNet for this, some use SAP figures. Then the raw data extracted from the two different systems is manually corrected: one purchaser might end up

considering some lines late even if another considers them on time based on some internal reason, such as ABB owned tester problems. So if the employees are not managed to get committed to start using this transaction on a regular basis, they will most likely not continue to do so. Or if the instructions are not sufficient or clear enough, purchasers might understand them in different ways and hence start using the transaction in different manners. Also the information on the transaction can be interpreted in different, even insufficient manners. Another risk is the one-way connection between Z70TOC and material master. This was seen as a problem mainly because updating the safety stock or reorder point fields on material master will not automatically update the info on Z70TOC whereas changing the maximum buffer on Z70TOC will automatically change the values on material master. This creates a risk to manual mistakes – to update the information only to material master which will leave Z70TOC un-updated. Also changing the Z70TOC maximum buffer without taking the connections to material master into consideration might result in erroneous master data.

The fact that this project has been initialized before but the transaction has never been taken into use is a conspicuous obstacle to overcome. Letting the purchasers understand and digest the potential and benefits of the solution is great challenge. The essence of this research is to analyze whether the DSBM approach is a suitable solution – and to convince the end users of the possible suitability as well. The fit of the transaction and its major features to the current circumstances will be discussed thoroughly in the coming chapters. Yet, there are some minor, less profound obstacles, which were discussed already when the possible implementation was first discussed in the summer 2011. The biggest problem has been the issue of DHL stock. All materials handled through DHL stock, an external separate storage location operated by a supplier, are concerned with a certain problem – the safety stock is being used in a wrong manner. Instead of being used as an alarm limit which should never be crossed, it's used as reorder point, a trigger for creating an order, under which the inventory levels usually stay. This is because the usual reorder point MRP type VB, which is a special SAP feature, used in FISUB is not applicable in connection to DHL stock, because with this particular MRP Type, the spare part orders are not visible on the regular SAP transaction, MD04. In closer detail, this means that when sales open a new sales order including purchasing items, these will not appear as purchasing requests in SAP.

The bin location problem refers to the lack of detailed information on storage locations; the more detailed bin storage locations are going to be taken into use in FISUB, but it is

not tested whether DSBM will work in unison with the new storage location specifications. Yet, these obstacles and risks are possible to overcome and they should rather be treated as hindrances to the implementation, they do not ruin the suitability of the transaction.

3. THE (BALANCED) CRITICAL FACTOR INDEX ANALYSIS

3.1. The Core Idea and the Structure of the Research

As mentioned before, the original core idea of CFI, the Critical Factor Index, is to sense and respond to customer satisfaction. The customer satisfaction is measured by studying the criticality of different attributes and pointing out the most critical ones (Rautiainen & Takala 2003; Nadler & Takala 2010). The BCFI, balanced critical factor index, on the other hand is derived from the critical factor index: it has been further developed to literally balance the index and to minimize the effect of the high standard deviation (Nadler 2010). These indexes are discussed hand in hand in this research and hence they are mentioned as (B)CFI when being referred to both indexes.

Implementing the (B)CFI method can be divided into three phases: assessing the current situation and making observations, defining the suitable attributes for finding critical factors and data analysis and application of the (B)CFI tool (Nadler & Takala 2010; Jyrälä & Takala 2011). In this research, the first phase consists of interviewing the FICON and FISUB purchasers and mapping the current circumstances. Both the FICON and FISUB purchasers were asked to map the current situation: especially to point out the challenges and problems faced in everyday operations. Still, the researcher has obtained a quite a broad understanding of the current situation in FISUB while working there so no extensive additional interviews are needed as the issues related to the research have been brought up repeatedly in different meetings, other occasions and every day work in the department. The second phase consists of defining the attributes. This phase is the most time and effort consuming phase as the definition of the attributes directly limits the possible results. In short, the attributes should cover exactly the field of research: if the scope is too broad, irrelevant factors will be included and if it's too narrow, relevant factors will be left out. Also the interactions between different attributes would be impossible to map if the scope would be too wide, while the interactions are too obvious when the scope of attributes is too narrow. Both alternatives will obviously corrupt the research results. The third phase includes the data analysis and application of the CFI method to practice. In this research, an additional DSBM block has been added to the (B)CFI method, but this DSBM block will be discussed later on.

3.2. The Formation of the Questionnaire

The core element of the (B)CFI method is the questionnaire form: the data is gathered from the respondents' answers to the questionnaire which has been constructed out of separate blocks bonded together to form an appropriate basis for a comprehensive analysis. The questionnaire has been kept as short and unambiguous as possible to ensure the convenience of answering, which allows reliability of results and a high response rate (Nadler 2010). The point was to create a questionnaire comprehensive enough but yet as un-time-consuming to answer as possible. The questionnaire form presented below represents the questionnaire given out to FISUB purchasers. The FICON purchasers received a slightly different questionnaire because they already have experiences concerning the DSBM as it has been implemented in FICON, but the only differences in the questionnaires are in the yellow columns; the FISUB purchasers are supposed to express their expectations while the FICON purchasers express their experiences.

The red lines in the figure below stand for the division of the questionnaire to different sections treated separately when analyzing the results.

FISUB	Scale: 1=low, 10 = high		Direction of development, expectations (future)			Direction of development, experiences (past)			Will the attribute be affected by implementing DSBM/Z70TOC?	*Direction of development after the transaction has been implemeted (expectations)*			Comments
ATTRIBUTES	Expectations (1-10)	Experience (1-10)	Worse	Same	Better	Worse	Same	Better	Yes/No	*Worse*	*Better (minor effect, 1-5)*	*Better (major effect, 6-10)*	
Supplier relations perspective													
Attribute 1													
Attribute 2													
Attribute 3													
Attribute 4													
Attribute 5													
Attribute 6													
SAP/technical perspective													
Attribute 1													
Attribute 2													
Attribute 3													
Attribute 4													
Attribute 5													
Attribute 6													
User persective (Evaluate your own performance here)													
Attribute 1													
Attribute 2													
Attribute 3													
Attribute 4													
Attribute 5													
Attribute 6													
Purchasing process perspective													
Attribute 1													
Attribute 2													
Attribute 3													
Attribute 4													
Attribute 5													
Attribute 6													

Figure 8. the five blocks of the questionnaire.

The most apparent section is **the list of attributes**. The attributes are certain contingency dependent features of a business process. By contingency dependent it's meant that the attributes are not universal, but have to be reformed to suit each individual research: in some research the field they cover can be wider, sometimes it has to be narrower (Nadler 2010). The attributes have to be well defined and comprehensive, while still precise enough to guarantee the relevancy and validity of the results. Another block is **the experiences and expectations** each respondent have concerning each attribute. These measures rate each attribute on a scale from one to ten based on the respondents' past experiences and future expectations on a predefined time span. This rating is rather qualitative as different respondents evaluate the attributes on different basis – based on their personal perception and conception. A high variation in values given to the attributes by respondents may reveal the different interpretations and misunderstandings between the respondents. In this particular block or section of the questionnaire, the coherence of the group can be evaluated. The coherence will also be checked using the IMPL method in the next chapter.

The third section is **the direction of development** concerning both expectations and experiences. In these columns the respondents are supposed to evaluate the past and future trends of development concerning each attribute (Nadler & Takala 2010). The fourth block is individually designed to this research. It is the element binding the CFI method to the DSBM approach and basically forming the core contribution of the study. By this specially tailored **DSBM block**, the CFI method has been further developed to evaluate the usefulness and suitability of a separate tool, the DSBM, to certain circumstances. The functionality of the yellow column is simple: the respondents are supposed to tick the column under each attribute if – and only if – the particular attribute is affected negatively or positively by the implementation of the transaction. As there are two different groups of respondents, the questionnaire forms are also different in this aspect: the FICON respondents were requested to evaluate their past experiences concerning the DSBM approach while FISUB respondents were asked to evaluate their future expectations as the approach is not implemented. In the column next to the previously mentioned, the respondents were supposed to tick the degree of the effect; minor, major or negative. The final column was left for free comments. This column was added for the respondents to open up their answers and express their opinions.

3.3. The Aspects

In this research, the questionnaire has been modified so that there are four different aspects: the supplier aspect, technological aspect, purchasing process aspect and the user aspect. Roughly divided, the supplier aspect can be seen as an external aspect and the user aspect an internal aspect while the technological aspect and purchasing process aspect are mostly internal but they do reach to the areas between the two first aspects. This means that even if the basis for the technological aspect is internal, this aspect covers also the external customer: SAP connects the suppliers to the company via different tunnel connections. Like this the suppliers can reach information inside the ERP-system, such as planned orders. The purchasing process aspect on the other hand is a two-way process: different tangible and intangible flows should move to both directions between ABB and the suppliers. This division into four aspects has been adopted to ensure a holistic view on the subject: all relevant factors should be taken into consideration. The four aspects are presented in the next figure.

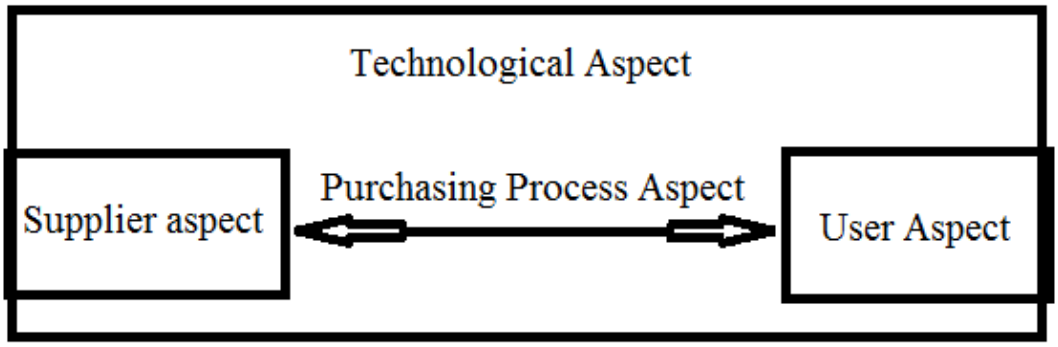

Figure 9. the four aspects of the questionnaire.

Even if the point is to identify the attributes which are influenced by the DSBM implementation, it is necessary to include all essential aspects into the scope to validate the results – so evaluating the impact of the transaction on different areas in forehand has been avoided and an objective overall view over the current circumstances has been tried to form. Too narrow a scope would not give a comprehensive overview of the field of operative purchasing. Still, notice has to be taken of the fact that the scope in this research has to be narrow enough to be able to focus on the relevant issues: operative

purchasing covers for quite a small fraction of the whole materials management function.

3.4. The Attributes

The questionnaire has been divided into two different versions: one was handed out to FICON personnel and the other to FISUB personnel. This is because FICON has implemented the transaction in August 2011 while in FISUB, the implementation is still pending and hence, there is no experience on using the transaction. The attributes were planned based on analysis of the circumstances purchasing is taking place in: the attributes stand for features or sectors the operative purchasers are dealing with.

The twenty-four attributes were the same in both questionnaires and they are listed in the table attached below.

Table 2. the twenty-four attributes.

ATTRIBUTES
Supplier relations perspective
On-time delivery (meeting requested dates)
Openness (information available of different measures; in sharepoint etc)
The suppliers' ability to react to changing demand (especially peaks)
Meeting the required buffer levels (by ABB) in supplier premises
The timeliness of communication and information sharing
Proactive interaction (suggesting changes in order lot sizes, deliver times etc. when needed)
SAP/technical perspective
ERP-system's support (to purchasing) - long lead time
ERP-system's support (to purchasing) - unexpected, urgent purchasing
ERP-system flexibility
Erp system fit to manual purchasing process
Usability and functionality
Quality & reliability of information available (eg. concerning stock levels)
User persective (Evaluate your own performance here)
Technical understanding of the system
Ability to set the buffers to an optimal level
Ability to evaluate the coming consumption of materials
Having time to monitor the stock levels
Being aware/keeping track of reasons behind delivery problems (eg. Stock outs)

Proactivity in operative purchasing (= acting before it's too late, eg. stockout has already occurred)
Purchasing process perspective
Synchronization of the personal purchasing procedures of purchasers
Purchasers' engagement in using the common tools
Dealing with unexpected, urgent purchasing
Dealing with standard, long lead time purchasing
Fit between the purchasing process and other connected processes (eg. sales process)
The purchasing process fit to different MRP Types as a whole

As previously mentioned, the attributes are divided into four aspects: the supplier relations perspective, the technical perspective, the user perspective and the purchasing process perspective. Under each aspect there are six attributes related to that particular view. These four aspects and twenty-four attributes were planned to cover the field of focus as properly as possible in order to maximize the research validity and to guarantee the usefulness and practical feasibility of the study.

3.5. The Formulae and Interpretation of Results

Even if the method is partly qualitative, the responses given by the respondents are treated in a quantitative manner. The CFI and BCFI indexes are based on mathematical calculations executed according to the following formulas.

(1) CFI = (SD of expectation * SD of experience)/(Importance index * Gap Index * Direction of Development Index)

(2) BCFI = (SD Expectation Index * SD Experience Index * Performance Index)/ (Importance Index * Gap index * Direction of Development Index)

SD Expectation Index = ((SD of Expectation)/10) + 1

SD Experience Index = ((SD of Experience)/10) + 1

Gap Index = |(Average of Experience – Average of Expectation)/10 – 1|

Performance Index = Average of Experience/10

Importance Index = Average of Expectation/10

Direction of Development = |(Better-% - Worse-%)/100 – 1|

(Nadler & Takala 2010; Grönholm & Takala 2011)

The different indexes used to be able to compile the CFI and BCFI indexes need to be clarified. **The SD expectation index** represents the standard deviation of the answers given regarding to the expected level of the attributes during the coming three months. If the value of this index is high, the respondents have dispersed perceptions concerning the attribute in question, and if low the respondents share a mutual perception of the state of the attribute. **The SD experience index** on the other hand represents the deviation of the opinions or perceptions concerning the state of the attributes based on past experiences from a three months period. These indexes might also be affected by different interpretations about the states of the attributes, one person might see some attribute to be on a poor level while another considers the same attribute to be on a good level based on some other point of view. **The gap index** represents the gap between the expectations and experiences; what it basically measures is how valid the expectations are based on realized, past experiences – if the gap is wide, the expectations are not necessarily on a realistic basis. **The performance index** measures the past performance of the attribute based on respondents' actualized experiences. This index relates to the importance of an attribute, whereas **the importance index** indicates directly the importance of an attribute. Yet, the performance and gap indexes should be regarded together with the importance index to be able to evaluate the index's validity. **The direction of development index** provides insight on the direction of attribute development; it can be either negative, positive or remain the same. (Takala 2011.) The conclusion is that high values of the importance index, gap index and direction of development index increase the relative criticality of the attribute whereas high SD expectation index, SD experience index and performance index lower it. Still, the sum of the index values is a complex entity composed of several interactive blocks; all indexes have an effect of their own.

The indexes used in the research are listed in the table below along with their ranges of possible values. As visualized in the table, the ranges have a critical and non-critical extremity and the values for each attribute should land somewhere along the range.

Table 3. the index ranges.

Index	The range of possible values: high = critical, low = not critical
Standard Deviation Index	1 (high) – 1,5 (low)
Performance Index	0,1 (high) – 1 (low)
Importance Index	0,1 (low) – 1 (high)
Gap Index	0,1 (low) – 1,9 (high)
Direction of Development Index	0 (low) – 2 (high)

The actual CFI and BCFI indexes are calculated based on the indexes mentioned above. Based on the CFI and BCFI indexes, the relative criticality of the attributes can be measured. The attributes with the lowest CFI and BCFI values represent the critical factors whereas the attributes with the highest CFI and BCFI values are considered as possibly critical factors which require extra attention. The conceptual difference between difference between the CFI and BCFI indexes is related to the interpretation: the CFI index implies the sufficiency of the resource articulated by the attribute in question whereas the BCFI index concerns the performance of the attribute. The mathematical difference relates to the BCFI minimizing the effect of the standard deviation by including the performance index in the calculations. Nadler has also stated concerning the BCFI index that the closer to the value zero the attributes get the more critical they are whereas attributes with value of exactly one are optimal and attributes with values over one are referred to as high performers. However, the expression of a high performer could lead to a misinterpretation. The term high performer does not necessarily mean that the attribute has a high performance, but it only indicates, for example, that the expectations are met by the experiences and the direction of development is higher than one (positive direction), or the experiences exceed the level of expectations". (Nadler & Takala 2010; Takala 2011.)

As mentioned in the restrictions paragraph, the analysis of different applications of the indexes has been left to minimum to keep the focus of the research in the development of the method to suit the DSBM block. Yet, it's worth mentioning that the emphasis of the indexes is modifiable: for example the gap index can be modified by increasing its influence by 0,3. Like this the formula would be shape of

(3) Gap Index = |(avg. of experience - avg. of expectation)*1,3/10-1|

By modifying the indexes, their reciprocal weights change and the criticality of the attributes can be shifted to better reflect some preconditions such as management tacit knowledge of the prevailing circumstances (Nadler 2010; Takala 2011).

3.6. The Respondents

In this research, the customers are considered to be the operative purchasers to whose work the DSBM-tool has been designed to add value. This means that the original function of the (B)CFI method has been modified to suit the purposes of this study: the aim is not in external customer relations, but in enhancing the efficiency and fluency of internal processes, especially the operative purchasing process and related issues. The customers act as respondents to the (B)CFI questionnaire. Even if this research is focusing on the FISUB purchasing department, the research may also result in benefit to the FICON purchasers.

The questionnaires were given out on week 49/2011, along with short instructions on how to interpret the table, and the questionnaire forms were asked to be returned before Christmas 2011. Altogether seven people from FICON were requested to answer the questionnaire: the supply manager, the logistics manager, a SAP specialist and four purchasers. From FISUB, eight people were assigned the questionnaire: the operations manager, the purchasing manager and six purchasers. In addition, the questionnaire was also handed out to a consultant whose expert opinions were used as reference as well. Yet, the reference was only used to evaluate the DSBM effect on the attributes; the consultant has no knowledge of the FICON or FISUB purchasing. Out of these desired respondents seven persons from FISUB returned the questionnaire whereas two persons from FICON didn't and five did. Nevertheless, it's still noticeable that the respondents have different levels of expertise concerning the transaction. One person from FISUB refused to take a stance on whether the Z70TOC has any effect on the attributes and another declared that she didn't really have a valid opinion as the transaction was not familiar to her. In addition, one person from FICON didn't fill in the direction of development part. Yet, these shortcomings don't have crucial effect on the final results as they manage not to distort the calculations.

4. THE RESEARCH RESULTS

4.1. The Primary Results

4.1.1. The FICON Overall Situation

The average experienced and expected states of attributes are briefly discussed to open up the basis for the further analysis. The indexes are also being examined. Yet, this is merely background information to support the essential findings and hence the analysis has not been taken into deeper levels and is kept as short as possible yet including the relevant information.

Altogether five persons from FICON returned the questionnaire. Out of these five respondents, one left the direction of development block empty, but otherwise the responses seemed logical. The experiences and future expectations from three months time spans concerning the twenty-four attributes evaluated by the five respondents are visualized in the graph below.

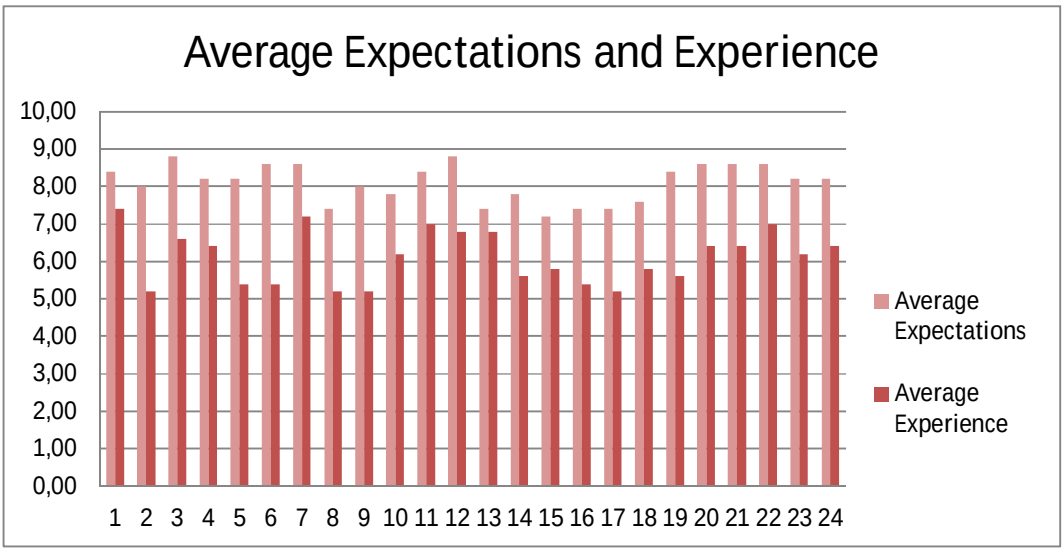

Figure 10. FICON expectations and experiences.

As visible, the levels of all attributes are expected to improve during the coming three months period – and the gaps between the expectations and experiences are remarkably

wide. This seems like a rather unrealistic pattern of development, yet there is a logical reason behind these positive expectations: there is an ongoing wide scale project which aims at on-time-delivery performance improvement in FICON. This project is carried out in different departments and the purchasing department's DSBM solution is just a small piece in a larger puzzle. The most essential renewal concerning the purchasing function is the customer driven ordering process control, which refers to the customer, FICON, aiming at controlling their internal processes to be able to control the interaction towards the supplier (Sahi 2011). Yet, the project's impact on all the individual attributes seems at minimum a bit unclear so no definite correlations between the attributes and the project goals should be specified – at least before a comprehensive analysis would be carried out. Another, more obvious reason is that at least some of the respondents have answered the expectations columns according to their wishes and hopes rather than a realistic basis for development.

In the interview, the FICON purchasers brought up the technical perspective as the most challenging one. The purchasers summarized that the biggest problems arise from the problems with mining up relevant information from the ERP system: the problem is not that there wouldn't be enough information available but finding and separating the relevant information from the irrelevant is a problem. A lot of manual work has been done using for example separate excel charts: the objective has been to get rid of this kind of unnecessary work. It was even stated that the system does not support purchasing on a sufficient level. Yet, the ERP aspect doesn't stand out from the results: according to the results, the lowest average experiences were in the user aspect – which is closely linked to the ERP aspect as the system complexity is basically on the level it is perceived to be on; this is dependent on the respondents' subjective evaluation.

As a summary, none of the aspects draws particular attention but the high gaps between the experiences and expectations erode the reliability of the results to some extent.

4.1.2. The FICON Index Figures

The importance index is related to the level of average respondent expectations concerning the attribute in question whereas the performance index reveals the level of experiences. As presented earlier, the expectations are systematically on a higher level than experiences and consequently, also the importance index values are higher in general than the performance index values which in theory raises the criticality of all

attributes. All the attributes with the lowest, critical performance index values – attributes 2, 8, 9 and 17 – have quite high importance index values as presented in the table below. These attributes have naturally also relatively high gap index values, as the gap between the expectations and experiences is wide. The gap index on the other hand receives a value of one if the average expectations and experiences are on exactly the same level, otherwise the index causes relative positive or negative direction to the CFI index (Nadler 2010). As the GAP index value range spans between 0,1 and 1,9, it's significant that all the gap index values are located closer to the high, critical end than to the not critical, low end. The direction of development has the same effect than the gap index: there is either a positive or negative direction, or no direction at all.

Table 4. the FICON index figures.

Attribute Number	Average Expectations (1-10)	Average Experience (1-10)	Gap Index	Importance Index	Direction of Development Index	Performance Index	SD Expectation index	SD Experience Index
1	8,40	7,40	1,10	0,84	0,99	0,74	1,15	1,13
2	8,00	5,20	1,28	0,80	0,99	0,52	1,07	1,25
3	8,80	6,60	1,22	0,88	0,99	0,66	1,08	1,11
4	8,20	6,40	1,18	0,82	0,99	0,64	1,13	1,11
5	8,20	5,40	1,28	0,82	1,00	0,54	1,13	1,15
6	8,60	5,40	1,32	0,86	0,99	0,54	1,05	1,18
7	8,60	7,20	1,14	0,86	0,99	0,72	1,11	1,08
8	7,40	5,20	1,22	0,74	1,00	0,52	1,17	1,30
9	8,00	5,20	1,28	0,80	1,00	0,52	1,19	1,24
10	7,80	6,20	1,16	0,78	1,00	0,62	1,13	1,25
11	8,40	7,00	1,14	0,84	1,00	0,70	1,15	1,12
12	8,80	6,80	1,20	0,88	1,00	0,68	1,08	1,19
13	7,40	6,80	1,06	0,74	1,00	0,68	1,21	1,19
14	7,80	5,60	1,22	0,78	1,00	0,56	1,22	1,17
15	7,20	5,80	1,14	0,72	1,00	0,58	1,22	1,18
16	7,40	5,40	1,20	0,74	1,00	0,54	1,25	1,21
17	7,40	5,20	1,22	0,74	1,00	0,52	1,25	1,16
18	7,60	5,80	1,18	0,76	0,99	0,58	1,26	1,18
19	8,40	5,60	1,28	0,84	0,99	0,56	1,13	1,13
20	8,60	6,40	1,22	0,86	1,00	0,64	1,11	1,21
21	8,60	6,40	1,22	0,86	0,99	0,64	1,05	1,24
22	8,60	7,00	1,16	0,86	0,99	0,70	1,05	1,12

23	8,20	6,20	1,20	0,82	1,00	0,62	1,11	1,15
24	8,20	6,40	1,18	0,82	1,00	0,64	1,16	1,17

4.1.3. The FICON IMPL Reliability Check

The implementation index (IMPL) was used in this research to evaluate the reliability of the results. The IMPL index is a highly applicable index, initially designed to measure opinions and commitments about strategic and operative focus in strategy implementation processes (Hirvelä et al. 2005). The IMPL index values are calculated simply by dividing the standard deviation of each attribute with the average value. For example the IMPL value for attribute 1 concerning the expectations has been calculated by dividing the standard deviation (1,36) by the average expectations (8,13) which results in an IMPL value of 0,17. If the index receives a value of over 1, in other words the standard deviation is the size of the average value, the attribute in question can be disqualified: the results are not reliable as the diversion of the answers is major. As the SD indexes measure the dispersion of the answers given by the respondents, the logical implication is that when the SD index lands a value close to zero the respondents have agreed over the level of the attribute and hence the results are reliable whereas when the standard deviation is high, the respondents have dispersed opinions concerning the level of the attribute and the attribute is less significant (Nadler 2010). The figure below presents the FICON IMPL values for the twenty-four attributes.

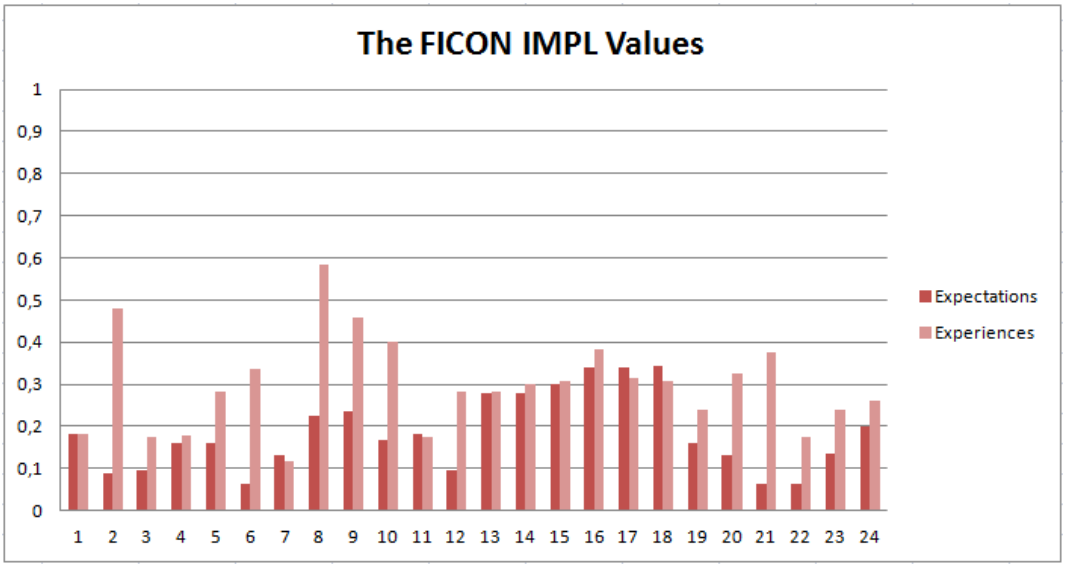

Figure 11. the FICON IMPL values.

As one can see, most values are closer to zero than one, and thus on an acceptable level. Only attribute 8, ERP-system's support (to purchasing) - unexpected, urgent purchasing, stands put with a high standard deviation in relation to the average value concerning experiences. This could be related to the different levels of technical understanding and knowhow related to the ERP system; persons who have deeper understanding and experience of the system might experience the system as supporting the operative purchasing whereas persons with less profound understanding might experience the system incompatible. When it comes to the aspects the highest IMPL values, on average, were in the user aspect, which is quite logical as the respondents have varying levels of expertise concerning the ERP system. Yet, the user aspect didn't dominate the other aspects; the average IMPL value in this aspect concerning expectations was 0,31 and concerning experiences 0,32 while the lowest average IMPL values, related to the purchasing process perspective, were 0,13 concerning expectations and 0,27 concerning experiences. So there were no huge gaps between the different aspects and none of them stood clearly out.

But what's interesting, is that the IMPL values concerning experiences are on a higher level in general: the average IMPL value concerning expectations is 0,18 whereas the average IMPL value concerning experiences is 0,30. The lowest average IMPL values concerning expectations were in the supplier (0,12) and purchasing process (0,13) aspects whereas the highest average values concerning experiences were in the SAP

(0,34) and user (0,32) perspectives. It seems like the FICON purchasers share a mutual understanding of where they are going but not where they are currently standing.

As a summary, the IMPL figures are on a relatively low level, in other words they do not remarkably erode the results, even if there were some interesting patterns behind the figures.

4.1.4. The FISUB Overall Situation

The FISUB purchasers are also expecting the levels of all attributes to improve in average in the near future. The main reason behind these positive expectations seems to be the different improvement actions or projects taking place; according to the interview, the biggest problems have been overcome in the past few years and there is a solid base for purchasing – the potential improvements should rather deal with fine tuning. Still, also the FISUB positive expectations seem unrealistic: only attribute 24, the purchasing process fit to different MRP types as a whole, has no average expected improvement in the coming three months. The reason for perceiving this overall improvement seems to be, also based on informal discussions, the willingness to evaluate the development of the attributes based on “how things should be”, rather than “how they actually are”, or “realistically will be”. Yet, the gaps between the experiences and expectations seem to be on a lower level than the corresponding FICON gaps.

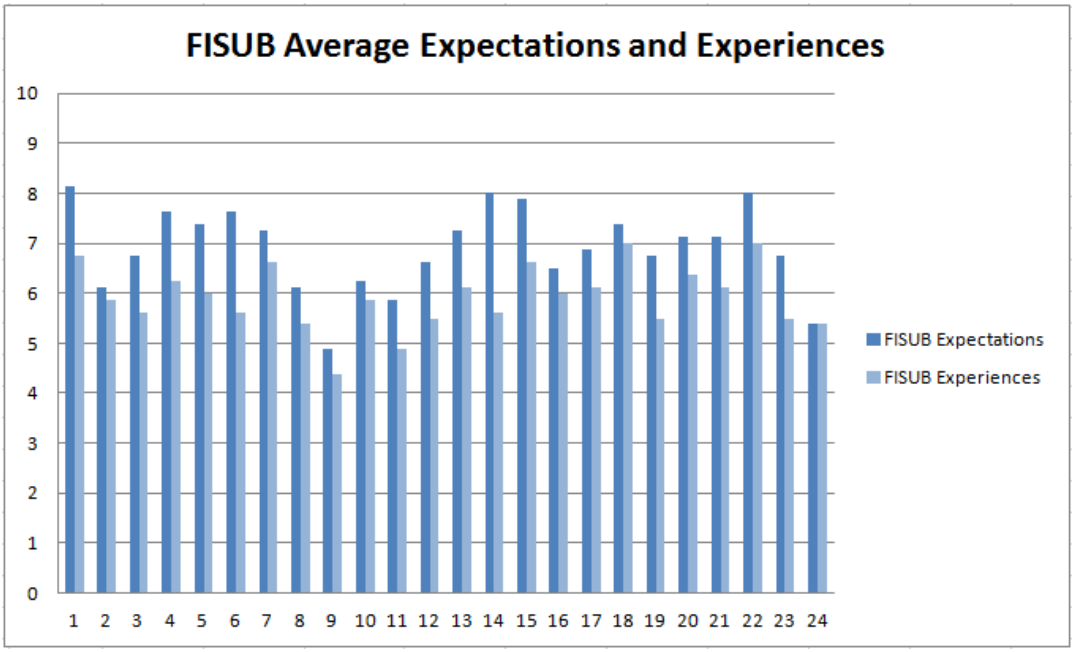

Figure 12. the FISUB experiences and expectations.

Based on the purchasers' expert opinions, the attribute number nine, ERP system flexibility, seems to be on a lowest level concerning both experiences and expectations. This is in correlation with the interviews; most purchasers consider SAP as an inflexible system, not primarily based on the actual functionalities, but on the way it is used in FISUB. There are plenty of separate tools which are basically designed for bypassing SAP functionalities. The problems usually arise in synchronizing these kinds of tools to SAP and other systems: the information becomes diverged. The highest expectations on the other hand are related to attribute 1, on-time delivery (meeting requested dates). The expectations related to this attribute are at least partly on a valid basis, as the main suppliers have been constantly improving their performance throughout the years 2011 and 2012 and the direction still seems to be upwards. On the other hand, for example attribute 22, Dealing with standard, long lead time purchasing, is another of the high performers: both the experiences and expectations are on a high level. This attribute deals with one of the core elements of purchasing: the high value strongly indicates that the core of purchasing is in good shape, the improvements are needed elsewhere.

4.1.5. The FISUB Index Figures

The different indexes which form the basis of the calculations are presented in the table below. They were calculated in exactly the same manner as the FICON indexes using the formulae presented in chapter 3.

Table 5. the FICON index figures.

Number of the Attribute	Expectations (1-10) AVERAGE	Experience (1-10) AVERAGE	GAP Index	Importance Index	Direction of Development Index	Performance Index	SD Expectation index	SD Experience Index
1	8,13	6,75	1,14	0,81	0,99	0,68	1,14	1,19
2	6,13	5,88	1,03	0,61	0,99	0,59	1,32	1,19
3	6,75	5,63	1,11	0,68	0,99	0,56	1,24	1,18
4	7,63	6,25	1,14	0,76	0,99	0,63	1,18	1,13
5	7,38	6,00	1,14	0,74	1,00	0,60	1,16	1,15
6	7,63	5,63	1,20	0,76	0,99	0,56	1,13	1,23
7	7,25	6,63	1,06	0,73	0,99	0,66	1,25	1,23
8	6,13	5,38	1,08	0,61	1,00	0,54	1,22	1,27
9	4,88	4,38	1,05	0,49	1,00	0,44	1,27	1,24
10	6,25	5,88	1,04	0,63	1,00	0,59	1,25	1,24
11	5,88	4,88	1,10	0,59	1,00	0,49	1,33	1,28
12	6,63	5,50	1,11	0,66	1,00	0,55	1,31	1,21
13	7,25	6,13	1,11	0,73	1,00	0,61	1,15	1,20
14	8,00	5,63	1,24	0,80	1,00	0,56	1,09	1,25
15	7,88	6,63	1,13	0,79	1,00	0,66	1,12	1,13
16	6,50	6,00	1,05	0,65	1,00	0,60	1,19	1,26
17	6,88	6,13	1,08	0,69	1,00	0,61	1,26	1,15
18	7,38	7,00	1,04	0,74	0,99	0,70	1,28	1,23
19	6,75	5,50	1,13	0,68	0,99	0,55	1,13	1,19
20	7,13	6,38	1,08	0,71	1,00	0,64	1,17	1,21
21	7,13	6,13	1,10	0,71	0,99	0,61	1,21	1,17
22	8,00	7,00	1,10	0,80	0,99	0,70	1,13	1,21
23	6,75	5,50	1,13	0,68	1,00	0,55	1,17	1,15
24	5,38	5,38	1,00	0,54	1,00	0,54	1,22	1,16

As visualized, **the gap index** reached the highest value concerning attribute 14, Ability to set the buffers to an optimal level. This means that the respondents might have

misinterpreted the instructions and have answered to the expectations column with regard to the DSBM approach being implemented, as one of the most obvious advantages of the approach relates to setting the buffers to an optimal level. The other high gap index values might also be related to similar issues; misinterpretations of the instructions concerning to answer the expectations column without taking the DSBM approach into account. **The importance index** and **performance index** are related to the significance of the results: a high importance index increases the proportional criticality of the attribute whereas a high performance index lowers it. This means that when the gap between the expectations and experiences is high, the gap index receives a high value and the criticality is emphasized. **The direction of development index** is directing the results into a positive direction: none of the attributes has a value which would point into a negative direction in this column, in other words the direction of development is positive concerning each attribute. The standard deviation indexes related to expectations and experiences are related to the IMPL values presented in the next paragraph.

4.1.6. The FISUB IMPL Reliability Check

As the IMPL index has been introduced earlier, there is no need to repeat the principles. The FISUB IMPL values are on average on a slightly higher level than the FICON IMPL values. This means that the respondents have disagreed on the performance and importance of the attributes more than the FICON respondents. Yet, none of the values are close to one, which indicates that all the attributes are on a reliable level and the results are not corrupted by high IMPL values. The FISUB IMPL values are presented in the figure below.

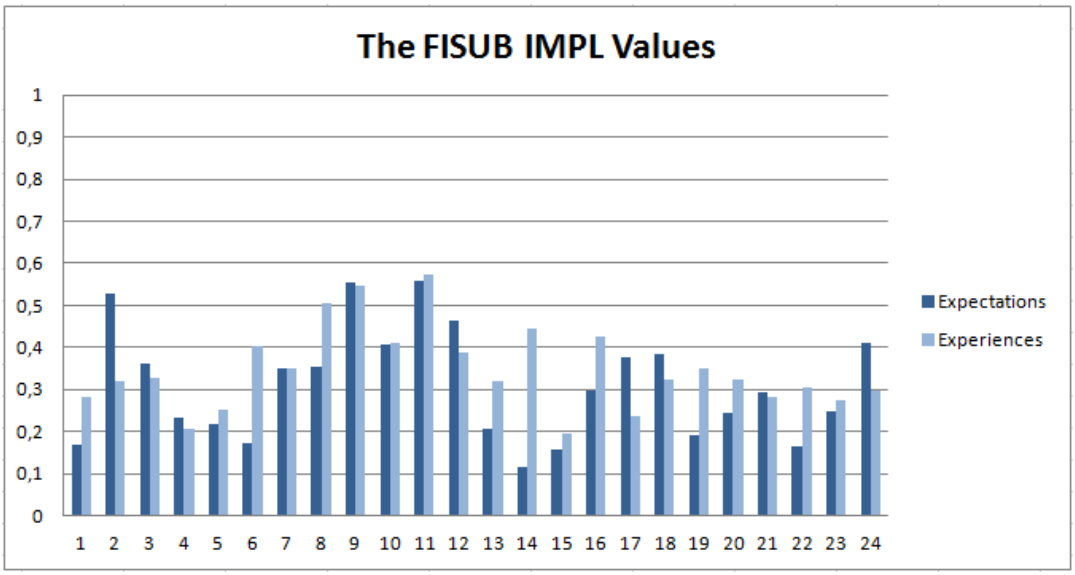

Figure 13. the FISUB IMPL values.

The highest IMPL values are related to attributes 9, ERP-system flexibility, and 11, Usability and functionality, which both belong to the SAP/technical perspective. This aspect, which includes attributes from 7 to 12, seemed to dominate the IMPL values, as the average IMPL value in this aspect was 0,45 concerning expectations and 0,46 concerning experiences. The reason behind disagreement in this aspect might be the different stances the purchasers take to SAP issues: some consider the comprehensiveness and complexity of the system an advantage and as a support to purchasing whereas others see the same properties as rigid and complicated. In contrast to the FICON values, there isn't such a wide gap between the experiences and expectations: the average IMPL of all attributes concerning expectations is 0,31 and concerning experiences 0,35. Still, noteworthy is that both the average values are somewhat higher than the FICON corresponding values. As mentioned before, the IMPL index was calculated to evaluate the reliability of the results, and according to the findings, no actual reliability deficit was detected.

4.2. The Critical Factors

4.2.1. The FICON Critical Factors

The results from the questionnaires were gathered and analyzed. As mentioned previously, altogether five respondents gave in the questionnaire, which is a small sample but it has been stated that the minimum focus group is three people (Grönholm & Takala 2011), so the focus group this small still fits into the frame of the method. The focus of the analysis is on the critical factors, the non-critical factors are left to less attention.

As visualized in the figure below, the CFI factors are in general on a higher level than the BCFI factors. Also, their values seem more erratic: the gap between the smallest (attribute 22; 0,68) and highest (attribute 16; 5,81) CFI value is 5,21 whereas the difference between the highest (attribute 13; 1,25) and lowest (attribute 6; 0,60) BCFI values is only 0,65. The FICON CFI and BCFI values are presented in the figure below.

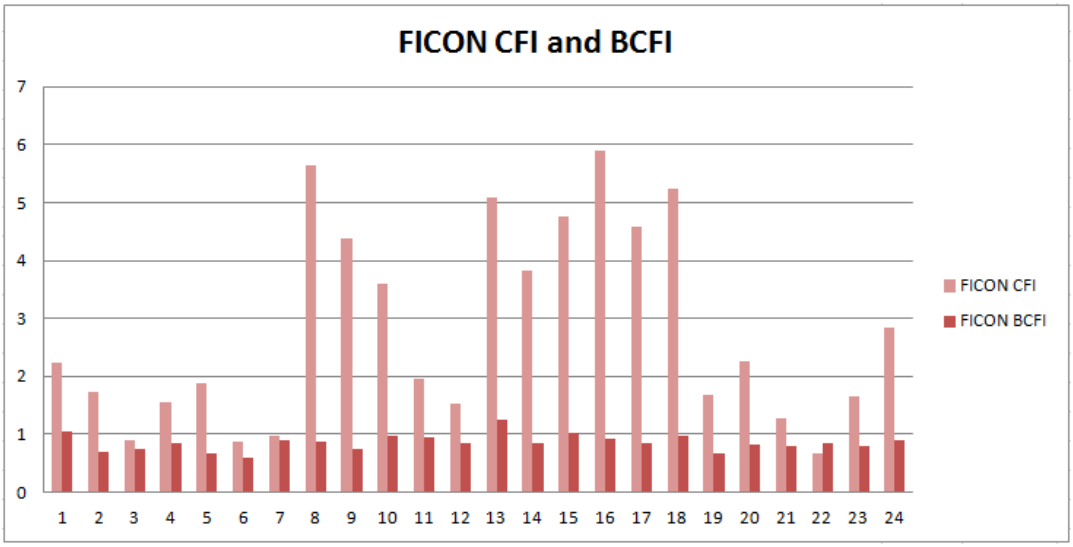

Figure 14. the FICON CFI and BCFI results.

As there are twenty-four attributes and four aspects with six attributes in each aspect, it has been decided that the six attributes (25 % of all attributes) with the lowest values are referred to as critical. The critical CFI attributes are the following attributes: 3, the

suppliers' ability to react to changing demand (especially peaks); 6, suppliers' proactive interaction (suggesting changes in order lot sizes, deliver times etc. when needed); 7, ERP-system's support (to purchasing) - long lead time; 12, Quality & reliability of information available in the ERP system (eg. concerning stock levels); 21, the purchasers' ability of dealing with unexpected, urgent purchasing and 22, the purchasers' ability of dealing with standard, long lead time purchasing. The BCFI critical attributes on the other hand differ from the CFI critical attributes: only two of them overlap. Yet all the six critical CFI attributes have BCFI values under the average BCFI value, which is 0,86. The critical BCFI attributes are: 2, the suppliers' openness (information available of different measures; in sharepoint etc); 3, the suppliers' ability to react to changing demand (especially peaks); 5, the suppliers' timeliness of communication and information sharing; 6, the suppliers' proactive interaction (suggesting changes in order lot sizes, deliver times etc. when needed); 9, ERP-system flexibility and 19, synchronization of the personal purchasing procedures of purchasers.

The accurate CFI and BCFI values are presented in the table below. The red cells stand for the critical factors, the yellow for the highest (B)CFI value attributes and the green for the attributes which are on a good level. The light blue rows present the average figures from each aspect. For example the values to the supplier relations perspective row has been calculated as an average from the individual CFI and BCFI values concerning the attributes 1-6.

Table 6. the FICON detailed CFI and BCFI results.

ATTRIBUTES	Attribute Number	CFI FICON	BCFI FICON
Supplier relations perspective		1,53	0,77
On-time delivery (meeting requested dates)	1	2,22	1,06
Openness (information available of different measures; in sharepoint etc)	2	1,74	0,69
The suppliers' ability to react to changing demand (especially peaks)	3	0,90	0,75
Meeting the required buffer levels (by ABB) in supplier premises	4	1,55	0,84
The timeliness of communication and information sharing	5	1,89	0,67
Proactive interaction (suggesting changes in order lot sizes, deliver times etc. when needed)	6	0,88	**0,60**
SAP/technical perspective		3,02	0,88
ERP-system's support (to purchasing) - long lead time	7	0,98	0,89
ERP-system's support (to purchasing) - unexpected, urgent purchasing	8	5,65	0,88

ERP-system flexibility	9	4,38	0,75
Erp system fit to manual purchasing process	10	3,60	0,97
Usability and functionality	11	1,95	0,95
Quality & reliability of information available (eg. concerning stock levels)	12	1,53	0,84
User persective (Evaluate your own performance here)		4,90	0,97
Technical understanding of the system	13	5,09	**1,25**
Ability to set the buffers to an optimal level	14	3,83	0,84
Ability to evaluate the coming consumption of materials	15	4,75	1,02
Having time to monitor the stock levels	16	**5,89**	0,92
Being aware/keeping track of reasons behind delivery problems (eg. Stock outs)	17	4,59	0,84
Proactivity in operative purchasing (= acting before it's too late, eg. stockout has already occurred)	18	5,24	0,97
Purchasing process perspective		1,73	0,81
Synchronization of the personal purchasing procedures of purchasers	19	1,69	0,68
Purchasers' engagement in using the common tools	20	2,26	0,82
Dealing with unexpected, urgent purchasing	21	1,27	0,80
Dealing with standard, long lead time purchasing	22	**0,68**	0,84
Fit between the purchasing process and other connected processes (eg. sales process)	23	1,66	0,80
The purchasing process fit to different MRP Types as a whole	24	2,85	0,90

According to the results, the most critical aspect seemed to be the supplier relations aspect with the average CFI value of 1,53 and BCFI value of 0,77. Two out of six critical CFI attributes were related to this aspect; attributes number 3, the suppliers' ability to react to changing demand (especially peaks), and 6, proactive interaction (suggesting changes in order lot sizes, deliver times etc. when needed). Out of the BCFI critical factors, the number was higher; altogether four attributes belonged to the supplier aspect: attributes 2, the suppliers' openness (information available of different measures; in sharepoint etc); 3, the suppliers' ability to react to changing demand (especially peaks); 5, the suppliers' timeliness of communication and information sharing; and 6, the suppliers' proactive interaction (suggesting changes in order lot sizes, deliver times etc. when needed). The supplier perspective being the most critical suggests that extra effort should be directed to those issues in order to gain most overall benefit.

4.2.2. The FISUB Critical Factors

The FISUB critical factors calculated according to both the CFI and BCFI indexes are

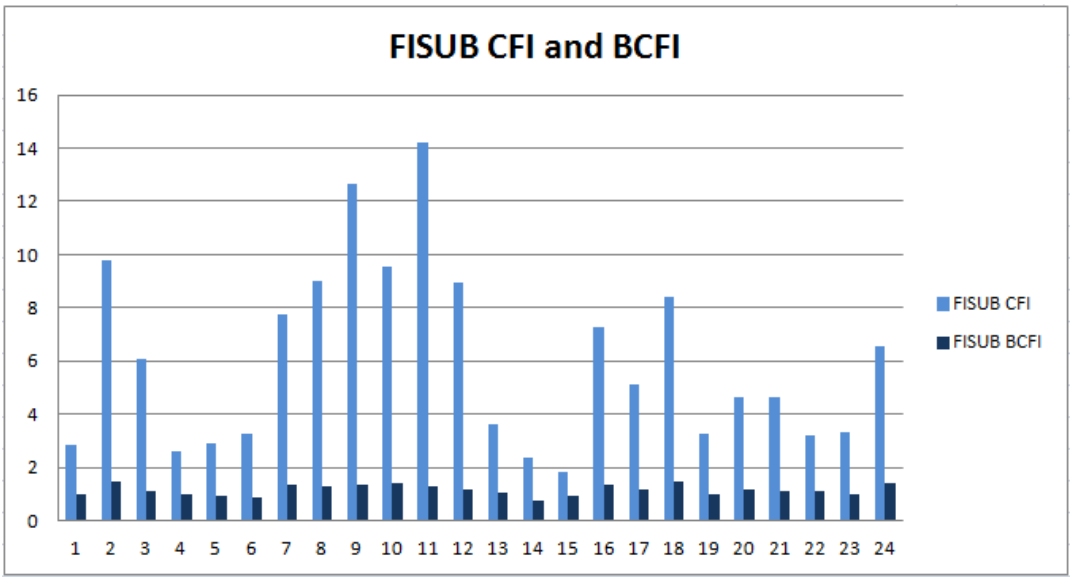

Figure 15. the FISUB CFI and BCFI results.

presented in the figure below.

The FISUB CFI values are quite erratic too; attribute 11, usability and functionality of the ERP system, has the highest CFI value of 14,24 whereas attribute 15, ability to evaluate the coming consumption of materials, has the lowest (1,84). The gap between the highest and lowest CFI value is 12,40, which is over six times the lowest value and a lot wider than the FICON corresponding cap, which was only 5,21. The highest CFI values seem to have been affected by the shortcoming of the CFI formula Nadler (2010) discussed in his study: the high influence of standard deviation. The lowest CFI values – the critical factor values – on the other hand are not affected by the standard deviation issues, so the shortfall does not erode the core results of this study. The critical CFI factors are the following: attribute 1, the suppliers' on-time delivery (meeting requested dates); 4, the suppliers meeting the required buffer levels (by ABB) in supplier premises; 5, the suppliers' timeliness of communication and information sharing; 14, the purchasers' ability to set the buffers to an optimal level; 15, the purchasers' ability to evaluate the coming consumption of materials and 22, dealing with standard, long lead time purchasing. The critical BCFI factors are overlapped with the CFI factors more than in FICON: four out of six critical factors were the same – attributes 4, 5, 14

and 15. The remaining two critical BCFI factors are number 6, suppliers' proactive interaction (suggesting changes in order lot sizes, deliver times etc. when needed) and 23, fit between the purchasing process and other connected processes (eg. sales process). The precise CFI and BCFI values are presented in the table below.

Table 7. the FISUB detailed CFI and BCFI results.

ATTRIBUTES	Attribute Number	CFI FISUB	BCFI FISUB
Supplier relations perspective		4,57	1,06
On-time delivery (meeting requested dates)	1	2,83	1,00
Openness (information available of different measures; in sharepoint etc)	2	9,79	**1,49**
The suppliers' ability to react to changing demand (especially peaks)	3	6,05	1,11
Meeting the required buffer levels (by ABB) in supplier premises	4	2,63	0,96
The timeliness of communication and information sharing	5	2,89	0,96
Proactive interaction (suggesting changes in order lot sizes, deliver times etc. when needed)	6	3,25	0,86
SAP/technical perspective		10,35	1,31
ERP-system's support (to purchasing) - long lead time	7	7,76	1,34
ERP-system's support (to purchasing) - unexpected, urgent purchasing	8	9,00	1,27
ERP-system flexibility	9	12,63	1,35
Erp system fit to manual purchasing process	10	9,52	1,42
Usability and functionality	11	**14,24**	1,29
Quality & reliability of information available (eg. concerning stock levels)	12	8,94	1,19
User persective (Evaluate your own performance here)		4,78	1,13
Technical understanding of the system	13	3,61	1,04
Ability to set the buffers to an optimal level	14	2,35	**0,78**
Ability to evaluate the coming consumption of materials	15	**1,84**	0,96
Having time to monitor the stock levels	16	7,28	1,32
Being aware/keeping track of reasons behind delivery problems (eg. Stock outs)	17	5,13	1,20
Proactivity in operative purchasing (= acting before it's too late, eg. stockout has already occurred)	18	8,44	1,45
Purchasing process perspective		4,29	1,13
Synchronization of the personal purchasing procedures of purchasers	19	3,29	0,98
Purchasers' engagement in using the common tools	20	4,67	1,18
Dealing with unexpected, urgent purchasing	21	4,66	1,12
Dealing with standard, long lead time purchasing	22	3,21	1,10
Fit between the purchasing process and other connected processes (eg. sales process)	23	3,33	0,98
The purchasing process fit to different MRP Types as a whole	24	6,56	1,42

The critical factors are dispersed between the different aspects and the average CFI and BCFI values are on a similar level: only the SAP perspective stands out as the most uncritical with the highest average CFI and BCFI values and no critical factors at all. The most critical factors are concentrated in the supplier relations perspective which also has the lowest average BCFI value of 1,06. The supplier aspect was also the most critical aspect in FICON: both business units could benefit from development and improvement undertakings in this aspect relatively more than similar projects in other aspects.

4.3. The DSBM Factors

4.3.1. The DSBM Reference Factors

Before handing out the questionnaires to the desired respondents, the questionnaire was given to an internal ABB consultant – who is an expert in the DSBM approach – for closer examination. The consultant is considered to have expertise in the matter because he has been designing and coding modifications to the DSBM tool which has been developed by the consultant team he is working in. He was asked to evaluate whether the state of the twenty-four attributes of the same questionnaire given out to FICON and FISUB can be improved by means of DSBM or not and the degree of the effect on a scale from zero (no effect at all) to three (major effect). This was done to be able to compare the FISUB expectations and FICON experiences to his answers; hence, his answers are considered as reference values in the research and will be referred to as **DSBM reference values**. **The DSBM reference factors**, the factors considered by the consultant to be positively affected by the DSBM implementation, are considered to present the maximum potential of the transaction. The answers given by the consultant are presented below.

Table 8. the DSBM reference factors.

ATTRIBUTES	Attribute Number	Is the Attribute affected by DSBM? Expectations	The degree of the effect 1-3
Supplier relations perspective			
On-time delivery (meeting requested dates)	1	Yes	2
Openness (information available of different measures; in sharepoint etc)	2	Yes	3
The suppliers' ability to react to changing demand (especially peaks)	3	No	2
Meeting the required buffer levels (by ABB) in supplier premises	4	No	0
The timeliness of communication and information sharing	5	Yes	3
Proactive interaction (suggesting changes in order lot sizes, deliver times etc. when needed)	6	Yes	3
SAP/technical perspective			
ERP-system's support (to purchasing) - long lead time	7	Yes	2
ERP-system's support (to prchasing) - unexpected, urgent purchasing	8	No	0
ERP-system flexibility	9	Yes	2
Erp system fit to manual purchasing process	10	No	0
Usability and functionality	11	Yes	3
Quality & reliability of information available (eg. concerning stock levels)	12	Yes	2
User persective (Evaluate your own performance here)			
Technical understanding of the system	13	No	0
Ability to set the buffers to an optimal level	14	Yes	3
Ability to evaluate the coming consumption of materials	15	No	0
Having time to monitor the stock levels	16	Yes	2
Being aware/keeping track of reasons behind delivery problems (eg. Stock outs)	17	Yes	2
Proactivity in operative purchasing (= acting before it's too late, eg. stockout has already occurred)	18	Yes	3
Purchasing process perspective			
Synchronization of the personal purchasing procedures of purchasers	19	No	0
Purchasers' engagement in using the common tools	20	Yes	2
Dealing with unexpected, urgent purchasing	21	No	0
Dealing with standard, long lead time purchasing	22	Yes	2
Fit between the purchasing process and other connected processes (eg. sales process)	23	Yes	2
The purchasing process fit to different MRP Types as a whole	24	No	1

As one can see, the consultant evaluated that most of the attributes are affected by DSBM positively. Out of the 24 attributes he evaluated that 17 attributes are affected and out of these 17 attributes, for six the effect is major (attributes 2, 5, 6, 11, 14 and 18). As presented in the graph below, only seven out of twenty-four attributes are not affected by the DSBM tool according to the expert view; the attributes in question are 4, 8, 10, 13, 15, 19 and 21. The DSBM values are presented in the figure below. The column heights follow a defined logic: the maximum degree of the effect is considered to be three, whereas the minimum is zero – no effect at all.

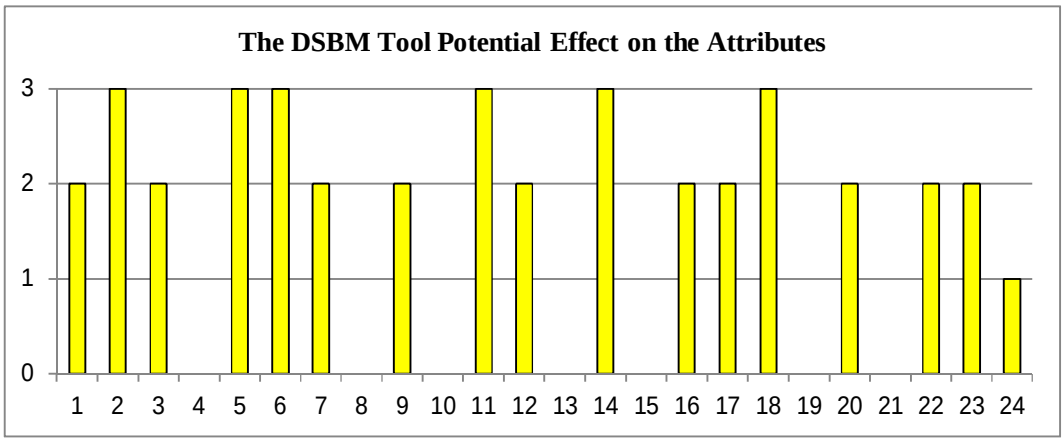

Figure 16. the DSBM reference values.

Even if the consultant can be considered an expert in this area, it's still worth considering that the reference framework cannot be solely based on one person's view: the evaluations are persons' opinions, not universal facts. This is why the consultant's view is considered as a reference: the maximum potential benefit gained by implementing the transaction or in short, the best case scenario.

4.3.2. The FICON DSBM Factors

The FICON purchasers evaluated that 18 factors are affected by DSBM. These 18 factors are factors that at least one respondent considers to be affected by the DSBM positively – later in the research, they are simply called **DSBM Factors**. Yet, as there were a different number of respondents in FICON and FISUB, the answers had to be proportioned to the number of respondents. This was done by adding up the number of

respondents who had considered the DSBM to affect a factor in question and dividing this number by the number of respondents. For example attribute number one was considered to be affected by the DSBM by two respondents out of five, which results in a DSBM value of 0,40 – or as a percentage 40,00 %. The DSBM values are presented in the table below.

Table 9. the FICON DSBM values.

	ATTRIBUTES	FICON DSBM Factor	FICON DSBM Factor / 5	FICON DSBM FACTOR/ 5 - %
1	On-time delivery (meeting requested dates)	2	0,40	40,00 %
2	Openness (information available of different measures; in sharepoint etc)	1	0,2	20,00 %
3	The suppliers' ability to react to changing demand (especially peaks)	0	0	0,00 %
4	Meeting the required buffer levels (by ABB) in supplier premises	1	0,2	20,00 %
5	The timeliness of communication and information sharing	0	0	0,00 %
6	Proactive interaction (suggesting changes in order lot sizes, deliver times etc. when needed)	3	0,60	60,00 %
7	ERP-system's support (to purchasing) - long lead time	3	0,60	60,00 %
8	ERP-system's support (to purchasing) - unexpected, urgent purchasing	1	0,2	20,00 %
9	ERP-system flexibility	0	0	0,00 %
10	Erp system fit to manual purchasing process	0	0	0,00 %
11	Usability and functionality	0	0	0,00 %
12	Quality & reliability of information available (eg. concerning stock levels)	2	0,4	40,00 %
13	Technical understanding of the system	1	0,2	20,00 %
14	Ability to set the buffers to an optimal level	2	0,40	40,00 %
15	Ability to evaluate the coming consumption of materials	1	0,2	20,00 %
16	Having time to monitor the stock levels	2	0,40	40,00 %
17	Being aware/keeping track of reasons behind delivery problems (eg. Stock outs)	1	0,2	20,00 %
18	Proactivity in operative purchasing (= acting before it's too late, eg. stockout has already occurred)	1	0,20	20,00 %
19	Synchronization of the personal purchasing procedures of purchasers	2	0,4	40,00 %
20	Purchasers' engagement in using the common tools	2	0,4	40,00 %
21	Dealing with unexpected, urgent purchasing	1	0,2	20,00 %
22	Dealing with standard, long lead time purchasing	2	0,40	40,00 %
23	Fit between the purchasing process and other connected processes (eg. sales process)	0	0	0,00 %
24	The purchasing process fit to different MRP Types as a whole	1	0,2	20,00 %

The fractions presented in the table above have been gathered into the graph below as percentages. The graph can be interpreted so that for example in the first column, which stands for attribute number 1, the percentage is 40 % – two out of five respondents considered the attribute to be affected by DSBM.

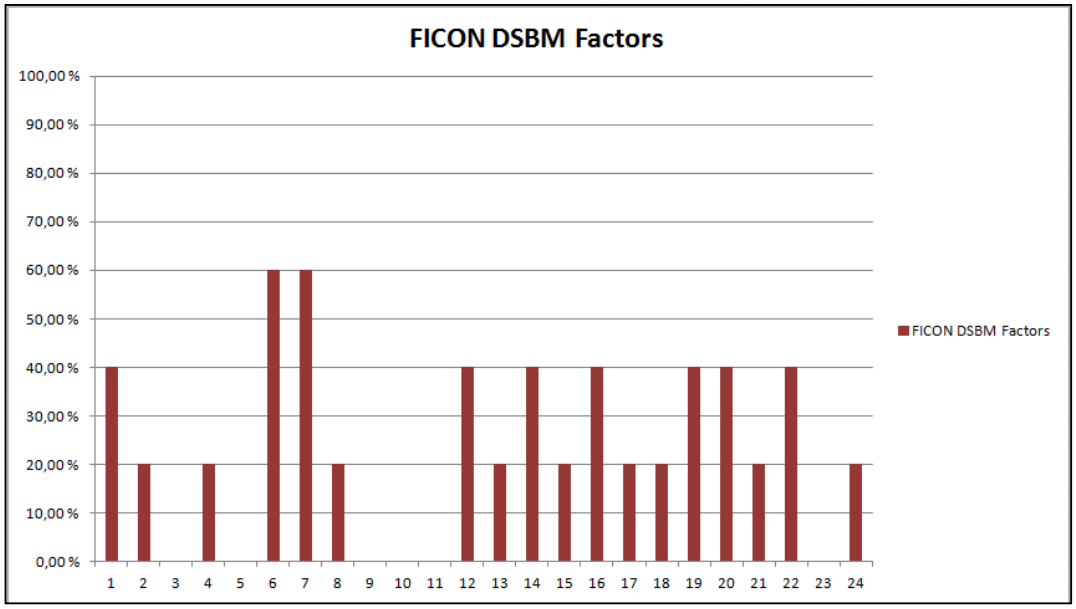

Figure 17. the FICON DSBM factors.

The highlight in the picture is that none of the columns reach 100%, which means that not a single attribute was considered a DSBM factor by all respondents – even the strongest factors, which are considered by most respondents to be affected, have only a 60% endorsement. In addition, 6 attributes were not considered as DSBM factors by any of the respondents, and hence they got a percentage value of zero (attributes 3, 5, 9, 10, 11, and 23). The FICON purchasers mentioned in the interview that they haven't had much time to familiarize with the transaction and explore its possibilities, which might be one reason behind the values being this low. The purchasing department had been suffering from an internal need to acquire a solution to handle the stock balances and indirectly to improve OTD figures. The DSBM transaction was served as a ready, unmodified solution to provide with what was needed. The transaction was not tailored to fit the purchasing procedures – it was simply provided as it was. In the free comment column of the questionnaire, the respondents wrote comments indicating that there has

not been enough experience on using the transaction yet to evaluate the eventual effect and that the transaction does not entirely fit to the FICON purchasing process but it will be further modified in the future. These kinds of comments suggest that the transaction might bring more benefit, than what has yet materialized, after being modified to fit the purchasing environment. This requires also the purchasers to study the transaction, its logic and opportunities more deeply and profoundly, only then the full potential of the transaction can be utilized.

4.3.3. The FISUB DSBM Factors

In FISUB, the DSBM factors are on a higher level than in FICON. The percentages are counted in the exact same manner; there were seven respondents – the number of respondents in the whole questionnaire was eight, but one respondent commented that he didn't have the necessary knowledge over the transaction to take a stance – and the number of ticks marked in the questionnaire's "will the attribute be affected by implementing DSBM" columns was divided by seven to allow comparison between FISUB and FICON figures. The FISUB figures are presented in the graph below.

Table 10. FISUB DSBM values.

Attribute Number	ATTRIBUTES	FISUB DSBM Factor	FISUB DSBM Factor / 5	FISUB DSBM FACTOR/ 5 - %
1	On-time delivery (meeting requested dates)	6	0,86	85,71 %
2	Openness (information available of different measures; in sharepoint etc)	3	0,43	42,86 %
3	The suppliers' ability to react to changing demand (especially peaks)	5	0,71	71,43 %
4	Meeting the required buffer levels (by ABB) in supplier premises	3	0,43	42,86 %
5	The timeliness of communication and information sharing	1	0,14	14,29 %
6	Proactive interaction (suggesting changes in order lot sizes, deliver times etc. when needed)	4	0,57	57,14 %
7	ERP-system's support (to purchasing) - long lead time	6	0,86	85,71 %
8	ERP-system's support (to purchasing) - unexpected, urgent purchasing	3	0,43	42,86 %
9	ERP-system flexibility	3	0,43	42,86 %
10	Erp system fit to manual purchasing process	2	0,29	28,57 %
11	Usability and functionality	4	0,57	57,14 %
12	Quality & reliability of information available (eg. concerning stock levels)	3	0,43	42,86 %
13	Technical understanding of the system	5	0,71	71,43 %

14	Ability to set the buffers to an optimal level	6	0,86	85,71 %
15	Ability to evaluate the coming consumption of materials	3	0,43	42,86 %
16	Having time to monitor the stock levels	5	0,71	71,43 %
17	Being aware/keeping track of reasons behind delivery problems (eg. Stock outs)	5	0,71	71,43 %
18	Proactivity in operative purchasing (= acting before it's too late, eg. stockout has already occurred)	6	0,86	85,71 %
19	Synchronization of the personal purchasing procedures of purchasers	5	0,71	71,43 %
20	Purchasers' engagement in using the common tools	4	0,57	57,14 %
21	Dealing with unexpected, urgent purchasing	3	0,43	42,86 %
22	Dealing with standard, long lead time purchasing	5	0,71	71,43 %
23	Fit between the purchasing process and other connected processes (eg. sales process)	3	0,43	42,86 %
24	The purchasing process fit to different MRP Types as a whole	3	0,43	42,86 %

To ensure visuality of the results, the FISUB DSBM factors have been gathered to the graph below.

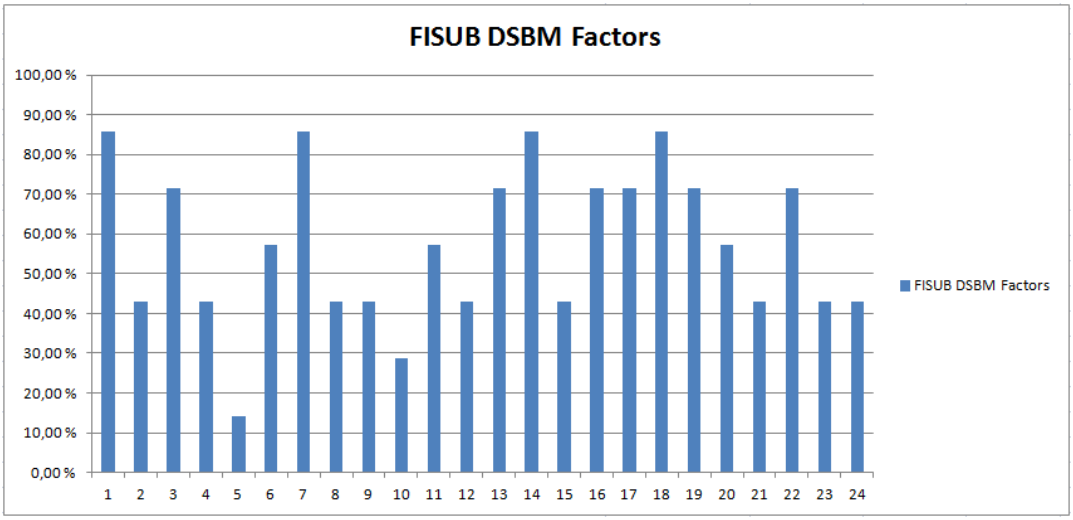

Figure 18. FISUB DSBM factors.

The FISUB DSBM factors are in general on a higher level than the FICON DSBM factors: this means that the FISUB purchasers have higher expectation when it comes to the potential of the DSBM approach than the FICON purchasers have experienced over the time they have been using it. This can partly be because the transaction along with its functionalities, logic and applications has been presented to the purchasers, even if the introduction has not reached a deeper level. Still, part of these so called high hopes may be considered as "excess expectations" – unrealistic hopes when it comes to the applicability of the transaction. It certainly strikes out that the FISUB purchasers have evaluated some factors as DSBM factors which are not considered as so by the consultant.

4.3.4. DSBM factors fit to DSBM Reference Factors

The DSBM reference factors, FICON DSBM factors and FISUB DSBM factors are gathered to the figure below. The DSBM reference factors are not in actual proportion to the DSBM factors; the yellow columns only present the reference values, based on the consultant's evaluation on a scale from zero to three. The red (FICON DSBM factors) and blue (FISUB DSBM factors) columns on the contrary are comparable as the summarized FICON and FISUB DSNM values have been divided with the number of respondents.

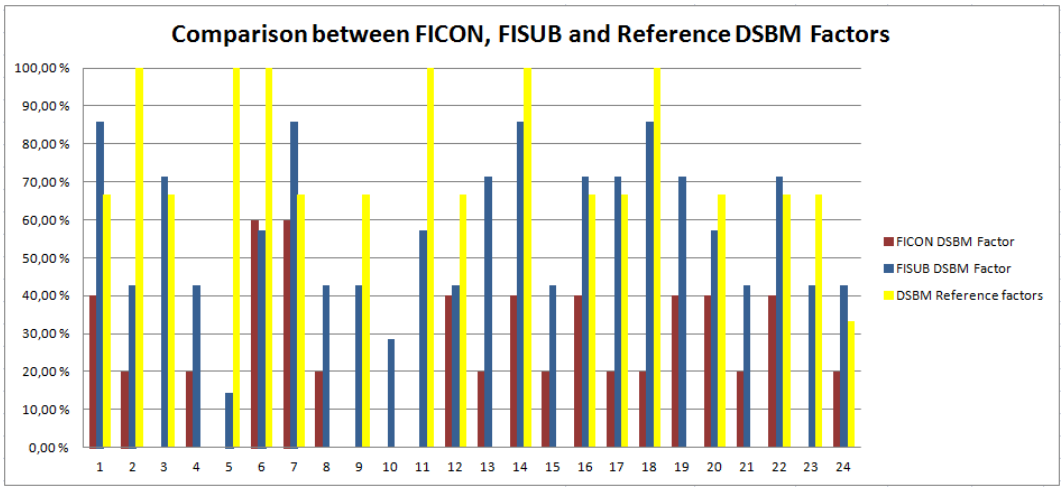

Figure 19. the DSBM factors and reference DSBM factors.

As mentioned previously, the DSBM reference factors are the factors which are considered to be influenced by the DSBM approach by the consultant and the red and blue columns on the other hand stand for FICON and FISUB. The respondents were asked to evaluate the degree of the effect on an indefinite scale from minor to major effect. Still, the division between minor and major effect was abandoned in the closer analysis, as it seemed too vague: the majority of respondents are not considered to have such an expertise on the subject that they could make a precise evaluation. The consultant on the other hand, is legitimate to make a separation between the degrees based on his expertise in the field.

Essential in the graph is that the FICON DSBM factors based on their experiences are way lower than the FISUB DSBM factors based on future expectations. Yet both of them are in general lower than the DSBM reference factors which is quite logical as the consultant can be considered to have the broadest view: he can be considered to know the full, theoretical potential of the DSBM approach and the transaction. There are a few attributes that are considered as DSBM factors by none of the FICON purchasers, such as attributes 5 and 11, even though the consultant considers the effect strong. These are areas where the lack of familiarization with the transaction might lead to inadequate results. Still, there are also opposite phenomena: all the non-DSBM reference factors have encountered endorsement as DSBM factors. In other words, at least one purchaser from FICON or FISUB has considered each attribute to be influenced by the DSBM even if the consultant has evaluated the influence to cover only 17 attributes.

4.3.5. The Strongest DSBM Factors

The strongest DSBM factors are presented in the next table: the attributes 1, 6, 7, 14, 16, 18 and 22. These are attributes which most respondents consider to be affected by the DSBM approach. The strongest DSBM factors were calculated by adding up the value of the three columns: the first yellow (DSBM reference value), the second red (FICON DSBM value/5) and the second blue (FSIUB DSBM value/ 7). The attributes which have the highest number of respondents considering them as DSBM factors are systematically considered as strongest DSBM factors in this research. For simplicity and logicality reasons, the six attributes with highest DSBM value were chosen – but as the two lowest attributes from this sample had the same value, they were both chosen as strong DSBM factors.

Table 11. the comparison of DSBM factors.

Attribute Number	DSBM Reference Value	DSBM Reference Value - %	FICON DSBM Value	FICON DSBM Value / 5	FICON DSBM Value/ 5 - %	FISUB DSBM Value	FISUB DSBM Value / 7	FISUB DSBM Value/ 7 - %	The Strength of DSBM Values
1	0,7	67 %	2	0,4	40,00 %	6	0,86	85,71 %	1,92
6	1,0	100 %	3	0,6	60,00 %	4	0,57	57,14 %	2,17
7	0,7	67 %	3	0,6	60,00 %	6	0,86	85,71 %	2,12
14	1,0	100 %	2	0,4	40,00 %	6	0,86	85,71 %	2,26
16	0,7	67 %	2	0,4	40,00 %	5	0,71	71,43 %	1,78
18	1,0	100 %	1	0,2	20,00 %	6	0,86	85,71 %	2,06
22	0,7	67 %	2	0,4	40,00 %	5	0,71	71,43 %	1,78

As one can see in the table, the strength of the factors is calculated by summing the DSBM reference factor value, the relative FICON DSBM value and the relative FISUB DSBM value. For example concerning attribute 1: 0,7+0,4+0,86=1,92. As one can see, the strong DSBM factors are quite evenly dispersed between the different aspects: attributes 1 and 6 belong to the supplier relation perspective; attribute 7 to the SAP/technical perspective, attributes 14, 16 and 18 to the user perspective and attribute 22 to the purchasing process perspective. The strongest DSBM perspective based on calculating the average DSBM values is the user perspective with an average

summarized DSBM value of 1,54; whereas the weakest DSBM perspective is the purchasing process perspective (1,20). The average summarized DSBM values are visualized in the table below.

Table 12. average DSBM values per aspect.

Aspect	Average DSBM Reference Value	Average FICON DSBM Value	Average FISUB DSBM Value	Average Summarized DSBM Value
Supplier relations perspective	0,72	0,23	0,52	1,48
SAP/technical perspective	0,50	0,20	0,50	1,20
User perspective (Evaluate your own performance here)	0,56	0,27	0,71	1,54
Purchasing process perspective	0,39	0,27	0,55	1,20

4.4. The DSBM Factors Fit to the Critical Factors

4.4.1. The FICON DSBM Factors fit to the Critical Factors

The FICON critical factors, calculated in both CFI and BCFI manners, are presented in the table below in red – all other attributes are excluded from the table to allow simplicity. The yellow column presents the DSBM reference values and the pale red column the DSBM values concerning each attribute. As visible, five out of six CFI critical factors have a positive DSBM reference value, and so have five out of six BCFI factors. Only the CFI critical factor – attribute 21, dealing with unexpected, urgent purchasing – and BCFI critical factor – attribute 19, synchronization of the personal purchasing procedures of purchasers – have no DSBM reference value. This means that five out of six both CFI and BCFI critical factors could be positively affected by the DSBM approach if most of its potential could be utilized.

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Table 13. the FICON critical factors fit to the DSBM factors.

ATTRIBUTES	Attribute Number	CFI FICON	BCFI FICON	DSBM Reference	FICON DSBM value/ 5
Openness (information available of different measures; in sharepoint etc)	2	1,74	0,69	1,00	0,20
The suppliers' ability to react to changing demand (especially peaks)	3	0,90	0,75	0,67	0,00
The timeliness of communication and information sharing	5	1,89	0,67	1,00	0,00
Proactive interaction (suggesting changes in order lot sizes, deliver times etc. when needed)	6	0,88	**0,60**	1,00	0,60
ERP-system's support (to purchasing) - long lead time	7	0,98	0,89	0,67	0,60
ERP-system flexibility	9	4,38	0,75	0,67	0,00
Quality & reliability of information available (eg. concerning stock levels)	12	1,53	0,84	0,67	0,40
Synchronization of the personal purchasing procedures of purchasers	19	1,69	0,68	0,00	0,40
Dealing with unexpected, urgent purchasing	21	1,27	0,80	0,00	0,20
Dealing with standard, long lead time purchasing	22	**0,68**	0,84	0,67	0,40

Five out of six critical CFI factors are considered to be affected by the DSBM approach positively by at least one FICON respondent. Only attribute 3, the suppliers' ability to react to changing demand (especially peaks), has a DSBM value of zero, which means that none of the FICON purchasers has considered the DSBM to have an effect on the attribute. Yet, the consultant has considered the effect to be fairly strong – 2 on a scale from 0 to 3. The reason behind the different values might be that the FICON purchasers have not considered the indirect effects of the DSBM approach: the DSBM can have an influence on the suppliers' ability to react on changing demand via the FICON purchasers being better able to react to changing demand and hence also informing the suppliers in time. For the BCFI factors, the fit to critical factors is scarcer: only three out of six critical BCFI factors have a positive DSBM value. Three attributes, attributes 3, 5 and 9 have no DSBM value at all, while they all still have DSBM reference values.

As a summary, the fit between FICON critical factors and DSBM reference factors is comprehensive whereas the fit between the critical factors and FICON DSBM factors isn't that promising: firstly the FICON DSBM factors are on a much lower level the DSBM reference factors and their correlation to the critical factors isn't advisable even if the fit between the critical CFI factors and DSBM factors was five out of six. Yet the

base for these five DSBM factors isn't so profound as none of them can be considered very "strong" as the highest support for any DSBM factor is 0,60: only three out of five FICON respondents have considered the DSBM to have effect on the attribute. Yet, both these highest DSBM factors are also critical factors.

4.4.2. The FISUB DSBM Factors fit to the Critical Factors

The FISUB critical CFI and BCFI factors are presented in the next table. The columns represent the same logic than in the FICON table: the CFI and BCFI FISUB columns include the critical factor values, the yellow column the DSBM reference values and the pale blue column FISUB DSBM values. As one can see, four out of six critical CFI and BCFI factors have a positive DSBM reference value.

When it comes to the DSBM values, one characteristic is striking out, the FISUB DSBM values are, in general, on a higher level than the FICON corresponding values. While the maximum FICON DSBM value is 0,60, the maximum FISUB DSBM value is 0,86; six out of seven respondents have considered the DSBM to have positive effect on the attribute in question. Each of the CFI and BCFI critical factors have a positive DSBM value of some magnitude. Yet, later on in the study, only the DSBM factors with DSBM value over 0,5 are considered as more "valid" DSBM factors as they have the endorsement of over half of the respondents. This validity check also relates to the fact that many of the attributes are considered to be DSBM factors by the FISUB respondents even if they're not DSBM reference factors. For example attributes 4 and 15, which are the only critical factors not fitting to the DSBM reference factors, do have DSBM values of 0,43. An assumption has been made that as the DSBM reference values are considered to be the maximum potential values of the research, no DSBM values exceeding them are considered valid. The relevant data is presented in the table below.

Table 14. the FISUB critical factors fit to the DSBM factors.

ATTRIBUTES	Attribute Number	CFI FISUB	BCFI FISUB	DSBM Reference	FISUB DSBM FACTOR / 7
On-time delivery (meeting requested dates)	1	2,83	1,00	0,67	0,86
Meeting the required buffer levels (by ABB) in supplier premises	4	2,63	0,96	0,00	0,43
The timeliness of communication and information sharing	5	2,89	0,96	1,00	0,14

Proactive interaction (suggesting changes in order lot sizes, deliver times etc. when needed)	6	3,25	0,86	1,00	0,57
Ability to set the buffers to an optimal level	14	2,35	**0,78**	1,00	0,86
Ability to evaluate the coming consumption of materials	15	**1,84**	0,96	0,00	0,43
Dealing with standard, long lead time purchasing	22	3,21	1,10	0,67	0,71
Fit between the purchasing process and other connected processes (eg. sales process)	23	3,33	0,98	0,67	0,43

4.4.3. The Strongest DSBM factors Fit to the Critical Factors

As defined previously, the strongest DSBM factors are the factors which got most support from the FICON and FISUB respondents and the consultant when evaluating the DSBM effect on the attributes. The strongest DSBM factors, which are marked in yellow, are compared to the FICON and FISUB critical factor indexes in the figure below.

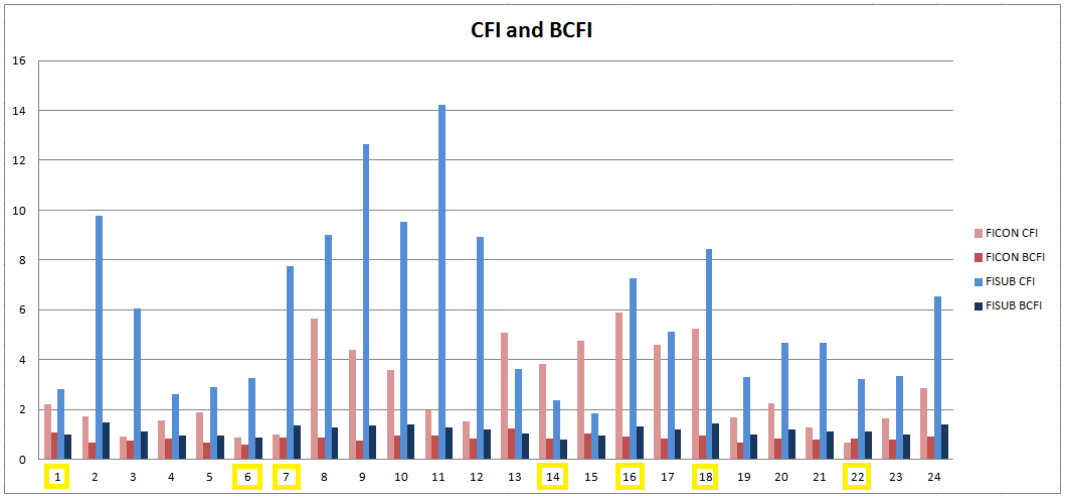

Figure 20. the strongest DSBM factors meeting CFI/BCFI.

As visualized in the graph, the seven strongest DSBM factors meet three out of FICON's critical CFI factors but only one critical BCFI factor. Yet, this one BCFI factor is the most critical factor, in other words it presents the scarcest resource. When it comes to FISUB figures, the strongest DSBM factors manage to meet three critical CFI factors and two critical BCFI factors. Still, the strong DSBM factors also meet attributes with less criticality: for example attributes 16 and 18, which are among the strongest

DSBM factors, have relatively high CFI and BCFI values and are not among the critical factors, and consequently they are not in the focus area of this research. The seven strongest DSBM factors are presented in the table below along with their DSBM reference values, DSBM FICON and FISUB values and the CFI and BCFI values. The strongest DSBM factor, attribute 14, the purchasers' ability to set the buffers to an optimal level, which has a summarized DSBM value of 2,26, is also a critical CFI and BCFI factor in FISUB; this is a strong signal advocating the DSBM implementation.

Table 15. the strong DSBM factors fit to (B)CFI factors.

Attribute Number	CFI FICON	BCFI FICON	CFI FISUB	BCFI FISUB	DSBM Reference	FICON DSBM factor / 5	FISUB DSBM FACTOR / 7	The Strength of DSBM Factors
1	2,22	1,06	2,83	1,00	0,67	0,40	0,86	1,92
6	0,88	0,60	3,25	0,86	1,00	0,60	0,57	2,17
7	0,98	0,89	7,76	1,34	0,67	0,60	0,86	2,12
14	3,83	0,84	2,35	0,78	1,00	0,40	0,86	2,26
16	5,89	0,92	7,28	1,32	0,67	0,40	0,71	1,78
18	5,24	0,97	8,44	1,45	1,00	0,20	0,86	2,06
22	0,68	0,84	3,21	1,10	0,67	0,40	0,71	1,78

4.4.4. Unutilized Potential and Excess Expectations

After analyzing and comparing the FICON, FISUB and reference DSBM factors to both FICON and FISUB critical factors, one can pay attention to two interesting findings which have been brought up superficially earlier in the research: **the unutilized potential** and **excess expectations**. These terms need closer examination as they stand out from the results. Unutilized potential refers to the unseen, unexploited potential the DSBM approach offers. The mathematical calculation of this potential is slightly vague but yet directional; as the consultant has a profound view on the affordances of the transaction, he is considered to see its full potential whereas the FICON purchasers lack, at minimum, the essential introduction and the FISUB purchasers the practical experience. The excess expectations on the other hand stand for the DSBM value related to the attributes which don't have DSBM reference value; in other words the attributes which at least one FICON or FISUB purchaser considers as a DSBM factor even if the consultant does not.

The excess expectations and unutilized potential are terms developed uniquely for this research: their universality has not been tested. Even if these terms are supposed to be treated with certain criticism, they do point out a useful applicability of the research method. The excess expectations and unutilized potential are visible in the graph below. Being simplified, the excess expectations are visible as the shares of the red and blue columns exceeding the yellow DSBM reference factor columns and the unutilized potential as the gaps between the reference factor levels and the red and blue columns shorter than the DSBM reference columns. These values are compared in the figure below.

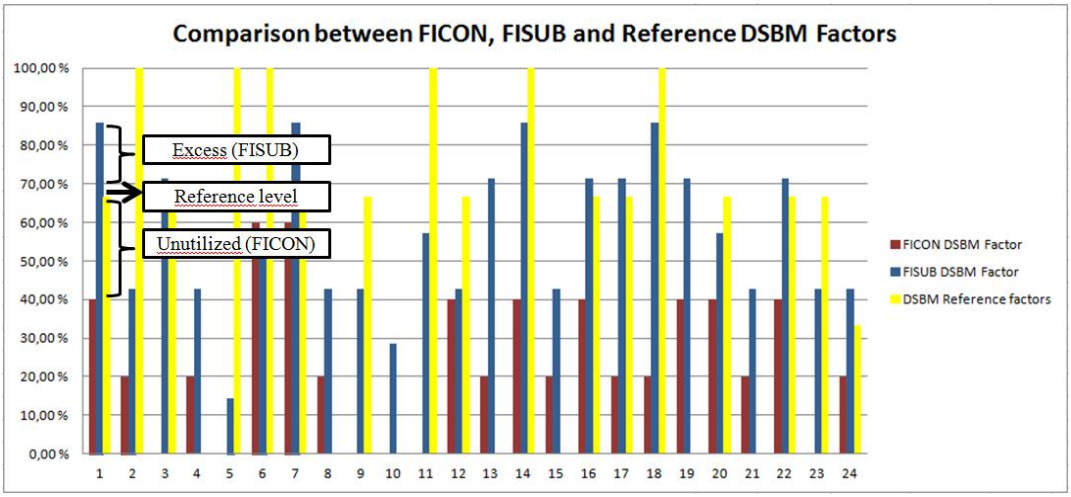

Figure 21. excess expectations and unutilized potential.

The texts in the picture indicate the interpretation of the two terms discussed above. When the yellow columns are seen as DSBM reference factors, they are indicating the maximum potential of the transaction; the value of the red and blue columns, standing for FICON and FISUB DSBM values, above the yellow maximum potential are assumed to be unrealistic, fallacious and overly positive interpretations of the DSBM approach features while a gap between the red or blue column level and the reference level stands for unidentified and untapped potential. Visually significant are for example attributes 4, 8, 13, 15, 19 and 21 which are not considered as DSBM reference factors but yet they have DSBM value. Yet, for example attribute number eight, ERP-system's support (to purchasing) - unexpected, urgent purchasing, is not considered to be affected by DSBM by the consultant whereas number seven, ERP-system's support

(to purchasing) - long lead time, is. In this case, the consultant has made a strict division between these two types of purchasing: some of the respondents might not have considered the difference that strict but merely ambiguous and hence the attribute 8 has gathered DSBM value. Also attribute number nineteen, Synchronization of the personal purchasing procedures of purchasers, is a non DSBM reference factor even if it has relatively high DSBM value according to both FICON and FISUB parameters. Attribute 11 on the other hand is a good example for expressing the unutilized potential: the consultant considers the DSBM effect to be major, and over 50 % of the FISUB respondents consider the attribute to be affected, but none of the FICON purchasers considers the attribute in question to have any DSBM value at all.

Because both the excess expectations and unutilized potential are compared to the DSBM reference values, they are basically contrary phenomena: when there is for example a value of 0,2 for excess expectations, there is consequently a value of -0,2 for unutilized potential concerning the attribute in question. This means that when an attribute has a negative unutilized potential value, it must have a positive excess expectation value of the same magnitude, and vice versa. The values referring to each attribute are presented in the graph below.

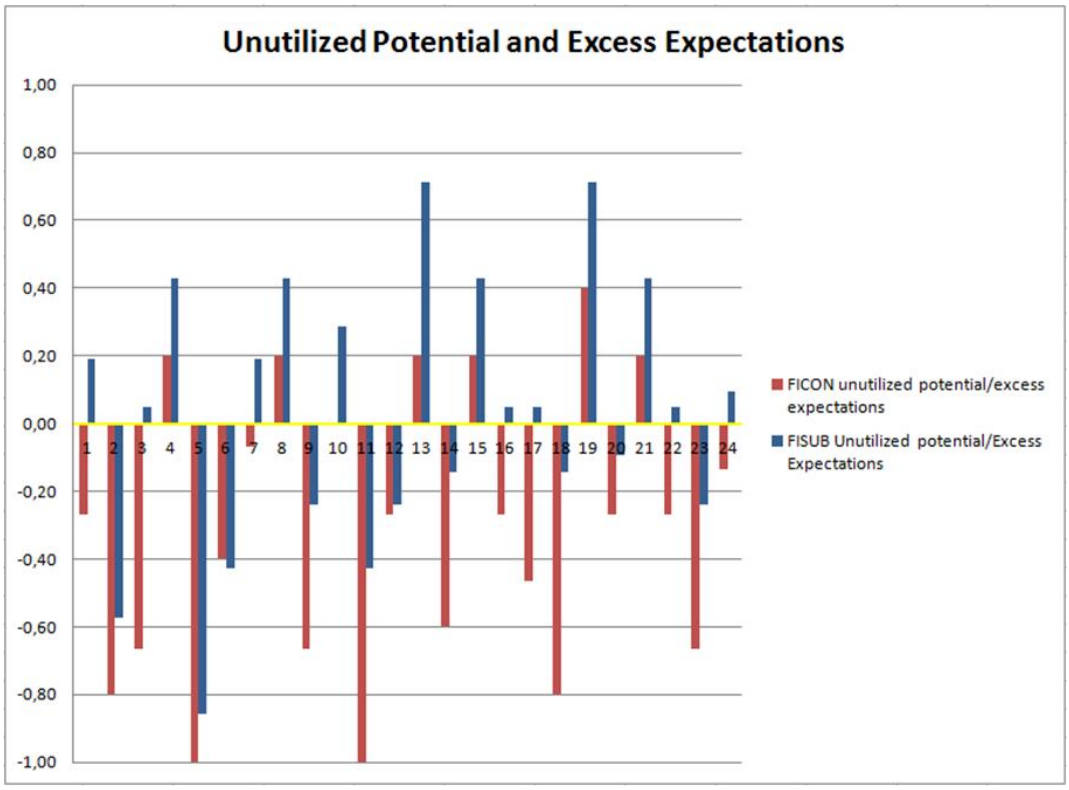

Figure 22. unutilized potential and excess expectations compared to the reference level.

The yellow zero line represents the DSBM reference level concerning each attribute while the red and blue columns stand for the surplus or shortfall of DSBM value compared to the reference value. For example attribute 1 has a DSBM reference value of 0,67 – which is not visible in the graph – while FICON DSBM value is 0,40 and FISUB DSBM value 0,86. The values displayed in the graph are calculated as DSBM value minus DSBM reference value; in this case 0,40-0,67 = -0,27 for FICON and 0,86-0,67 = 0,19 for FISUB. The FICON negative value -0,27 represents unutilized potential: the difference between full potential (0,67) and actual, utilized potential (0,40) is 0,27. The FISUB 0,19 value for excess expectations is the positive difference between the FISUB DSBM value of 0,86 and DSBM reference value 0,67. As visualized, all columns in the negative direction from -1 up to zero stand for unutilized potential whereas all columns above zero stand for excess expectations. What's relevant in the graph is that the FISUB columns are largely in the excess zone while the FICON columns land in the deficit zone. For example attributes 5 and 11 have an unutilized potential value of -1, which is the maximum; the consultant has considered the effect

major while none of the FICON respondents have seen any positive effect. On the other hand attributes 13 and 19 stand out with their high FISUB excess expectations; neither of these high DSBM values is on a reliable base. Yet, the root causes for most unutilized potential and excess expectations have been identified and these values do not erode the research results. Actually, these two terms form an interesting subject for future research.

5. CONCLUSIONS

5.1. Summary of the Results

5.1.1. Summary of the FICON Results

The FICON critical CFI factors are the following attributes:

- 3, The suppliers' ability to react to changing demand (especially peaks)
- 6, The suppliers' proactive interaction (suggesting changes in order lot sizes, delivery times etc. when needed).
- 7, ERP-system's support (to purchasing) - long lead time.
- 12, Quality & reliability of information available in the ERP system (eg. concerning stock levels)
- 21, Dealing with unexpected, urgent purchasing
- 22, Dealing with standard, long lead time purchasing.

Whereas the FICON critical BCFI factors are the following

- 2, Suppliers' openness (information available of different measures; in SharePoint etc
- 3, The suppliers' ability to react to changing demand (especially peaks)
- 5, The suppliers' timeliness of communication and information sharing
- 6, The suppliers' proactive interaction (suggesting changes in order lot sizes, deliver times etc. when needed)
- 9, ERP-system flexibility
- 19, Synchronization of the personal purchasing procedures of purchasers

As visualized, the critical factors are quite dispersed between the four aspects: supplier relations perspective (attributes 1-6), SAP/technical perspective (attributes 7-12), user perspective (attributes 13-18) and purchasing process perspective (attributes 19-24). Yet, the supplier relations perspective might be considered as the most critical aspect as two out of the six critical CFI factors – attributes 3 and 6 – and even four out of the six BCFI critical factors – attributes 2, 3, 5 and 6 – belong to that aspect. The least critical aspect based solely on the results is the user aspect with no critical attributes at all – yet, the user perspective is the strongest DSBM aspect based on the summarized DSBM

values. Also worth noticing is, that the CFI and BCFI critical factors overlap only concerning two attributes - 3 and 6.

Out of the FICON critical BCFI factors, only one attribute, attribute 6, is a strong DSBM factor whereas three critical CFI factors – 6, 7 and 22 – are among the strongest DSBM factors, which means that the consultant and over half of the respondents have considered these attributes to be affected by the DSBM positively. Attributes 6 and 7 are also the two strongest FICON DSBM factors with a DSBM value of 0,60 and attribute 22 is the most critical CFI factor with a CFI value of only 0,68. Also in general, these three strong DSBM factors are primary, elementary components of the purchasing function: the success of the function is based on these kinds of components. There is little benefit from fine tuning the function if the core processes aren't working. Thus, the main effort should be directed into obtaining a strong basis for purchasing and, according to the research results, focusing the attention on these three attributes will benefit the purchasing function as a whole. The unutilized potential figures also show that the FICON purchasers might not have seen the full potential of the DSBM approach concerning these attributes. The unutilized potential values are 0,40 for attribute 6; 0,07 for attribute 7 and 0,27 for attribute 22. These figures imply that further engrossing to the DSBM approach could be beneficial.

Five out of six CFI critical factors have a positive DSBM reference value (attributes 3, 6, 7, 12 and 22), and so have five out of six critical BCFI factors (attributes 2, 3, 5, 6 and 9). Yet, the DSBM reference values are on a much higher level in general than the DSBM values. The fit between the FICON critical CFI factors and FICON DSBM factors is five out of six (attributes 6, 7, 12, 21 and 22), but the fit between the DSBM factors with a value over 0,50 and the critical factors is only two out of six – these two factors, attributes 6 and 7, have the highest DSBM values of all the FICON attributes: 0,60. The fit between the critical BCFI factors and DSBM factors is three out of six (attributes 2, 6 and 19). Out of these three DSBM factors, only one (attribute 6) has a DSBM value of over 0,5.

5.1.2. Summary of the FISUB Results

The FISUB critical CFI factors are the following attributes:

- 1, Suppliers' on-time delivery (meeting requested dates)

- 4, Suppliers meeting the required buffer levels (by ABB) in supplier premises
- 5, The suppliers' timeliness of communication and information sharing
- 14, The users' ability to set the buffers to an optimal level
- 15, The users' ability to evaluate the coming consumption of materials
- 22, Dealing with standard, long lead time purchasing

And the FISUB critical BCFI attributes are:

- 4, Suppliers meeting the required buffer levels (by ABB) in supplier premises
- 5, The suppliers' timeliness of communication and information sharing
- 6, The suppliers' proactive interaction (suggesting changes in order lot sizes, deliver times etc. when needed)
- 14, The users' ability to set the buffers to an optimal level
- 15, The users' ability to evaluate the coming consumption of materials
- 23, Fit between the purchasing process and other connected processes (eg. sales process)

Also the FISUB critical factors are somewhat dispersed between the aspects, but interesting is that the SAP/technical perspective included no critical factors at all. Half of both the critical CFI factors and critical BCFI factors belong to the supplier relations perspective (attributes 1, 4, 5 and 6). Hence, out of the four overlapping critical factors, attributes 4, 5, 14 and 15, two factors (attributes 4 and 5) belonged to the supplier relations perspective and the remaining two, 14 and 15, to the user perspective. Noteworthy is, that the user perspective and the supplier relations perspective are the strongest DSBM perspectives, and the attribute 14 has the strongest DSBM value of all the attributes.

So, three attributes out of the six critical CFI factors are also strong DSBM factors: attributes 1, 14 and 22. This is a strong signal indicating that implementing DSBM would definitely result in improved overall performance as these are all attributes affected by the DSBM. Especially attributes 14 and 22 are covered by the basic functionalities of the transaction and the potential benefit of implementation in these areas is apparent. Only two out of the six critical BCFI factors are among the strongest DSBM factors.

Four out of six of both critical CFI factors (attributes 1, 5, 14 and 22) and BCFI factors (attributes 5, 6, 14 and 23) have a positive DSBM references value, which means that the consultant has perceived the attributes to be affected by the DSM approach. The FISUB DSBM values are on higher level than the FICON DSBM values, which means that the FISUB purchasers have higher expectations toward the DSBM approach possibilities than the FICON purchasers have experiences on. Consequently, all the critical CFI and BCFI factors experience a positive DSBM value between 0,14 and 0,86. Even if the FISUB DSBM values are on a high level, none of the attributes reach a DSBM value of 1,00, which would mean that all FISUB respondents have considered the attribute to be affected by the DSBM. Yet, altogether thirteen attributes have a DSBM value of over 0,50, whereas in FICON the same number was only two.

5.1.3. Comparison of the FICON and FISUB Results

All the attributes are presented in the table below along with relevant information concerning the different values. All the CFI and BCFI critical factors concerning both FICON and FISUB have been marked in red in the BCFI and CFI columns. The green cells stand for the (B)CFI values which are on a acceptable level and the yellow cells for the values which should be paid closer attention to, but like explained earlier, the yellow (B)CFI factors are neglected in this research to maintain the focus on the essential issues. The DSBM reference value column presents the DSBM values given to the attributes by the external consultant on a scale from zero to three; the FICON and FISUB DSBM value columns present the comparable DSBM values: the number of respondent considering the DSBM has an effect on the attribute divided with the number of respondents. The FICON DSBM value represents experiences, as the DSBM approach has been implemented, while the FISUB DSBM values relate to experiences, as the approach is not implemented – at least yet. The strength of the DSBM factors has been calculated as the DSBM reference value plus the FICON DSBM value plus the FISUB DSBM value. The strongest DSBM factors are marked with yellow in the strongest DSBM factors column. The excess expectations/ unutilized potential FICON and FISUB columns stand for the unrealistically high presumptions when it comes to the DSBM functionalities or unexploited, unseen potential of the same functionalities. The excess expectations, the positive figures, are marked in green, while the negative figures stand for the unutilized potential.

Table 16. the summary of critical factors and related DSBM factors.

Attribute Number	CFI FICON	BCFI FICON	CFI FISUB	BCFI FISUB	DSBM Reference Value	FICON DSBM Value	FISUB DSBM Value	The Strength of the DSBM Factors	Exc.Exp/Unutil.Pot. FICON	Exc.Exp/Unutil.Pot. FISUB
1	2,22	1,06	2,83	1,00	0,67	0,40	0,86	1,92	-0,27	0,19
2	1,74	0,69	9,79	1,49	1,00	0,20	0,43	1,63	-0,80	-0,57
3	0,90	0,75	6,05	1,11	0,67	0,00	0,71	1,38	-0,67	0,05
4	1,55	0,84	2,63	0,96	0,0	0,2	0,43	0,63	0,20	0,43
5	1,89	0,67	2,89	0,96	1,00	0,00	0,14	1,14	-1,00	-0,86
6	0,88	0,60	3,25	0,86	1,00	0,60	0,57	2,17	-0,40	-0,43
7	0,98	0,89	7,76	1,34	0,67	0,60	0,86	2,12	-0,07	0,19
8	5,65	0,88	9,00	1,27	0,0	0,2	0,43	0,63	0,20	0,43
9	4,38	0,75	12,63	1,35	0,67	0,00	0,43	1,10	-0,67	-0,24
10	3,60	0,97	9,52	1,42	0,0	0	0,29	0,29	0,00	0,29
11	1,95	0,95	14,24	1,29	1,00	0,00	0,57	1,57	-1,00	-0,43
12	1,53	0,84	8,94	1,19	0,67	0,40	0,43	1,50	-0,27	-0,24
13	5,09	1,25	3,61	1,04	0,0	0,2	0,71	0,91	0,20	0,71
14	3,83	0,84	2,35	0,78	1,00	0,40	0,86	2,26	-0,60	-0,14
15	4,75	1,02	1,84	0,96	0,0	0,2	0,43	0,63	0,20	0,43
16	5,89	0,92	7,28	1,32	0,67	0,40	0,71	1,78	-0,27	0,05
17	4,59	0,84	5,13	1,20	0,67	0,20	0,71	1,58	-0,47	0,05
18	5,24	0,97	8,44	1,45	1,00	0,20	0,86	2,06	-0,80	-0,14
19	1,69	0,68	3,29	0,98	0,0	0,4	0,71	1,11	0,40	0,71
20	2,26	0,82	4,67	1,18	0,67	0,40	0,57	1,64	-0,27	-0,10
21	1,27	0,80	4,66	1,12	0,0	0,2	0,43	0,63	0,20	0,43
22	0,68	0,84	3,21	1,10	0,67	0,40	0,71	1,78	-0,27	0,05
23	1,66	0,80	3,33	0,98	0,67	0,00	0,43	1,10	-0,67	-0,24
24	2,85	0,90	6,56	1,42	0,33	0,20	0,43	0,96	-0,13	0,10

The table below presents the mainline components and results of this research. The figures are based on the previous table, but they are summarized to facilitate understanding. The results are in a pure summarized mathematical form to obtain simplicity: no deeper, expertise based analyze is included in the figures in this table. The FICON and FISUB columns present the number of each feature presented on the vertical rows.

Table 17. the summarized results: the fits between the different factors.

Feature	FICON	FISUB
Number of Attributes	24	24
Number of Critical Factors	6	6
Number of DSBM reference factors	17	17
Number of DSBM factors	18	24
DSBM factors with 100 % respondent unity	0	0
DSBM factors with ≥ 50% respondent unity	2	13
Fit between critical factors and DSBM reference factors according to CFI	5	4
Fit between critical factors and DSBM reference factors according to BCFI	5	4
Fit between critical CFI and BCFI factors	2	4
Fit between critical CFI factors and DSBM factors with ≥ 50% respondent unity	2	3
Fit between critical BCFI factors and DSBM factors with ≥ 50% respondent unity	1	2
Fit between critical CFI factors, DSBM factors with ≥ 50% unity and DSBM reference factors	2	3
Fit between critical BCFI factors, DSBM factors with ≥ 50% unity and DSBM reference factors	1	2
Fit between critical CFI factors and strong DSBM factors	3	3
Fit between critical BCFI factors and strong DSBM factors	1	2
"Unutilized Potential": Number of attributes with zero DSBM value but positive DSBM reference value	5	0
"Unutilized Potential": Total value compared to DSBM reference value	8,60	3,38
"Excess Expectations": Total value	1,40	4,10

The number of attributes is 24: the same attributes were used in both the FICON and FISUB questionnaires as well as in the questionnaire given out to the consultant. Based on the number of attributes, **the number of critical factors** was chosen to be six based on a simple statistical rule; six accounts for 25 % of all attributes. Like this the division between red (25 %), green (50 %) and yellow (25 %) attributes was logical. **The number of DSBM reference factors** is obviously the same for both FICON and FISUB as the consultant evaluated the DSBM effect on the same shared attributes. **The number of DSBM factors** is 18 in FICON and a full 24 in FISUB, which accounts for 100 % of the attributes. The hundred per cent figure suggests that each attribute has been considered to be affected by the DSBM approach by at least one respondent. **DSBM factors with 100 % respondent unity** represent the number of attributes that all the FICON or FISUB respondents consider as a DSBM factor: the number of these 100 % DSBM factors is zero in both business units. **The number of DSBM factors with more than 50 % respondent unity** comprises that at least half of the respondents have considered the DSBM to have an influence the attribute in question. There are only

two such attributes in FICON while the number is 13 in FISUB. The **Fit between critical factors and DSBM reference factors according to CFI and BCFI** rows represent the fit between the critical factors and consultant's perceptions of the DSBM potential. **The fit between critical CFI and BCFI factors** describes the internal fit between the critical factors calculated according to both the critical factor index and balanced critical factor index; the FICON fit is only two whereas the FISUB fit is four out of six.

Fit between critical CFI and BCFI factors and DSBM factors with ≥ 50% respondent unity rows stand for the match between the critical factors and the DSBM factors with a DSBM value over 0,50. Noteworthy is that the FICON number for such DSBM factors is only two, whereas the FISUB number is thirteen; yet, the FICON CFI fit is two, which accounts for 100 % of all factors as there were only two DSBM factors with a value over 0,50. Out of the FISUB thirteen DSBM factors, with a DSBM value over 0,50, only three are critical factors. According to the BCFI manner of calculating the critical factors, the fit is only one in FICON and two in FISUB. The **fit between critical CFI and BCFI factors, DSBM factors with ≥ 50% respondent unity and DSBM reference factors** is exactly the same: all the FICON and FISUB DSBM factors (value over 0,50) which meet the critical factors have positive DSBM reference values. The fit between the critical CFI and BCFI factors and strong DSBM factors improves the FICON CFI match to the DSBM attributes by one, but otherwise remains on the same level.

The unutilized potential and excess expectations are terms developed exclusively during this research. They represent the gaps between the FICON or FISUB DSBM values and the DSBM reference values. **"Unutilized Potential": Number of attributes with zero DSBM value but positive reference DSBM value** refers to attributes which none of the respondents considers to be affected by the DSBM even as the consultant considers an effect to exist. **The unutilized Potential: Total value compared to DSBM reference value** row values present the calculated total value of the unutilized potential; the value has been summarized from all the positive differences between the DSBM reference values and DSBM values. The FICON unutilized potential value is 8,60 whereas the FISUB unutilized potential value is only 3,38. Theoretically, this means that the FICON purchasers haven't realized the full potential of the approach even if it has been in use for several months. When it comes to FISUB, the unutilized potential value isn't that significant, as the transaction hasn't been implemented yet. A more

signaling figure is the high FISUB excess expectations value; 4,10. This value represents the unrealistic, unfeasible expectations the purchasers have towards the DSBM approach. The excess expectations value being this high refers to the purchasers expecting too much from the approach; which might lead into disappointment and rejection. The FICON figure for excess expectations is 1,40 – it could relate to misinterpretations of the transaction functionalities. Worth mentioning is that both the unutilized potential and excess expectations are quantitative measures derived from initially qualitative research data; they are only suggestive values, which are not to be considered as universal facts.

As a conclusion, these summarized research results act as basis for the purchasers to decide on whether to implement the transaction or not – no absolute, measurable answer can be give to the research question. Still, this research aims at enhancing the understanding of the DSBM approach and its potential and the understanding and consciousness of the prevailing circumstances in the purchasing department. The question on whether the fit between the DSBM approach and the purchasers' needs is strong enough to implement the transaction is for the purchasers to decide.

5.2. The Core Contribution

The theoretical contribution of this research can be encapsulated to the development of the research method. The (B)CFI research method has proven its applicability in a different kind of research composition. The method flexibility and applicability have been tested in the research. As the (B)CFI method has been earlier applied to identifying the critical factors, in this research the idea was taken further: the identification of the critical factors was just a formatting of equal added value than the other sub goal: identifying the DSBM factors. The main goal was to analyze the fit between the critical factors and DSBM factors to evaluate the suitability of the DSBM approach to the FISUB purchasing function.

On the other hand, the **practical contribution** of the study lies firstly in the identification of the critical (B)CFI factors; the critical factors present the scarcity of the resources, in other words identifying the critical factors can be assimilated to identifying customer needs. Once the critical factors have been recognized, improvement projects can be allocated towards the areas where they are needed. Like this, the maximum

added value can be obtained with least input. Also the full potential of the DSBM approach has been revealed and the applicability proven. The question about the fit of the DSBM approach to the purchasing function has been justified in the research, but the question whether the implementation actually should take place has been left to the research customers to decide.

Yet, one has to keep in mind that the research results are merely theoretical even if scientifically justified; the formulas and calculations base indirectly on generalizations and customers' subjective presumptions. The respondents might have for example interpreted the questionnaire in slightly different manners or they might even not have understood some questions at all. There are plenty of uncontrollable elements in scientific research which the researcher has to just try to take into account. Like a lecturer once stated, "Scientific research is essentially nothing but lies for children".

5.3. Suggestions for Future Research

The time frame for this research is quite short: the questionnaires were handed out just once at predefined times and the scope over which the attributes were supposed to be evaluated was altogether six months – three to the past and three to the future. There was no longitudinal research either, which means that all the questionnaires to both focus groups were given out on the same week – no data was systematically collected over a longer time period. So a suggestion for further research is to give out the questionnaires again after a longer period of time to be able to fully evaluate the effect of using the transaction and benefiting from the DSBM approach. The questionnaire in itself could be used even inside FISUB to justify other implementation projects or measuring and analyzing customer satisfaction in some other function – or even concerning the actual end customers. Also further development and utilization of the excess expectations and unutilized potential initiated in this research is suggested as both the terms represent the countless possibilities of reshaping and developing the research method.

As the core idea in this research is to examine the fit between the actual needs of the purchasers and the DSBM tool provided, the research could also be further developed to include other tools or approaches and then evaluate their fit to the needs of internal customers, the purchasers. The necessity of a particular tool or solution could be thus

evaluated and the superiority of different tools compared. This kind of research composition would allow an even more pervasive research frame for future cases.

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