UNIVERSITY OF ECONOMICS IN PRAGUE

FACULTY OF BUSINESS ADMINISTRATION

Integrated Business Planning

State of art approach to Sales & Operations Planning and its implementation in the multinational company

Dissertation Thesis

Peter Jurečka

2012

Restriction Note

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Declaration

I hereby declare that dissertation thesis *Integrated Business Planning - State of art approach to Sales & Operations Planning and its implementation in multinational company* is my own work and all the sources have been quoted and acknowledged by means of complete references.

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ABSTRACT

JUREČKA, P: ***INTEGRATED BUSINESS PLANNING: State of art approach to Sales & Operations Planning and its implementation in the multinational company.*** **[Dissertation thesis]; University of Economics in Prague, Faculty of Business Administration; Business Economics and Management; Supervisor: Doc. Ing. Helena Sedláčková, CSc.**

Increasing competitive pressures on most markets force companies to continuously review the effectiveness and efficiencies of their operations. Traditional approach to business planning is becoming insufficient to cope with growing requirements on operational excellence. Concept of Integrated Business Planning (IBP) – constituting the latest development stage of well-known Sales and Operations Planning (S&OP) – is proposed as the right response on how to master the challenges of globalized economy in this field.

The thesis combines theoretical analysis of inefficiencies of traditional S&OP with applied research realized on the case from real business environment. Microeconomic optimization models are employed to demonstrate the sub-optimal outcomes resulting from the lack of cross-functional integration and potentially antagonistic incentives in business planning. Overview of latest best practices in this area further complements the theoretical part of the thesis.

Empirical part of the study summarizes author's experience from leading the large scale implementation of IBP concept in the multinational company. Theoretical assumptions of financial benefits of IBP implementation are tested against empirical observations via usage of statistical apparatus. This part may also be viewed as detailed guideline describing the project of IBP implementation.

As a result, integrated approach to business planning proves to bring measurable financial as well as non-financial improvements for the company.

Key Words: Integrated Business Planning, Sales and Operations Planning, Strategy Execution, Planning Process Optimization, Operational Excellence, Value Based Management, Project Management, Change Management

ABSTRAKT

JUREČKA, P: INTEGROVANÉ PODNIKOVÉ PLÁNOVÁNÍ*: Příklad nejlepší praxe v oblasti Obchodního a Operačního plánování a jeho implementace v nadnárodní společnosti.* [Disertační práce]; Vysoká škola ekonomická v Praze, Fakulta podnikohospodářská; Podniková ekonomika a magement; Školitel: Doc. Ing. Helena Sedláčková, CSc.

Rostoucí konkurence na většině trhů vytváří konstantní tlak na zvyšování efektivity vnitropodnikových procesů v obchodních společnostech. Tradiční přístup k podnikovému plánování se jen stěží vypořádává se zvyšujícími se požadavky na provozní optimalizaci. Integrované Podnikové Plánování (Integrated Business Planning; IBP), které představuje nejnovější vývojové stádium známějšího Obchodního a Operačního plánování (Sales and Operations Planning; S&OP), je představeno jako ideální koncepce jak čelit výzvám v oblasti podnikového plánování, které jsou důsledkem prohlubující se globalizace.

Disertační práce kombinuje teoretický rozbor nedostatků tradičního S&OP a aplikovaný výzkum z reálného firemního prostředí. Sub-optimální výstupy plánovacího procesu vyplývající z nedostatečné integrace napříč jednotlivými vnitropodnikovými funkcemi jsou analyzovány za pomocí mikroekonomických optimalizačních modelů.

Empirická část práce shrnuje vlastní zkušenosti autora z vedení projektu globální implementace konceptu IBP v nadnárodní společnosti. Teoretické předpoklady benefitů plynoucích z realizace IBP jsou empiricky testovány prostřednictvím využití statistických nástrojů.

Výsledkem je potvrzení, že integrovaný přístup pro obchodní plánování dokáže fimám přinést měřitelné finanční i nefinanční přínosy.

Klíčová slova: Integrované podnikové plánování, Obchodní a operační plánování, Implementace podnikové strategie, Optimalizace vnitropodnikových procesů, Hodnotový management, Projektové řízení, Řízení změn

List of main abbreviations

AI	Active Ingredient
CLRM	Classical Linear Regression Model
FCA	Forecast Accuracy
FFP	Finished Formulated Product
GBEI	Global Business Excellence Initiative
IBP	Integrated Business Planning
KPI	Key Performance Indicator
S&OP	Sales and Operations Planning
SKU	Stock Keeping Unit
TQM	Total Quality Management
VBM	Value Based Management

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1. Research topic, objectives and methods used in the dissertation

1.1. Introduction to the research topic

"A goal without a plan is just a wish."

Antoine de Saint-Exupéry

"By failing to prepare, you are preparing to fail."

Benjamin Franklin

The quotes of famous French writer and aviator respectively American statesman highlight the significance of planning not only for effective running of business, but also in many other areas of human endeavor. From the business perspective, economies and industries all over the world have witnessed rapid changes over the past several decades. One of the most visible outcomes of ongoing globalization has been the increasing level of competitiveness across all major markets. Businesses are becoming integral part of complex economic networks and megatrend of rising mobility of people and products makes the world one global marketplace. As a result, the necessity of constant performance improvement and pursue of business excellence aiming to the increase of efficiency of company's processes goes continuously up in the ranking of importance on the agenda of business executives. Especially in the current times of recovery from global economic crisis from 2008 and at the down of new debt crisis in Europe with impacts on global scale, even more attention is being focused on these issues.

Within the broad area of operational excellence, dissertation thesis "*INTEGRATED BUSINESS PLANNING: State of art approach to Sales & Operations Planning and its implementation in the multinational company"* focuses on the key business management process, whose outcomes serve as a basis for the effective functioning of the entire company – on planning. The attention is placed especially on the process of Sales and Operations Planning (S&OP) and the level of integration amongst different participating stakeholders

from various business functions within it. The traditional set-up of business planning and S&OP developed in 1980's are questioned as not being sufficient anymore to meet the challenges of current fast changing and highly competitive business environment. Adoption of the concept of Integrated Business Planning (IBP) is suggested and analyzed as a way for reaching operational excellence through the improvement of planning process in the company.

The applied research conducted in this work provides with the analysis of IBP concept from all important planning perspectives – strategic, financial and operational. From the view of strategic planning, on the model of effective portfolio management it is showed, how can IBP structurally translate strategy into operations and thus contribute to successful strategy execution. From financial standpoint, concept of Value Based Management is applied to analyze, how can the design of effective planning process impact company's financial performance and thus directly influence firm's competitive position on the market. From the perspective of operations planning, it is demonstrated how increased transparency and quality of planning data resulting from the implementation of pro-active gap management improve resource allocation and assets utilization.

The work also comprehensively summarizes the actual knowledge and best practices in the area of integration of business planning processes. It brings innovative views on the application of planning process redesign in the fields as strategy execution, generation of financial value or optimization of resource allocation. Moreover, it enriches the predominantly business topic with theoretical academic fundamentals when inefficiencies of traditional S&OP are analyzed through the application of microeconomic optimization methods. On the concept of Duality from microeconomic Theory of consumer it is showed, how diverse incentives of various planning process stakeholders adversely impacts financial performance of the company.

The work thus aims to represent a unique source of study of the concept of IBP and combined with captured real business experience provides the companies with a valuable guideline that may help them better manage the new post-crisis challenges.

1.1.1. Identification of research problem

The conventional, rather independent approach to planning tends to lack structured integration and cooperation amongst all relevant business functions in the company. As a result, it often leads to inefficiencies in business decision making, sub-optimal effectiveness of operations and utilization of human and capital assets.

Lack of transparency and cross-functional communication contributes to extension of management reaction time, till the problem with changing sales demand is recognized and the solution to it found and implemented. Moreover, operations, including production and supply chain, may become confused with multiple plans existing in the organization in parallel with impact on potential wrongful split of resources amongst various products and markets. Last but not least, inefficient set-up of planning process constitutes additional workload for employees that increase stress and distracts the workforce from focusing on the most value-adding activities.

The problem of optimal set-up of planning process is thus the main focal point analyzed in the thesis. Concept of Integrated Business Planning (IBP) is proposed as innovative, relatively easy to implement and sustainable approach designed to deal with the above mentioned challenges.

1.1.2. Formulation of research question

The basic question that is being analyzed in theoretical part of the thesis and tested in empirical one is stated as follows: *"What is the optimal set-up of planning processes in company that would enable it to meet the challenges of volatile business environment in effective and efficient way?"*

This research question is based on the assumption that traditional, rather independent approach to business planning is not sufficient anymore to meet the rising requirements on operational excellence. Concept of IBP aiming at structured cooperation of individual business functions is proposed and analyzed as the right response to these challenges.

Moreover, focus of the empirical part is placed on proving the supposition that implementation of IBP can bring improvements in business operations reflected in financial benefits. This part provides with concrete examples of IBP process set-up and with the overview of structure and set-up of concrete IBP implementation project.

1.1.3. Foundations of the thesis

Author's interest in the area of operational effectiveness begun in 2006, when he started to work as business analyst with the focus on performance improvement of company's internal processes. After almost three years working as management consultant, he was able to utilize the gained experience with process optimization further in the industry.

In 2009, he took over the responsibility for controlling and supply chain coordination for region Central and Eastern Europe in one of the world's largest chemical companies. Being active within the dual role covering finance and operations, he realized the importance of structured cross-functional cooperation in business planning as well as the negative implications occurring once the planning process is not set properly.

In 2010, author was offered with a unique opportunity to transfer to Germany and lead the global implementation of Integrated Business Planning in Agrochemical division of this chemical company. While getting further deeper into the topic of IBP, he became aware that conventional approaches to planning are becoming obsolete and insufficient to deal effectively with the challenges of current rapidly changing business environment.

The topic for dissertation was selected as author's intention to summarize, broaden and deepen the recently emerging concept of IBP. Lack of academic theoretical foundations as well as shortage of specialized literature dedicated to this area further contributed to the decision. Solid academic background together with profound professional experience accompanied with active participation of author as key note speaker on dedicated international conferences is combined to meet research objectives of the dissertation thesis.

1.1.4. Definition of research objectives

Research conducted within this dissertation focuses on one of the most fundamental processes in the firms – on planning, specifically on Sales and Operations Planning (S&OP) and its latest development stage – Integrated Business Planning (IBP). The main objectives of the thesis are to:

1. collect and summarize the recent best practices and developments in the field of S&OP/IBP
2. extend the pre-dominantly business praxis topic of S&OP/IBP for theoretical and academic foundations
3. analyze the concept development from traditional S&OP to IBP in the past three decades, describe the key distinguishing factors of the IBP as a latest stage of planning excellence
4. broaden and deepen the concept of S&OP/IBP for selected topics from finance, business strategy and operations management
5. summarize the main challenges and findings from practical experience of IBP implementation in multinational company – analyze key inefficiencies of planning processes in various organizations and propose their improvements following the IBP framework
6. via the employment statistical methods, evaluate measurable financial benefits of IBP implementation, especially on inventory management via the increase of forecast accuracy.

1.1.5. Main contributions of author to the topic

Author's main contribution to the analyzed topic is generally twofold. On one hand side, it lies in the application of theoretical academic concepts to explain specific phenomena occurring in business praxis. Moreover multiple topics from different functional business areas – e.g. Value Based Management from finance or product portfolio modeling from marketing are linked with operational planning process optimization. The second point is the unique

practical experience gained and summarized while implementing the proposed theoretical concepts in the real business environment of multinational company.

More specifically, the main own contributions of author to the topic are as follows:

- application of microeconomic optimization tools from the Theory of consumer and related topic of Duality to model certain behavioral antagonism that may occur in the companies' planning processes
- overview of current stage of knowledge regarding the research topic summarizing the most recent best practices in business planning
- innovative linkage of concepts from multiple business areas, e.g. finance, marketing and operations under the umbrella of operational planning
- summary of unique experience from large scale implementation of IBP concept in the multinational company from project and change management perspective
- analysis of financial and non-financial implications of IBP implementation.

1.2. Overview of research methods used in the dissertation

The dissertation is elaborated as applied research in the area of business administration with focus on operational excellence. As a **general conceptual approach**, the structure of the thesis summarized in the table of contents follows the *general-to-specific* logic. Explanation of general topics, e.g. overview of the most common types of planning in business, always precedes specific topics, e.g. Sales and Operations Planning. The same is applied for empirical part where e.g. company specific internal challenges in planning follow general industry related specialties, etc.

The research was carried out as both descriptive and normative field study including qualitative as well as quantitative analyses that are split into two main parts of the thesis: theoretical and empirical.

The following general theoretical methods and logical approaches were applied in this research study:

Descriptive method was used primarily in the first, theoretical part of the thesis and was applied while gathering, sorting, filtering and summarizing of information available in parts mainly from journals, business articles and whitepapers into structured and comprehensive overview. The main goal was to outline the "as-is" status of IBP concept development from various perspectives. In empirical part, it was applied to describe the planning set-up and related inefficiencies before the IBP implementation in the analyzed Agrochemical company.

Normative method of research was applied in both theoretical as well as empirical part of the thesis where its main purpose was to define the optimal set-up of planning process in the company. In the first, theoretical part, it focuses on the explanation of behavioral antagonisms within company's planning process via the application of microeconomic optimization methods. Normative approach is further applied to define the core elements of IBP concept.
In the second, empirical part, normative research method is employed to propose the ideal planning processes for organizations with varying maturity of people, processes and tools on concrete business examples. The conclusions made within this part were summarized as a result of ***structured and in-depth interviews*** conducted with several dozens of managers covering all relevant business functions of multinational "Financial Times 500" Agrochemical company. Most of them were based in Brazil, Germany, India, Italy and United States. These were made during the project of IBP implementation for which author held the position of Global project manager.

Qualitative analysis forms most of the theoretical part and significant portion of the empirical part of the thesis. In forefront lies the description of recent best practices in Sales and Operations Planning summarized under IBP concept. In the empirical part, qualitative analysis was applied to define the best fitting model for each of the analyzed individual pilot countries of IBP implementation project.

Quantitative analysis was used to prove the concept of IBP and to measure specific benefits that improved cross-functional cooperation and integration within the company's planning process deliver. The main focus was on the analysis of the relation between the improved forecast accuracy and decrease of average inventory levels. Econometric regression model was employed to analyze this dependency on real historical business data. Quantitative approach was also used to evaluate the improvements on master data quality across different planning systems after IBP concept was rolled-out in analyzed company.

Methods of Abstraction and Concretization were applied in the theoretical part of the thesis to define the general aspects of IBP implementation. They were also used while summarizing various best practices and extracting the most important features from them in order to define the general IBP concept and its key aspects. In the empirical part, various differing proposals of IBP process set-up in individual countries were presented against the general process model.

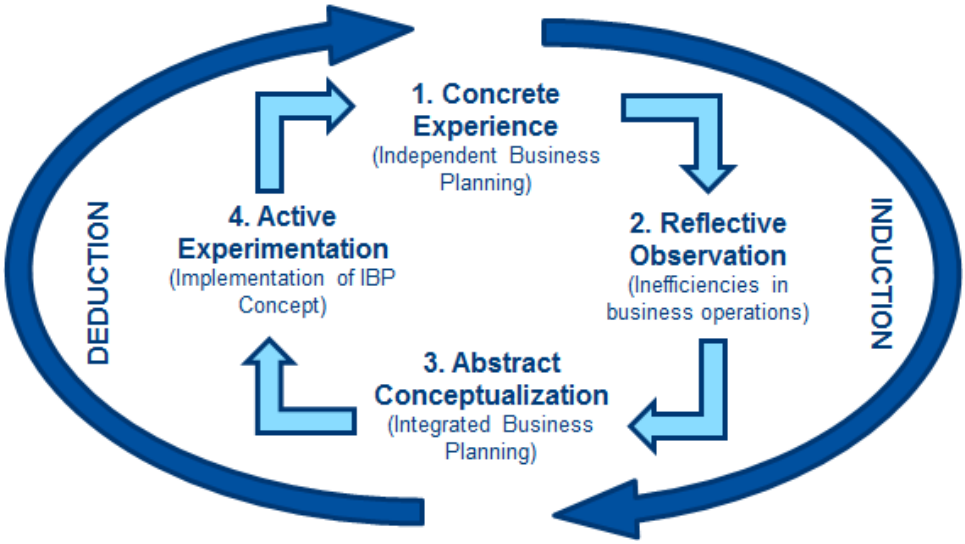
Application of the ***methods of Induction and Deduction*** is explained in more detail in the following chapter on the example of how the logical structure of the thesis was built. Generally, it can be stated that via the help of induction, the research question was defined. Induction was used to formulate the assumption that integrated approach to planning could be the right solution to issues resulting from independent planning approach. Individual problems were analyzed on more general level and proposal to their resolution was summarized under the IBP concept. On contrary, deduction was applied to answer the research question. From general IBP concept which was outlined in the theoretical part of the thesis, concrete applications and adjustments relevant for different organizational set-ups were proposed in empirical part.

Furthermore, specific methods for economic and financial analysis, like ***Value Tree Decomposition, Cost-Benefit Analysis, Microeconomic Optimization or Regression Analysis*** were applied when appropriate in both theoretical and empirical part of the thesis.

1.3. Structure of the thesis

The thesis is conceptually divided into two major interlinked parts – theoretical and empirical or applied one. Structure of both sections follows the built-up logic of **Kolb's Learning Cycle** which is outlined on the Figure 1.

Figure 1: Kolb Learning Cycle



Source: adopted from Kolb et. al (1974)

1.3.1. Theoretical part

The ultimate goal of the theoretical part of the dissertation thesis is to provide with rather general answer on the Research question: "*What is the optimal set-up of planning processes in company that would enable it to meet the challenges of volatile business environment in effective and efficient way?"*

Theoretical part starts with the overview of different types of conventional planning processes based on their ownership by individual business functions. Applying the logic of Kolb's Learning Cycle, this would correspond to its first part – *Concrete Experience* – where conventional business praxis of independent planning is being described. Further on, the main shortcomings of the traditional Sales and Operations Planning process are analyzed as a form of *Reflective Observation*.

Methods of microeconomic optimization are applied on theoretical basis to demonstrate, how misalignment of incentives and inappropriate set-up of planning process negatively influence company's financial results. Following the third point from the Figure 1 – *Abstract Conceptualization* – the second half of theoretical part of the thesis summarizes the main characteristics and key pillars of IBP concept. This part also outlines the recent best-practices in Sales and Operations Planning from available research sources to date.

Moreover, analysis of financial implications of IBP implementation on the bottom line performance of the firm is explained within the framework of Value Based Management. Analysis of linkage between strategic and operational aspects of business planning via portfolio management model further rounds this section. The fourth point – *Active Experimentation* – which is the main focus in empirical investigation is in the theoretical part of the thesis represented by analysis of foundations of IBP implementation covering the aspects of people, processes and tools or systems.

As the topic of IBP has been used pre-dominantly in business praxis, it has been lacking broader theoretical academic foundations. The theoretical part of the dissertation therefore covers the summary of wide range of journals, whitepapers, articles and research studies regarding S&OP and IBP. It is further shaped and enriched by authors own findings and experience gained while leading the global implementation of IBP concept in multinational Agrochemical company.

1.3.2. Empirical part

Second, empirical part, complements the theory and aims to provide with more specific answer on Research question defined in Chapter 1.1.2. It deals with very concrete applications of theoretical IBP concept in real business environment and analyzes the measurable financial as well as non-financial improvements gained from IBP implementation. The business case example is based on the IBP implementation project realized throughout the years 2010-2012 in 4,5 billion EUR sales division of major global player in chemical industry.

Focus of applied research is placed primarily on the evaluation of main challenges in planning leading to needs of integration of planning processes. It is also described, what adjustments in established planning processes were necessary in order to adopt IBP concept for the companies/countries with various complexity of organizations, business models and maturity of people, processes and tools. Furthermore, the examples of customization of general IBP process supporting the differing local specifics are outlined.

Last but not least, statistical apparatus is employed to evaluate concrete financial benefits of IBP implementation. The object of analysis is inventory optimization reached via increased forecast accuracy and thus the ability of the company to better match demand with supply.

Likewise theoretical part, the structure of the empirical part also follows the build-up logic of Kolb's Learning Cycle outlined on Figure 1. Description of as-is situation in planning in analyzed firm can be attributed to *Concrete Experience. Reflective Observations* are covered by analysis of internal and external challenges to the company and thereof related planning issues. *Abstract Conceptualization* is applied to translate the learnings from the previous two stages into unified IBP concept. It thus defines the concrete proposal that came out as globally standardized new approach to S&OP in the Agrochemical company. Definition of five key elements of IBP concept further rounds this section. The last part of Kolb's Learning Cycle – Active *Experimentation* – is used while testing the success of implemented changes. The analysis of increased forecast accuracy and its relation to inventory optimization for selected company represents the last section of applied research.

In the empirical part of the thesis, author shares his experience from leading the implementation of IBP in a complex multinational company. Findings related to more general topics of change and project management associated to IBP implementation can thus serve as unique implementation guideline. Any company with similar characteristics could therefore utilize it in its attempt to roll-out the ideas of IBP in pursue for their operational excellence.

2. Theoretical part: Integrated Business Planning

2.1. Business planning in general

The word planning occurs in the linguistic usage of almost everyone. Clarification of what should be understood under this term for business management purposes is essential prior to introduction of the topic of Integrated Business Planning. Various definitions of planning of from different authors follow the similar tack.

According to Koontz and Weihrich, planning is generally considered as one of the five major functions of management, alongside with leading, staffing, organizing and controlling. They further define planning as setting the goals, plans and tasks of an organization in a convenient way. In planning, managers set the goals first, and then define the strategies to use to achieve the goals. After identifying strategies, then they set the standards needed to implement the strategies, and collect the resources to be used.[1]

Ehrmann and Harald for instance refer to planning as to the outlook of an organization towards which prospective events or goals to get oriented. Accordingly, a systematic projection of future is the main goal of planning, whereby objectives, actions and therefore required resources are determined and coordinated. In doing so, planning acts as an instrument to recognize and structure problems and necessitates economic behavior and a reasonable approach. Through the planning process and the determination of objectives, employees are motivated to achieve certain goals and to act as a whole for the purpose of the business.[2] Via definition of actions for the achievement of those objectives, organizational frame is created for downstream functions of management. Aside, decision making as a choice between various mutually exclusive alternatives, has to be made in the composition of the future activities within the planning process.[3]

[1] Adopted from Koontz, Weihrich (2006), p. 84
[2] Adopted from Ehrmann (2007), p.19-20
[3] Adopted from Corsten, Reiß (2008), p. 3

According to Henri Fayol who was a pioneer in the study of the principles and functions of management, planning can be seen as a stage in the management process in businesses. Similarly to Koontz and Weihrich, he also identifies planning as one of five major functions of management in parallel to coordinating, organizing, controlling, and commanding.[4] Planning is considered as a helpful and substantial management tool, which is supportive in steering corporate transactions into the right direction and securing the success of a business. Hence, planning as one of the most important management functions is seen as the connection between goal setting, decision making and target-oriented actions.[5]

A term often used in the context of planning is forecasting. As mentioned above, influencing factors on the achievement of business objectives and future impacts have to be considered in planning. Related to the question about how the future should look like, also statements about how the future will look like have to be made. The generation of such statements is described as forecasting and the purpose of a forecast is to provide a most likely view of the future.

Through forecasting, prospective outcomes of alternatives can be predicted, whereby a solid and less uncertain basis for planning is created. Accordingly, satisfactory plans can be implemented and inadequate ones can be changed. Hence, being successful in planning is highly dependent on good forecasting, which is why forecasts are important instruments for planning activities.[6]

This brief overview shows that planning in businesses is a complex set of activities. Doing it on the whole under one isolated unit or single process for the entire organization would be hardly feasible. Therefore, the solution to this complexity is a segmentation of planning into different types according to various business functions with different focus and context. Planning types differentiated traditionally according to such pattern are described in the following chapters.

[4] Adopted from Lussier, R. N. (2008), p.40
[5] Adopted from Wöhe and Döring (2008). p.81
[6] Adopted from Finney, A., Joseph M. (2011), p. 32

2.2. Types of business planning

Due to the mentioned complexity of planning processes in organizations, planning is typically assigned to various business functions and several types of planning can be differentiated. Both practice and theory recognize multiple approaches to planning segmentation. The assignment of various planning types to different business functions is in practice also subject to individual business cases and the organizational structures. This chapter thus provides with a general classifications of planning summarized from various authors.

Several clusters for categorization of company's planning can be used, capturing different aspects of this activity. Synek and Kislingerova describe planning as a tool for exercising different levels of business management and differentiates between strategic, tactical and operational planning.[7] Similarly, Kootz and Weihrich also recognizes three general types of planning, namely strategic, tactical and contingency planning. Strategic planning involves development of long range plan. Tactical planning involves short range plans, and contingency planning involves alternative plans. In addition they classify plans as Missions or Purposes, Objectives or Goals, Strategies, Policies, Procedures, Rules, Programs and Budgets.[8] Both Ehrmann and Horváth make planning correspondent to a planning hierarchy. Here it is differentiated between strategic, tactical and operational planning, whereby strategic planning represents the highest level, towards which the other levels are oriented. On highest level, objectives are set to which the activities in the subordinate levels are adjusted.[9]

Split between long-term, mid-term and short-terms encompasses timing horizon. The length of individual timeframes may however also differ in following various authors or different business environments or industries. As per Ehrmann, short-term planning extends over a period of up to one year and medium-term planning spans from two to five years, whereas long-term planning describes a

[7] Adopted from Synek, Kislingerova et al. (2010)
[8] Koontz, Weihrich (2009), p.84-85
[9] Ehrmann, H. (2007), p.22 and Horváth, P. (2011), p.161

timeframe of five to ten years or even longer periods. Both shorter planning horizons are strongly determined by bottlenecks of a company, whereas a long-term planning over a period of more than five years aims more at counteracting those bottlenecks.[10]

Other classifications according to contents of planning or the data situation listed by Ehrmann or as per category of problems or others cited by Horváth are not mentioned here, as they do not matter in the context of this thesis.

Interestingly to the context of this work, Ehrmann as one of the few authors of the theory to the topic of business planning distinguishes also directly between integrated and non-integrated planning. Under integrated planning he understands that all divisions of an organization are planning in mutual alignment.[11]

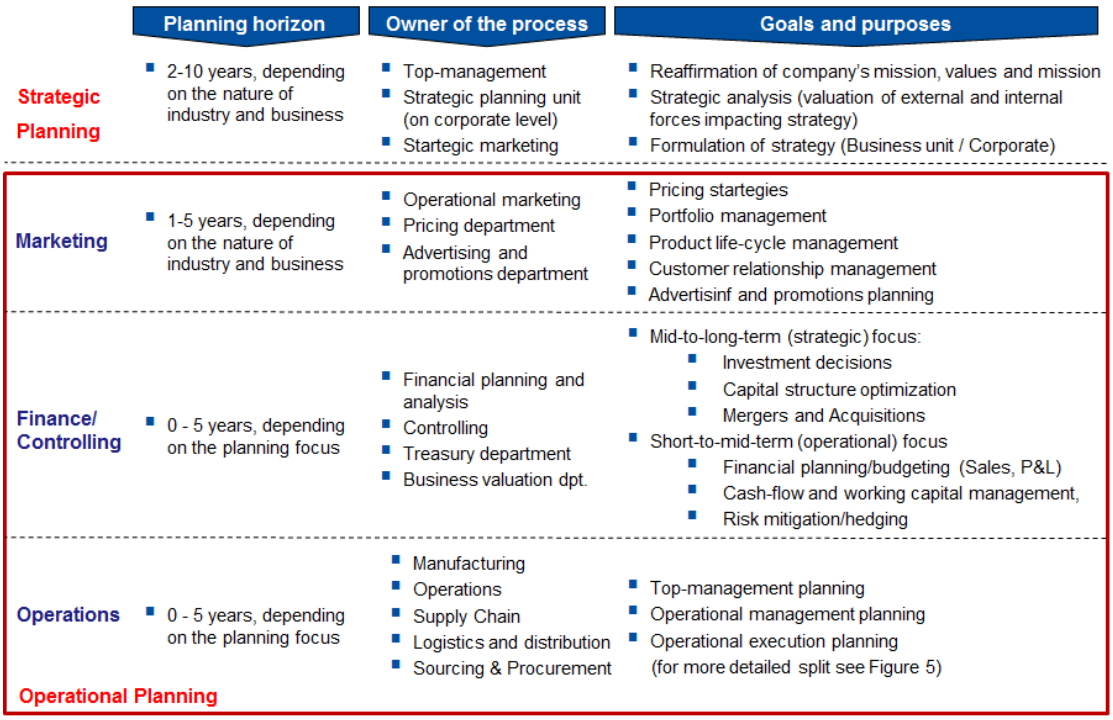
For the purpose of this thesis and in order to better outline the dynamics of S&OP or IBP concepts, the basic split will be done between Strategic – aiming at long-term and Operational planning – aiming on short- to-mid-term horizon.[12]

Moreover, operational planning part further distinguishes between planning of individual business functions. This distinction is used in order to better explain the differences amongst them and to understand the challenges related to the integration of various planning processes cross-functionally. It should help to set the grounds for the explanation of the concept of traditional Sales and Operations Planning (S&OP) aiming at the integration of various operational planning activities. It represents the basis for further conceptual enhancement and improvement towards Integrated Business Planning (IBP).

Figure 2 outlines the most common types of company's planning processes with brief description of owning business function, planning horizon, level of detail and purpose. Various performance indicators that may be applied for steering these processes are further described on Figure 19 in Chapter 2.3.5..

[10] Ehrmann, H. (2007), p.21
[11] Ehrmann, Harald (2007), p.22
[12] Operational planning for the purpose of this thesis is a combination of Tactical and Operations Planning as viewed e.g. by Synek and Kislingerova et. al, Kootz and Weihrich or Ehrmann and Horváth.
In this thesis, Operational planning is to be distinguished from Operations planning used further in text to describe the production and distribution planning of Operations and Supply Chain.

Figure 2: Overview of main types of planning by business function



Source: Author

2.2.1. Strategic planning

Starting from the longest-term horizon that can be reasonably taken into consideration for planning of the future business, we may well end up on the edge of what is more related to the topic of futurology.[13] The work of futurists that are trying to predict the global megatrends could have been seen not that long ago as the activity that is nothing more value-adding than pure crystal ball predictions and have not much to do with real business. However, in the view of growing importance of corporate social responsibility and sustainability of business solutions in the long-term, looking beyond the horizon of typical strategic planning cycle might be crucial for the success of the company.

This can be most evident for the high-tech businesses as well for the industries that are operating with highly socially sensitive products like

[13] Cambridge Business English Dictionary defines futurology as the study of social, political, and technical developments in order to understand what may happen in the future.

pharmaceuticals, agrochemicals or biotechnology. It should be one of the firm's key priorities to correctly estimate the social development and cultural attitudes to their products. In fact, most of the multinational corporations are spending significant resources on supporting their lobbying efforts in order to move social and political thinking to the desired way or simply to influence mass consumption patterns through media. Timing horizon for such visions may be in the range of decades.

Especially due to the high uncertainty related to such long-term horizons, it may be extremely difficult to evaluate the direct impact of such visions from the past on the companies' performance nowadays and therefore I will keep it out of scope of this thesis.

Within strategic planning we for the first time start to talk about more concrete goals and specific business objectives and in ideal case also about the main actions whose fulfillment should lead to reaching defined strategic targets. There have been numerous text books on this topic written as well as vast range of practical business approaches to strategy development evolved. Generally, strategic planning can be considered as organization's process that defines the strategy and provides the guidance on the resources that are needed to pursue this strategy. The outcome of strategic planning is normally a strategic plan which is used as guidance to define functional and divisional plans. The goal of strategic planning should not be focused only on the definition of typical aspect of strategic decisions like what, where, how, to whom and for how much is the company going to sell, but also include clear methods of strategy implementation and further monitoring.

Through the analysis of a company's potential and its competitive environment, statements can be made about a company's strengths and weaknesses. Taking further the market, political, social, technological, economical and environmental analysis into account, a company's opportunities and risks can then be recognized. According to Ehrmann and Harald, strategic planning is given the task of determining what has to be done to realize and use chances while avoiding risks as far as possible. Strengths of a company shall be

deployed and extended, whereas weaknesses have to be reduced or eliminated in the best case.[14] Thus, strategic planning is a question about strategic decisions which have to be concerned with organizational behaviors in the long-run while taking into account competitors as well as overall environmental conditions and developments.[15]

As also the name implies, strategic planning is the process where organizations come up with a strategic plan. This is a plan that comprises a company's mission, goals and objectives and defines particular actions necessary to achieve those.[16] Thus, the development of a strategy is in the center of strategic planning, as strategies denote plans and determine future-oriented corporate objectives.[17] Therefore, specific influencing factors have to be taken into account and certain preconditions have to be created in present so as to ensure the attainment of superior corporate objectives in future and to maintain a company's potentials for success. Amongst other things, securing a company's future livelihood and the realization of appropriate profits on an ongoing basis can be named as examples for such high-level corporate goals.[18]

For the purpose of creating preconditions necessary for the achievement of a company's long-term objectives, several internal and external factors pertinent for a company's success have to be considered. Potential have to be recognized and utilized to survive in a competitive environment. Without the knowledge about these internal and external influencing factors, a strategic plan would not be meaningful and this is why the analysis of a company's environment as well as the analysis of the company itself is the basis for a strategic planning process. Analyzing the company comprises an evaluation of its various individual potentials.

According to Steinmann and Schreyögg, the consideration of company's environment involves an examination of its competitors and market as well as an environmental analysis including for instance evaluations about the political,

[14] Ehrmann, Harald (2007), p.104, 112
[15] Meffert, Burmann, Kirchgeorg (2008), p.252
[16] Willcox (2009), (1), p.1
[17] Kreikebaum, Gilbert, Behnam (2011), p.24
[18] Grünig, Kühn (2004), p.7-9

ecological and technical environments or social developments.[19] They further claim that for strategic planning, strategic decisions can be clustered into different levels of planning. One is the corporate level, where the corporate strategy is elaborated. Within this strategy, business activities are determined and a company's resources are spread among the business segments according to defined strategic objectives. On a business level, business strategies are derived from the overall corporate strategy. Therefore, individual competitive strategies are set for each business segment. Thus, in companies with a number of different business segments, different business strategies can be determined for each segment, but they are all derived from one corporate strategy.[20]

These two categories provide the overall plan and support the organization's mission statement, which is the tool used to formally announce the company's intention, its cope of operations, and its purpose. Different functional strategies are further deduced from the corporate and business strategies. These can include, for instance, a marketing strategy, a financial strategy or an operations strategy, which all support the corporate and business strategy.[21]

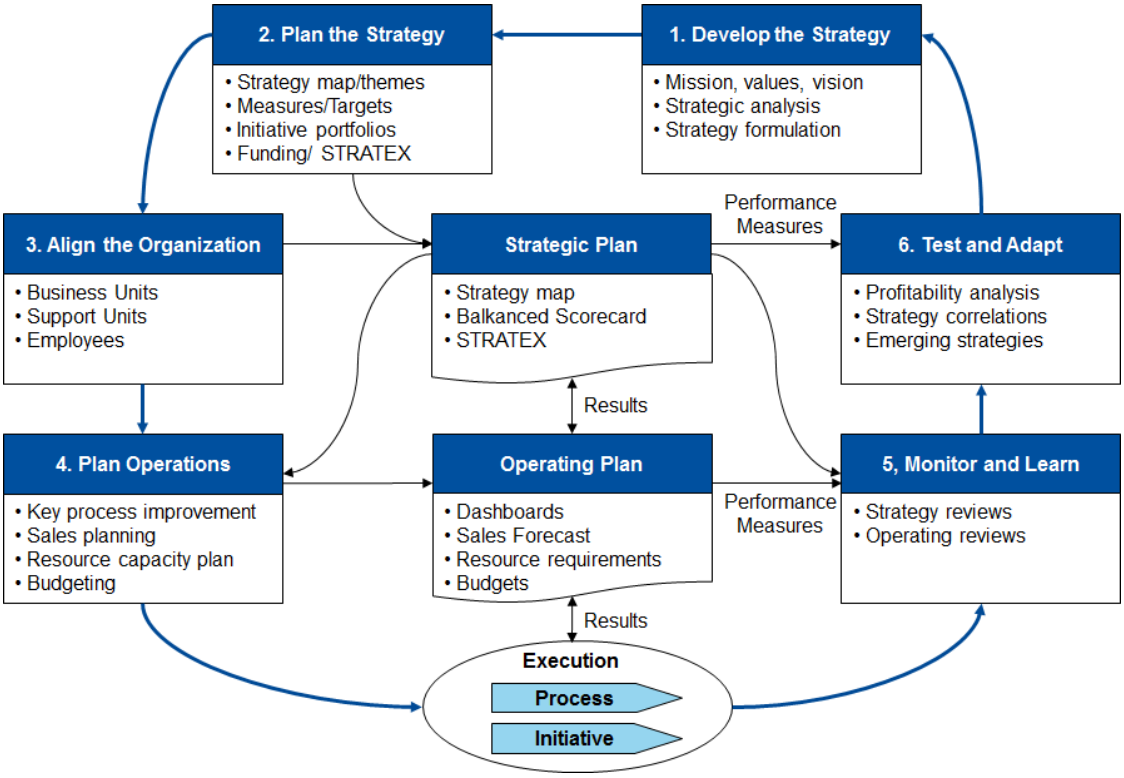
Another characteristic of strategic planning is the high uncertainty and thereof derived high risk attributable to a long-term planning horizon. From a strategic perspective, planning aims at activities covering a period of about five to fifteen or even more years, which makes predictions of prospective proceedings very difficult. However, the concrete length of a strategic planning horizon cannot be stated exactly, as relevant factors that determine a company's environment like, for instance, the reaction rate of competitors or the relevance of governmental defaults vary among different industries. Thus, a planning horizon of three years can be considered in strategic planning for companies operating in highly dynamic and innovative industries, whereas planning for the same horizon in very stable industries would be in the tasks of operational planning. In addition, issues dealt with in strategic planning are most often relatively complex and there is usually a wide range of possible approaches to solving the problems. Strategic

[19] Steinmann, Schreyögg (2005), p.176
[20] Steinmann, Schreyögg (2005), p.170
[21] Willcox (2009), p.5

planning therefore focuses on separate important problems on a relatively minor detailed level.[22]

Closely related term to strategic planning is strategic management. Kaplan and Norton defines is as a closed look process, where each part of the system is influencing the other as description on the Figure 3.[23]

Figure 3: Strategy management process



Source: Kaplan & Norton (2008)

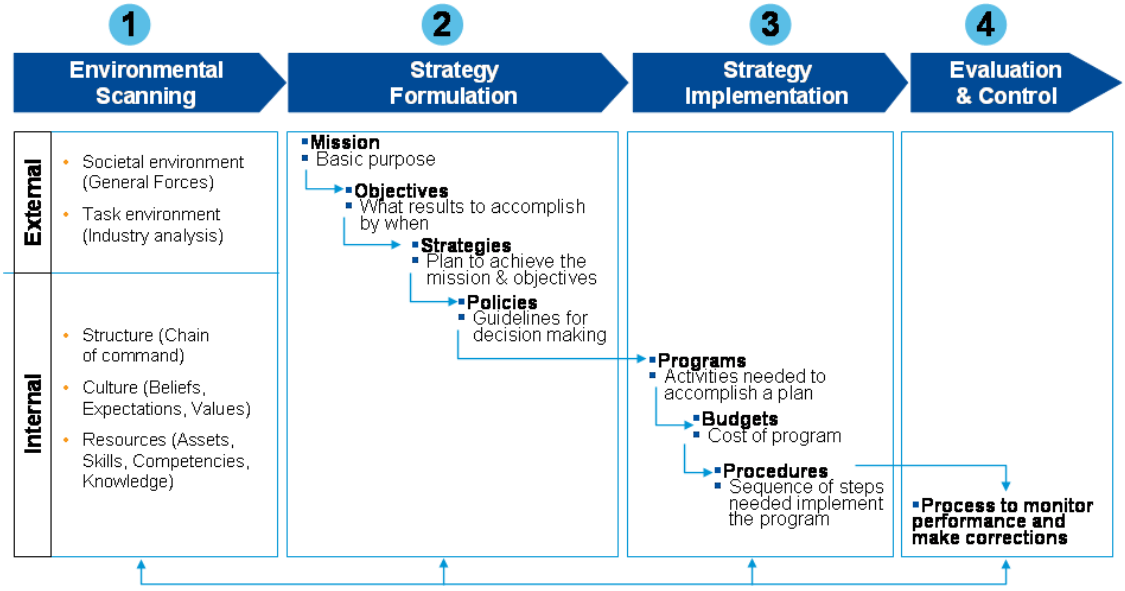
Before formulating concrete actions within strategic plan, company's purpose or mission needs to be (re)affirmed, general guidance for strategic actions in form of company's values agreed. Only on this clear basis the aspirations on future results – the vision – can be built.

As a last but certainly not least point to this topic is the enhancement of strategic planning for strategy implementation and consequent evaluation and

[22] Kreikebaum, Gilbert,Behnam (2011), p.20-21
[23] Kaplan and Norton (2008), p.36

control elements. Strategic planning should thus help in translation of intended strategies into realizable and finally realized strategy via process of strategy decomposition that may follow the following direction as: Evaluation of customers/stakeholders expectations → Mission/vision (Basic purpose) → Objectives (What result will be accomplished by when) → Strategies (Plan to achieve mission and objectives → Policies (Guidelines for decision making) → Programs (Activities needed to accomplish plan) → Budgets (Costs of program) → Procedures (Sequence of steps needed to implement the program) as described on the Figure 4.[24]

Figure 4: Strategic planning process



Source: Hunger, Wheelen (1998)

2.2.2. Operational planning

The primary task of operational planning is the realization of objectives defined in the strategy and in strategic planning. For this purpose, high level strategic objectives have to be broken down into detailed targets. Goals determined in strategy have to be translated into concrete individual measures

[24] Adopted from Hunger, Wheelen (1998)

for the individual business functions or divisions. Hence, the close linkage between strategic and operational planning is critical. Operational planning directed towards the specification of objectives as well as the quest for actions to be taken in order to realize the defined objectives.[25]

Comparing to strategic planning, the planning horizon extends rather over a short-to-mid-term and thus also the level of uncertainty and therewith associated risks are significantly reduced. The problems faced from an operational perspective are most often repetitive and therefore relatively well structured. The range of action alternatives is often limited and planning is done on a highly detailed level in order to be able to make as concrete statements as possible.[26]

Operational planning in businesses can be considered from the perspectives of various business functions like Marketing, Operations, Research and Development, Finance or Sales, Human Resources or Public relations. In the following pages, overview of different types of operational planning are outlined following the functional segmentation.[27]

Planning of Operational Marketing

Unlike strategic planning activities performed often also mainly by strategic marketing unit or by executive management team themselves, operational planning of marketing is not in the core task of top management. Comparing to strategic planning, here the focus is rather on mid-term activities related to launch of new products or promotion of existing product portfolio.

The fundamental tool of managing sales activities of the company is the sales/marketing plan. According to Synek and Kislingerova[28], the following steps are leading to creation of marketing/sales plan:

- Market diagnosis
- Market prognosis

[25] Ehrmann, Harald (2007), p.233 – 235
[26] Kreikebaum et al. (2011), p.20
[27] Only the business functions relevant for later S&OP / IBP concept are included in greater detail
[28] Synek (2010), p.182

- Target setting
- Planning of Marketing Mix
- Budgeting

Market diagnosis contains the characteristics of current market situation in order to find out the participation of individual product groups on generated turnover, profits, cash flow, gross margins and market share. Market prognosis further evaluates the market trends in order to find out if current market denominators will be applicable also in the future. Target setting differentiates between strategic and tactical targets and enables further detailed elaboration of marketing mix commonly known as “Four P’s”: Product, Price, Promotion and Place. The last part, budgeting, is finally used for detailed evaluation of planned revenues and costs related to marketing/sales plan as well as for individual target setting.

Financial Planning

Financial Planning is the topic so vast that it is difficult to capture it in single detailed definition. However, the split between short and mid-to- long-term view is the most commonly used basic differentiator.

The short-term view refers to the actions that are primarily trying to ensure the company will not run out of cash. These are often recognized as liquidity planning or cash budgeting and includes apart from the preparation of standard financial statements as planned balance sheet, profit and loss statement and plan of expected cash flows also financial sales plan, investment budget, or budget of external financing. In general, short-term financial planning refers to actions that have something to do with cash cycle or working capital management, covering the topic such as cash, inventories or accounts payables and receivables management.

On contrary, in long-term perspective financial planning is dealing more with the topic of strategic financial and investment decisions and therefore could be from certain point of view also considered as part of strategic planning.

Capital investments' planning focuses on the valuation of investments into long-term assets that are defining the future of the company. Strategic financial planning on the other hand evaluates the implications of alternative financial strategies from the perspective of capital structure. Long-term financial planning is also capturing the definition of goals of the firm, setting of individual targets for management and provides standards for measuring performance.

Historical development of financial planning and analysis (FP&A) is closely linked to its main function – capturing the financial value of the firm. As the main goals of the firm changed from revenue and profit maximization towards more general maximization of the value for its stakeholders, so did the function of the financial planning and analysis.

Kislingerova defines financial planning as decision making process of the firm assessing the risks that are interesting for the business as they are carrying certain opportunities, further defining the risks that are unavoidable and lastly those identification of risks that are not interesting for the company.[29] She further differentiates amongst four main consecutive steps that form the content of financial planning:

- Analysis of financial and investment possibilities available to the firm,
- Reflection of future impacts of current decisions with the goal to avoid unpleasant surprises,
- Selection of specific alternatives that finally incorporated into financial plan,
- Measurement of the final performance of the financial plan in comparison to the pre-defined targets.

Operations Planning

Similarly to financial planning, planning of operations especially for manufacturing company is also rather difficult to capture within single definition as it practically includes all activities from strategic planning of resources to detailed scheduling of orders and logistics.

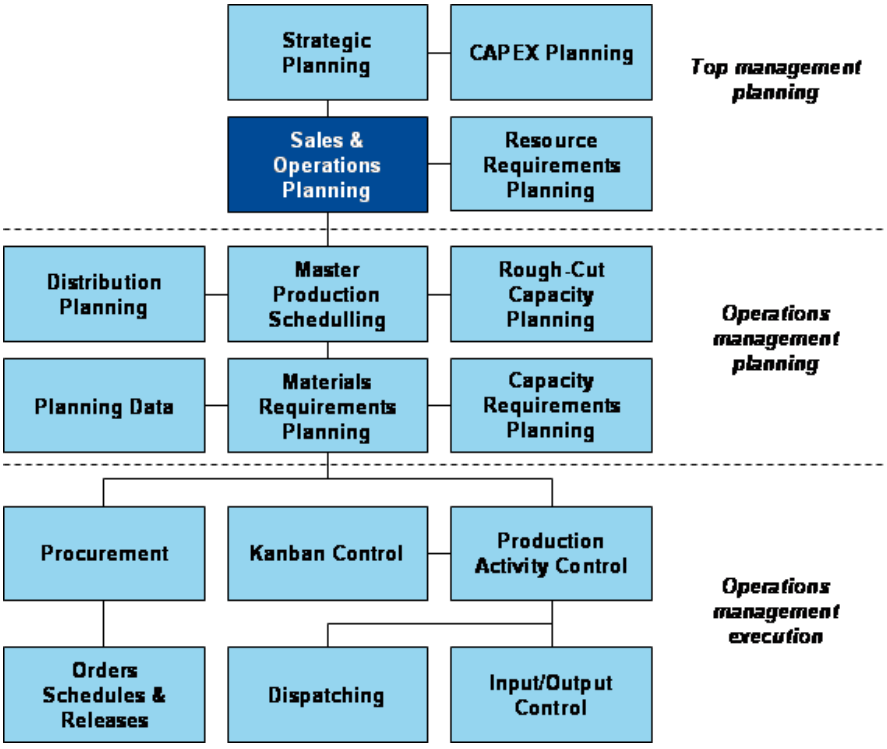
[29] Kislingerova et. al. (2010), p. 117

Synek and Kislingerova in general differentiate between two major operational planning activities: planning of production and sourcing.[30] Production planning is further split between:

- Planning of production program defining production volume per product mix and period,
- Planning of production process including technology and materials to be used,
- Planning of production capacity as general characteristics of production limitations of the company.

The main function of sourcing or its more specific sub-category – procurement, is effective meeting of material needs that are resulting from planning of basic production and non-production processes.

Figure 5: Overview of Operations planning types



Source: APICS, Willcox (2009)

[30] Synek, Kislingerova et.al. (2010), p. 182

Another split of operations planning is provided by APICS.[31] The general overview of operations planning structure according to this approach is outlined on the Figure 5.[32] It primarily differentiates amongst three main operations planning types not by timing aspect as in the case of financial planning, but on the basis of hierarchy starting from Top management planning, through Operations management planning down to Operations management execution.

Operations management planning normally follows up on the plans derived in the previous "management" planning levels and translates them to the executable operations. Operations management planning relates almost entirely to supply chain function and includes a) Master Production Scheduling (MPS), converting production plan into detailed manufacturing plan, b) Rough-Cut Capacity Planning (RCCP) which is the high level capacity check module for MPS, c) Distribution Planning concerned with management of distribution inventory including all administrative and physical controls and finally d) Material Requirements Planning (MRP) and e) Capacity Requirements Planning (CRP) related to planned production levels and timing.

The lowest level of planning relates to the detailed Operations Management Execution including Production Activity Controls (PAC) with Input/Output control and Dispatching concept, further on Procurement with the various releasing concepts and the Kanban technique.[33]

2.3. Sales and Operations Planning (S&OP)

Traditionally, companies have been organizationally structured in departments following the main functions as Marketing, Sales, Finance, Operations, R&D etc., operating under central control of general top management.[34] As a result, planning of strategy, financials, sales, production or distribution have often being managed as internal activity of each business

[31] APICS - The Association for Operations Management is the global leader and premier source of the body of knowledge in supply chain and operations management, including production, inventory, materials management, purchasing, and logistics (www.apics.org)
[32] Willcox (2) (2009)
[33] More detailed characteristics of individual planning sub-types can be found e.g. in Willcox (2009).
[34] Adopted from Kaplan, Norton (2001)

function rather independently on the others.[35] Natural result of the lack of alignment amongst independent planning types is the existence of gaps amongst individual plans, which consequently leads to sub-optimization and disconnection of the link between strategy and operations.

Planning should be therefore established as integrated management system starting from the definition of company's missions and objectives captured in business strategy, out of which all other, lower level and tactical plans are and dynamically and systematically derived. Business plan should describe rational actions to achieving the pre-selected strategic objectives and thus link the company's current position with what it wants to achieve. The first structured approach aiming at cross functional alignment in planning which has been accepted in business praxis worldwide is the concept of Sales and Operations Planning.

2.3.1. Concept of traditional S&OP

Before it is proceeded to the concept of Integrated Business Planning, it is essential to understand deeper its evolutionary predecessor – process of Sales & Operations Planning or S&OP. As the concept has been adopted in the past three decades by many companies globally, the economic turbulences and crisis of the past decade resulting e.g. in increased customer demand for faster response to market shifts and for more made-to-order products and services, has called again for review of this fundamental process of operational excellence.[36]

Different aspects of S&OP process have filled the pages of business journals and publications since then and S&OP has become one of the most discussed and appreciated process topics in business today.[37]

S&OP known also under the term Sales, Inventory and Operations planning (SIOP) should be understood as top-management planning system that

[35] Adopted from Feng et. al (2008)
[36] Adopted from Muzudumar & Fortanella (2006)
[37] See e.g. Bower (2005 - 2006) ; Dougherty &Christopher (2006); Dwyer (2000); Galluci (2008); Grimson & Pyke (2007); Harwell (2006); Lapide (2004 – 2007); Mentzer (2004); Palmatier (2003); Proud (2007); Sheldon (2005 – 2006); Vollman et al. (2005); and Whisenant (2006)

sets the monthly cycle and calibrates the operational execution with strategic business plans. Within S&OP process, customer expectations and internal operations are reviewed for accuracy, process accountability, lessons learned and future risk management.[38]

There is no single unified definition of S&OP, partially because different aspects of S&OP have relatively different importance for different industries and partially because the concept is being gradually fine-tuned as a reaction on the new business challenges.

Table 1 provides the overview of various different S&OP definitions and characteristics.

Table 1: Definition of S&OP

Author	**Definition of S&OP[39]**
APICS (2009)	S&OP is a process that provides management with the ability to strategically direct its businesses to achieve competitive advantage on a continuous basis by integrating customer focused marketing plans for new and existing products with the management of the supply chain. S&OP relates to all processes, concepts and techniques that are used to link strategic targets of the company and its operations and to coordinate the various planning efforts of the functional areas, i.e. operations, sales, sourcing, product development, marketing and finance, in a variety of business environments
Bower (2005)	S&OP is an orchestrated effort to influence future business, based on cooperative, ongoing analysis of available intelligence and key metrics.

[38] Adopted from Sheldon (2006), p.1

[39] The definitions are referring to latest best practice in advanced S&OP, recognized recently also under the term Integrated Business Planning (IBP). For more detailed recognition between S&OP and IBP see Chapter 2.3.6.

Dwyer (2000)	S&OP provides a simple link between a company's strategic plan and its day to day operations and forms the basis for a common set of numbers across all departments to help drive the business: this enables management to monitor the balance between supply and demand (production and sales) and so improve control
Grimson, & Pyke (2007)	S&OP is a business process that links the corporate strategic plan to daily operations plans and enables companies to balance demand and supply for their products.
Harwell (2006)	A structure of internal collaboration to resolve the natural tensions between supply and demand, to reach consensus on a single sales plan that every department in the company will support, and to coordinate and communicate operational plans required to achieve the sales plans
Muzumdar & Fontanella (2006)	S&OP is the set of business processes and technologies that enable an enterprise to respond effectively to demand and supply variability with insight into the optimal market deployment and most profitable supply chain mix.
Olhager et. al. (2001)	S&OP is the long-term planning of production levels relative to sales within the framework of a manufacturing planning and control system.
Oliver Wight (2010)	S&OP is a process led by senior management that evaluates and revises time-phased projections of demand, supply, product and portfolio changes, strategic projects and the resulting financial plans.
Proud (2007)	S&OP is an ongoing process, characterized by a monthly review and continually adjusted to match company plans in

	light of fluctuating customer demand and the company's available resources.
Palmatier & Crum (2010)	A process led by senior management that evaluates and revises time-phased projections for demand, supply, product and portfolio changes, strategic projects, and the resulting financial plans. This is done on a monthly basis, typically over a 24-month rolling planning horizon. It is a decision-making process that realigns the tactical plans for all business functions in all geographies to support the company's business goals and targets.
Smith (2008)	S&OP is a set of companywide planning and decision-making processes designed to balance the supply of products (or services) with the demand for them and to link day to day operations with business goals, operational planning, and financial planning.
Ventana Research (2008)	S&OP is a set of planning and decision-making processes that not only balance product supply and demand but also link day-today operations with business goals, operational planning and financial planning.
Vollman et al. (2005)	The sales and operations plan links strategic goals to production and coordinates the various planning efforts in a business, including marketing planning, financial planning, operations planning, human resources planning, etc.
Wallace (2004)	S&OP is a business process that helps companies keep demand and supply in balance. It does that by focusing on aggregated volumes (product families and groups), so that mix issues (individual products and customer orders) can be

	handled more readily. It occurs on the monthly cycle and displays information in both units and dollars, thus it integrates operational and financial planning. S&OP is cross-functional involving General Management, Sales, Operations, Finance and Product Development. It occurs within multiple levels in the company, up to and including the executive in charge of the business unit, e.g. division president, business unit general manager or CEO of a smaller corporation. S&OP links the company's Strategic plans and Business Plans to its detailed processes – the order entry, master scheduling, plant scheduling and purchasing tools it uses to run the business on week-to-week, day-to-day and hour-to-hour business. Used properly, S&OP enables the company's managers to view the business holistically and gives them a window into the future

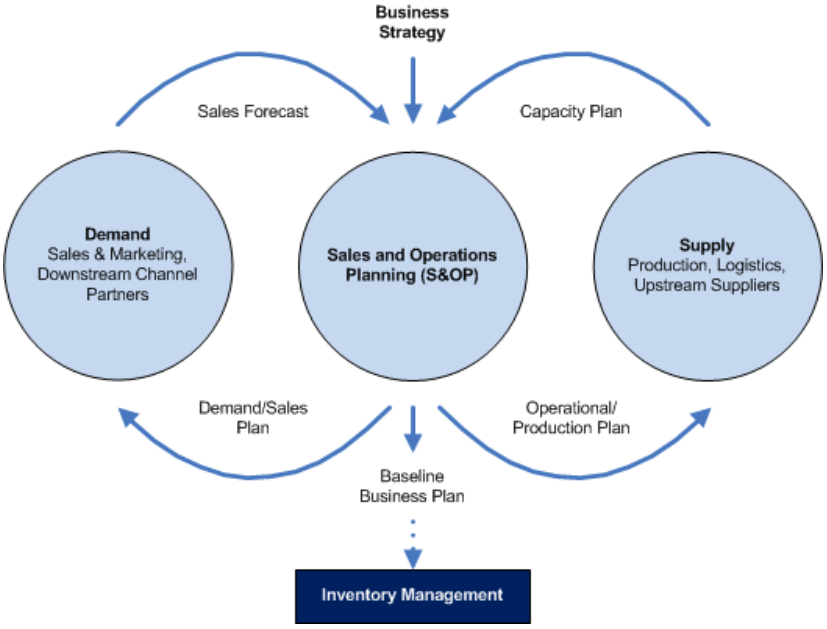
These definitions are following more the best practice approach that the traditional perception of this process as it is being defined and lived within most of the companies. As will be discussed in the following chapter, majority of the companies have merely started the transition beyond the basic demand and supply balancing process.

At the center of the S&OP process, there are two following two fundamental issues:

- Firstly, what is the best way to balance supply and demand with lowest possible costs on one side, but with still keeping the sufficient sales flexibility on the other side?
- Secondly, what is the appropriate production volume and product mix in the light of previously mentioned constrains?

Answers on these questions are heavily dependent on the type of business environment in which the company operates. Figure 6 displays the baseline structure of the S&OP proposed by author:

Figure 6: S&OP as a linkage between Supply and Demand



Source: Author

In general, S&OP is the process that should be taking three key inputs; the business plan, the anticipated demand and the available resources that are used to create and maintain at least two fundamental plans for managing the business in the medium and long-term. First is the sales plan, which is the agreed volume of expected future sales and second is the production plan, which is the agreed volume of production.

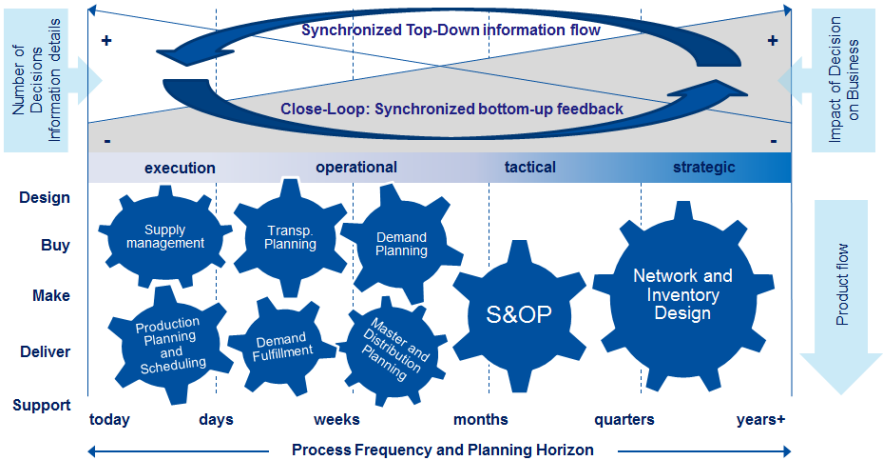
Another view on S&OP process could be from the perspective of time and functional synchronization of different parts of operational planning as outlined on the Figure 7.[40] In such case S&OP represents the important link between strategic decisions on overall supply chain network and inventory policy set-up and more detailed planning levels.

According to Sheldon, a center of S&OP is a business system, in most manufacturing companies known today as Enterprise Resource Planning (ERP),

[40] Adopted from "Intergated Business Planning – Synchronizing Demand, Supply, Finance and Execution" presentation by Director of Strategic Services of JDA Software Hans-Georg Kaltenbrunner; Integrated Business Planning Summit in Zurich, IE Group March, 2011 (http://theiegroup.com/Europe)

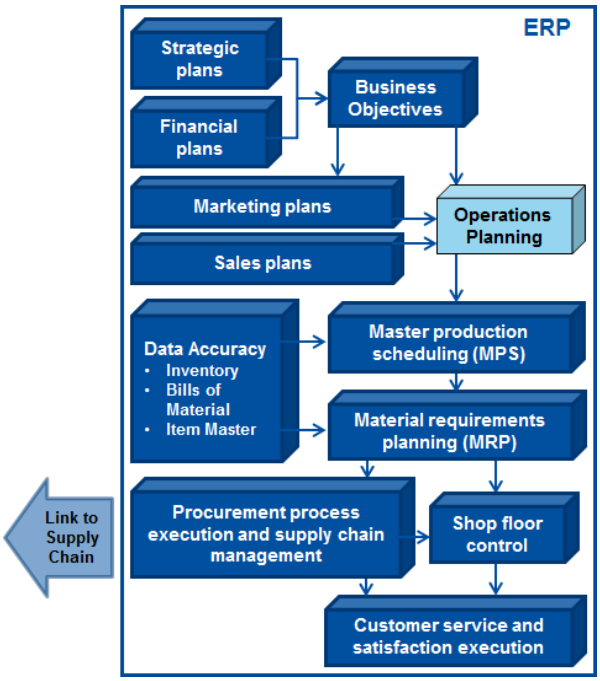
within which top-management planning links the operations and execution processes.[41] The Figure 8 describes his ERP business system model.

Figure 7: S&OP in the perspective of other planning types



Source: JDA

Figure 8: Operations planning as a part of ERP



Source: Sheldon (2007)

[41] Sheldon (2006), p.7

2.3.2. Inefficiencies of traditional S&OP in general

As mentioned earlier, the beginnings of the development of traditional S&OP concept dates back to 1980's. As the business environment has evolved and changed significantly since then, companies that kept on working with the conventional concept of S&OP observed several insufficiencies in the application of the early approaches. These are not only attributed to the basic idea of the concept itself, but rather to changing external business environment and increasing globalization. Companies are nowadays facing different challenges compared to which they had to deal with thirty years ago. This chapter outlines the challenges and the weaknesses of traditional S&OP concept.

Analyzing current changes in business environment and the dynamics of how companies try to adapt to them, market research company Aberdeen Group conducted a research about the best practices in Sales and Operations Planning.[42] They concluded that increased diversity and dynamics became the common denominators for most markets. Furthermore, increased demand for the larger product varieties lead to the need for broader and more complex product portfolios. Customers also request more and more individually customized products and solutions and single brand loyalty declines gradually. This in combination with shortening product lifecycles forces companies to be able to respond quicker on the changes of market demands. To sum, the above mentioned influences are leading to a high volatile markets making the demand more and more difficult to forecast.

According to Aberdeen's researches, companies that are still applying the more traditional approaches of S&OP are suffering from lost sales related to a limited flexibility and the inability of reacting to this increasingly dynamic market.[43] This is attributable to limited or even missing involvement and hence the input from Marketing and Finance in the conventional S&OP process.

[42] Aberdeen Group (2006), p.1
[43] Aberdeen Group (2005), p.1-2

Aberdeen Group further emphasizes the changes in the structures of organizations like mergers and acquisitions, joint ventures and outsourcing as being challenges that are as well putting growing pressures on companies, especially with regards to planning and adherence to company targets. Also the lowering inventory levels in the context of just-in-time production and the collaboration with offshore suppliers are increasing the "risk and impact of supply chain upsets".[44]

As a consequence of increasing uncertainty in the markets, companies tend to build up their safety stocks in order to ensure the ability of meeting unsteady customer demands. This may in turn further increase the imbalance between actual demand and supply representing just the opposite of the basic idea of traditional S&OP. Moreover, products held on stock are bounding the capital and create additional unnecessary inventory holding costs impacting negatively the bottom line financial performance of the firm. As a countermeasure for reduction of aging overstocks, unplanned price reduction are often necessary to sell the excess inventories leading to deterioration of profit margins. As can be seen, deciding about the optimal balance between supply and demand leading to "just enough" inventory levels represents one of the most critical decisions of the firm.

Last but not least, increasing levels of globalization over the past thirty years have contributed significantly to today's volatile market environment. This becomes apparent when looking at the growing complexity of companies' supply and value chains as well as rising importance of the procurement of resources on a global level. This presents businesses with an even bigger challenge in how to manage a supply and demand balance, which is essential to a company's success.

Taking all these challenges into consideration, the question arises how can the companies effectively respond to the challenges of today's dynamic economic environment and how the concept of S&OP has to be advanced in order to support them in improving their operational performance. To ensure the

[44] Aberdeen Group (2005), p.2.

success of a company, it is essential that not only the outside working environment is considered, but also the internal organization of business processes and effective application of S&OP tools. According to Aberdeen Group, traditional S&OP practices and supporting technologies are no longer sufficient in today's high-pressured business environments.[45]

When talking about traditional S&OP, it has often been the case that the concept is regarded as only being concerned of Sales and Operations focusing solely on volume based supply and demand planning. According to StrataBridge, a consulting firm specialized in the area of S&OP and IBP, especially the absence of Finance turns out to be problematic. As the performance of the company is ultimately evaluated by financial value indicators, volume forecasting of Supply Chain has been traditionally considered to be of lower priority than financial planning with limited attention of senior management of the company.[46]

All the above mentioned challenges related especially to current global and highly volatile business environment and the elaborated insufficiencies in the concept of traditional S&OP consequently led the organizations to redefine and further developed the concept of S&OP.

2.3.3. Inefficiencies of traditional S&OP explained by models of microeconomic optimization

2.3.3.1. Antagonism within S&OP

Based on the description of traditional S&OP, and also as the name itself indicates, the two main parties involved in this process have been Sales[47] and Operations / Supply Chain.[48] Although the general goal of the company is usually quite straightforward, aiming mostly on the sustainable profit growth and thus creating desirable value for stakeholders, specific targets of different parties

[45] Aberdeen Group (2006), p.1
[46] Coldrick, Ling, Turner (2003), p.7-8
[47] By Sales or Supply Chain contrary to sales or supply chain would be for the distinctive purposes meant the sales/supply chain department or function in the company.
[48] The Supply Chain here is represented mainly by Forecast managers, Supply chain managers or coordinators etc. depending on the organizational structure of each individual company.

involved in S&OP process might differ. Even though the objectives of S&OP process stakeholders should not be conflicting and in ideal case they should support each other, it often happens that individual incentives are misaligned, or even antagonistic. Motivations of Sales and Supply Chain are from the big part driven by their core competencies and roles in the company as well as by setting of personal performance targets.

As will be shown in this chapter, these different incentives might result in the antagonistic trends in the management of inventories, which represents the link between Supply Chain and Sales in this process. The level and structure of inventories[49] is the indirect outcome of S&OP process as it is the result of the physical production and distribution and actual sales.

Generally speaking, inventory levels and their structure should be kept so, that the company is able:

a) to effectively react on the demand fluctuations on the market,

b) at the lowest possible costs.

However, these two requirements on the process have contradictory effect on the total costs of inventories.

Looking closer at the motivation of Sales, the sales representatives and managers are in most cases focused on the increase of sales performance. The main contribution to the profit increase from Sales side is thus reached through growth on the side of revenues. From the view of product availability, the two main prerequisites of reaching their goals are:

a) to have sufficient amounts of product available,

b) early enough before the anticipated sales.

This would ensure the desired product flexibility so that Sales is able to react on the potential increase of demand volatility.

On the other hand, the core function of Supply Chain is to “supply the Sales” and eventually the customers at the lowest possible costs under the

[49] For the purposes of this text, under the term inventories, one should understand the finished goods (not assuming two other main inventory groups, raw materials and work-in-progress, as the S&OP process relates mainly to the part of supply chain from production to customers and not from suppliers to production)

assumption of maintaining certain agreed level of flexibility for Sales, defined usually in a certain form of Service Level Agreement. Supply Chain is thus primarily trying to contribute directly to profit creation through lowering the costs, instead of increasing the revenues.

As can be seen, different motivations of Sales and Supply Chain may influence the level of inventories, and thus eventually the costs, in the opposite direction. The request for “flexibility buffer/safety stocks” from the Sales point of view leads to the increase in the amounts and time of products on stock, which opposites the costs minimization efforts of Supply Chain.

To sum up, the efficiency of S&OP process can be viewed from two perspectives. On the one hand it is the ability of Supply Chain to meet the requirements of Sales regarding the amount and time availability of product; in other words, the satisfaction of Sales from having at disposal sufficient amounts of product soon enough on stock - named Product Availability – “PA”. On the other hand there are the Costs of inventories – “CoI”.

Both of these views meet under the topic of inventory management that deals mainly with two issues. Firstly, “What is the appropriate level/mix of inventories?” and secondly, “How long in advance should be the product available on stock before the planned sales?”.

In order answer these questions, it is useful to define the following two variables:

- average level of inventories (measured in quantitative units of measure, i.e. tons/Kg/L, named “Q_i”), capturing the “volume aspect” of inventory management,
- average period, for which the inventories are at stock before the planned sales (measured in days, named “T_i”), capturing the “time aspect” of inventory management.

The higher is each of the variables, the higher are the CoI, as well as PA.

It can be seen that the organizational setting of S&OP process and the split of decision making power between Sales and Supply Chain can have non-negligible impact on the costs of inventories which might represent significant

portion of company's total costs. This is valid especially in the case of selling organizations where big amount of capital is tied in form of finished, but not yet sold products.

2.3.3.2. Optimization model

Looking at the problem of antagonism in S&OP process through "microeconomic lenses", it is possible to recognize many common features of decision makers involved within this process with rational consumer from the classic microeconomic theory. Application of microeconomic findings on business S&OP process can explain the different motivation of involved parties and thus find the possible gaps in its efficient setting and functioning.

Preference ordering and Utility function for Sales

Reviewing the link to microeconomic Theory of consumer, it can be said that Sales is "consuming" certain levels of volume and timing flexibility of inventories, i.e. $Q_{i(S)}$ and $T_{i(S)}$[50], which defines the specific level of product availability - PA[51]. This "PA bundle"[52] is thus denoted by the vector:

$$PA_m = (Q_{i(S)m}, T_{i(S)m})$$

where $Q_{i(S)m}$ and $T_{i(S)m}$, m = 1,2,3…n, represents the specific quantity and time of inventories on stock. Moreover, the values of $Q_{i(S)}$ and $T_{i(S)}$ are not only not-negative, but are restricted within specific limits:

$$0 < Q_{iMin} < Q_{i(S)} < Q_{iMax}$$
$$0 < T_{iMin} < T_{i(S)} < T_{iMax}$$

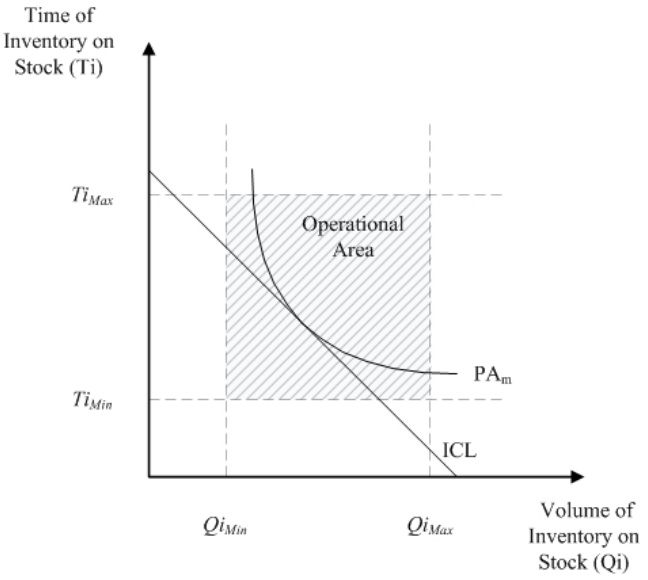
The rationale for this assumption is as follows: there is certain minimum level of $Q_{i(S)}$ and $T_{i(S)}$ (let's call it Q_{iMin} and T_{iMin}), that represents an unbiased minimal level of Inventories accepted/agreed by both Sales and Supply Chain, under which the normal functioning of the business is impossible. Contrary to this,

[50] In this work, wherever (S) or (SC) are used as a bottom indexes, it is to emphasize that the variable refers especially to Sales or Supply Chain, e.g. $Qi_{(S)}$* means the optimal level of Inventory volumes from the perspective of Sales.
[51] The higher the PA, the higher the utility for Sales.
[52] Consumption bundle in The theory of consumer

we can assume also certain maximum level of $Q_{i(S)}$ and $T_{i(S)}$ (let's call it Q_{iMax} and T_{iMax}), above which keeping any additional inventories would have no possible benefit for business. The maximum level of inventories might be for example defined by total market size, or by most optimistic market share scenario.

Therefore, we can determine the "Operational area" for inventory management within the area defined by these two points [Q_{iMin} ;T_{iMin}] x [Q_{iMax} ;T_{iMax}], as illustrated on the Figure 9.

Figure 9: Operational Area



Source: Author

Sales ranks the bundles in the feasible set in order of preference and choose the one with the higher ranking. We can further assume, that the ranking of preferences is bearing the desired properties of Completeness, Transitivity, Reflexivity, Non-Satation, Continuity and Strict convexity which enables us to represent the preference ordering of Sales by a set of the continuous, convex-to-the origin indifference curves, such that each bundle $Q_{i(S)}$ and $T_{i(S)}$ lies on one and only one of them.[53]

[53] For more information about assumptions and properties of indifference curves see e.g.: Gravelle, Rees, p.12-16.

Further on, each level of PA brings certain level of utility (u) to Sales, which can be expressed as:

$$u_{(S)}(PA) = u_S^0$$

where u_S^0 is some given number. Establishing the notion of Sales utility function (u_S) and with regards to the assumptions of preference ordering described above, the problem of finding the most desired level of PA can be redefined as the one of constrained maximization of a strictly quasi-concave function.[54]
Adding the assumption of Differentiability[55] we can further define the marginal rate of substitution for Sales ($MRS_{TQ(S)}$) between T_i for Q_i as:

$$MRS_{TQ(S)} = -\left.\frac{dT_{i(S)}}{dQ_{i(S)}}\right|_{u\ const.}$$

$MRS_{TQ(S)}$ represents the rate at which Sales are ready to substitute timing inventory flexibility for unit change of volume inventory flexibility while maintaining the same level of utility.

The feasible set for Supply Chain

Each combination of Q_i and T_i not only brings certain level of utility for Sales, but also bear inventory related costs. The higher is the Q_i or T_i, the higher amount of company's capital is bounded in form of inventories, and thus higher are the costs.

All combinations of Q_i and T_i that comes to the consideration from the perspective of Supply Chain form the so called "Feasible set". Each point within this set represents a specific level of Costs of Inventories (CoI), whose minimization belongs to one of key targets of Supply Chain. Supply Chain tries to manage the cost of holding the inventories in order not to exceed the certain maximum target or budgeted level of CoI, named CoI_{Max}. The total amount of

[54] For more information about the features of utility function see e.g. Gravelle, Rees, p. 16-18.
[55] Differentiability – Utility functions are differentiable to desired order.

CoI_{Max} is usually determined through various Key Performance Indicators (KPIs) in relation to other variables, such as level of sales.[56]

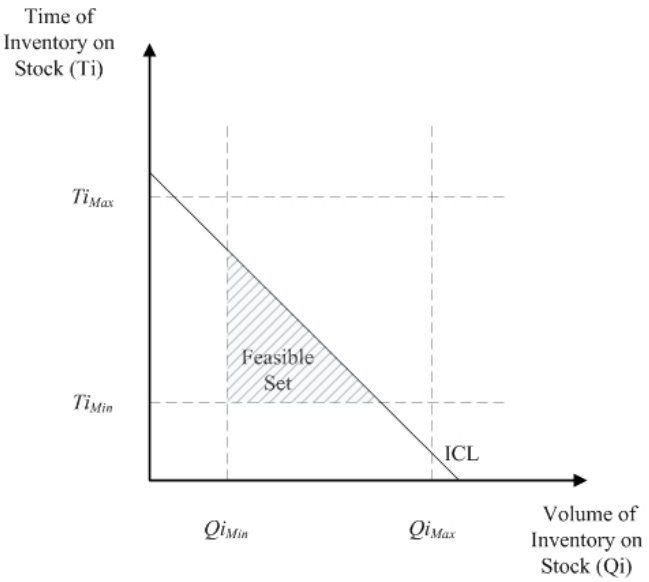
Formally, this feasible set showing the total cost of holding the Inventories can be calculated as follows:

$$p_{(Qi)}Q_i + p_{(Ti)}T_i = CoI \leq CoI_{Max}$$

where $P_{(Qi)}$ stands for the price of the unit of inventories related to stock volumes and $P_{(Ti)}$ represents the price of the unit of inventory related to time.[57]

As can be seen on the following figure, the Feasible set is a triangular area determined by the level of CoI_{Max} from "the top" and Operational area $[Q_{iMin};T_{iMin}]$ x $[Q_{iMax};T_{iMax}]$ described above from "the bottom".

Figure 10: Feasible set



Source: Author

[56] For the purpose of this analysis, CoI includes just the cost related to holding of inventories, not including the inventory value itself.

[57] $P_{(Qi)}$ is the compound measure most commonly represented by combination of the prices of transportation, warehousing and handling per square or cubic meter or palette based on the nature of the inventory. $P_{(Ti)}$ represents the compound measure too, capturing the time aspect of the inventory, (e.g. for how long is the product stored), including speed of transportation (air freight vs. ground shipping), price for the unit of time the goods are stored, etc.

The upper boundary of the Feasible set, named Inventory Cost Line (ICL) can be defined by the simple modification of CoI definition as:

$$T_i = CoI_{Max} / p_{(Ti)} - p_{(Qi)} Q_i / p_{(Ti)}$$

and its slope thus as:

$$\left.\frac{dT_i}{dQ_i}\right|_{CoI\ const.} = -\frac{p_{(Qi)}}{p_{(Ti)}}$$

2.3.3.3. Duality in decision making

This chapter analyses how the ownership of S&OP process impacts the internal decision making and thus ultimately also the outcomes of the process reflected in the certain level of product availability for Sales and thereof derived inventory holding costs.

Decision about the optimal level of inventories – Sales owning the S&OP process

In case that Sales has the major decision making power in the S&OP process, they would be trying to maximize the level of their utility by increasing the PA until the maximum possible CoI are reached.

Taken into consideration the assumptions mentioned in the previous two sections, the problem of choosing the most preferred mix of Q_i and T_i would be than formalized as follows:

$$\max u\,(Q_{i,}T_i);\ s.t.\ p_{(Qi)}Q_i + p_{(Ti)}T_i = CoI \le CoI_{Max};\ (Q_i, T_i) \in [Q_{i\,\mathrm{Min}}, Q_{i\,\mathrm{Max}}]\ \mathrm{x}\ [T_{i\,\mathrm{Min}}, T_{i\,\mathrm{Max}}]$$

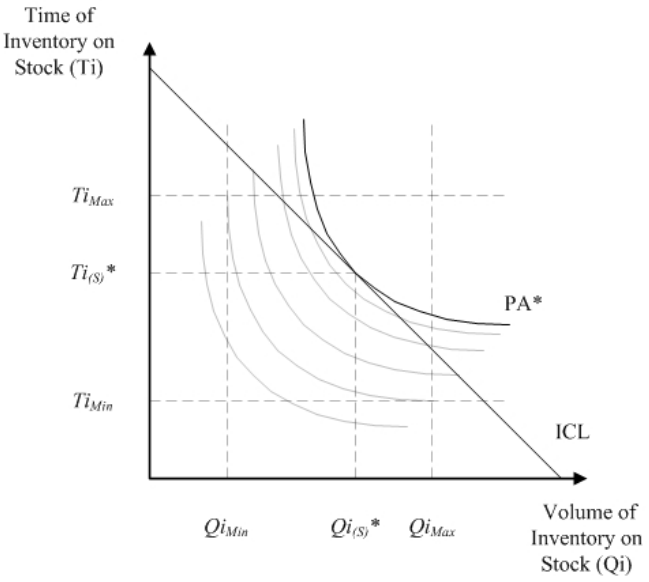
Based on these assumptions, the preferences of Sales about the optimal levels of product availability (PA) are represented by Sales utility function $u_{(S)}$ with indifference curves such as on the Figure 11. As both Q_i and T_i are positively related to PA and thus have positive marginal utility for Sales, the combinations of Q_i and T_i lying on higher indifference curves will be preferred to those on lower ones. This, together with assumption of Non-satation of preferences will result in

using the maximal level of CoI when maximizing $u_{(S)}$. Thus the combination of Q_i and T_i on the ICL will be chosen.

On displayed on Figure 11, the optimal combination of Q_i^* and T_i^* is a tangency solution, where the highest attainable indifference curve is tangent to ICL. In this point, slope of indifference curve is equal to the slope of ICL:

$$\left.\frac{dT_i}{dQ_i}\right|_{u\ const.} = \left.\frac{dT_i}{dQ_i}\right|_{CoI\ const.}$$

Figure 11: Optimal solution – Sales



Source: Author

Using the assumptions of strictly quasi-concavity of utility function and the characteristic features of feasible set (convex, non-empty, closed and bounded), we can derive that the optimization problem has a unique solution and there are no other non-global local solutions.[58]

In order to calculate the optimal levels of Q_i^* and T_i^* we define the Lagrange function derived from the formalization of optimization as stated above as:

[58] For more information see e.g. Gravelle, Rees; Appendixes A-D.

$$L(Q_i, T_i, \lambda) = u_{(S)}(Q_i, T_i) + \lambda(CoI - p_{(Q_i)}Q_i - p_{(T_i)}T_i)$$

And the first-order conditions for optimized solution are:

$$\frac{\partial L(Q_i*, T_i*, \lambda*)}{\partial Q_i} = \frac{\partial u_{(S)}(Q_i*)}{\partial Q_i} - \lambda p_{(Qi)} = 0$$
$$\frac{\partial L(Q_i*, T_i*, \lambda*)}{\partial T_i} = \frac{\partial u_{(S)}(T_i*)}{\partial T_i} - \lambda p_{(Ti)} = 0$$
$$\frac{\partial L(Q_i*, T_i*, \lambda*)}{\partial \lambda} = CoI_{Max} - p_{(Qi)}Q_i* - p_{(Ti)}T_i* = 0$$

The third condition again reminds us, that the maximal target level of inventory cost will be reached. After a few numerical adjustments, we are getting the following equation:

$$\frac{\frac{\partial u_{(S)}(Q_i*)}{\partial Q_i}}{\frac{\partial u_{(S)}(T_i*)}{\partial T_i}} = \frac{MU_{(Qi*)}}{MU_{(Ti*)}} = \frac{\lambda * p_{(Qi)}}{\lambda * p_{(Ti)}} = \frac{p_{(Qi)}}{p_{(Ti)}}$$

where “MU” stands for Marginal Utility for Sales from additional unit/time of inventory at stock. The equation also reveals that in equilibrium, the ratio of marginal utilities of Q_i* and T_i* is equal to their prices.

So far, we have been dealing with finding the optimal mix of Q_i and T_i under the assumption that Sales is the main decision making authority regarding the choice of the level of PA. In other words, we assumed that Sales drives the S&OP process. In the extreme case it would mean that Sales would take the maximum level of CoI (CoI_{Max}) as given, and move alongside Inventory Cost Line trying to find the common point on the highest indifference curve, i.e. the highest level of PA. It represents the application of Theory of consumer, where the consumer in order to assess the effects of price and income changes on his Marshallian demand function (here $D_{(S)}(p_{(Qi)}, p_{(Ti)}, CoI)$), tries to find the optimal combination of goods that would maximize his utility.

The optimal level of $PA_{(S)}^* = (Q_{i(S)}^*, T_{i(S)}^*)$[59] obtained from the optimization described above is at the given preference ordering the vector of values of functions *p* and *CoI*.:

$$Q_{i(S)}^* = D_{Qi}(p, CoI)$$

$$T_{i(S)}^* = D_{Ti}(p, CoI).$$

Putting these optimized values into original utility function $u_S(PA)$ we obtain:

$$u_{(S)}(PA^*) = u_S(Q_{i(S)}^*, T_{i(S)}^*) = u_S(D_{Qi}(p, CoI), D_{Ti}(p, CoI)) = v_{(S)}(p_{(Qi)}, p_{(Ti)}, CoI)$$

The function $v_{(S)}(p,CoI)$ can be recognized as Indirect utility function of Sales and captures the maximized value of u_S^* as a function of *p* and *CoI*.

The situation when commercial functions like Sales or Marketing are driving forces of the S&OP process will be more applicable for the companies selling highly profitable products, where the financial impact of the loss of sales outweighs the risk of higher inventory costs, therefore there is higher pressure on product availability. Chapter of optimal S&OP ownership following the business model is further discussed in Chapter 2.4.3.1. of this thesis.

Decision about the optimal level of inventories – Supply Chain owning the S&OP process

Different approach to the solution of the presented optimization problem would be applied, if the main driving part of S&OP process would not be Sales, but Supply Chain. This would appear most likely in the cases of more "cost driven industries" with relatively smaller profit margins or where the costs of holding the inventories have relatively more significant negative impact on profits.

In such situations, Supply Chain would take the preference ordering of Sales as given and they would be looking for the cheapest way of how to achieve certain minimum level of PA. In other words, by finding the optimal solution, it would move alongside given indifference curve looking for the common PA point[60] lying at the lowest possible Inventory Cost Line. We would be dealing with

[59] (S) stresses that the optimal level of PA is from Sales point of view.
[60] Meaning the common combination of Qi and Ti

dual optimization problem to that described in previous chapter. Formally, we can write it as:

$$\min\left(p_{(Qi)}Q_i + p_{(Ti)}T_i\right);\ 1)\ u_{(S)}(PA) \geq u^0_{(S)},$$
$$2)\ (Q_i, T_i) \in [(Q_{i\,Min}Q_{i\,Max}), (T_{i\,Min}, T_{i\,Max})] \in R^2$$

If again, we describe $Q_{i(SC)}$* and $T_{i(SC)}$*, which are the outcomes of the optimization, as the functions of their constrains *p* and *u*, we get the Hicksian demand functions as we know from the Theory of consumer:

$$Q_{i(SC)}^* = H_{Qi}\,(p_{(Qi)}, u_{(S)})$$

$$T_{i(SC)}^* = H_{Ti}\,(p_{(Ti)}, u_{(S)}).$$

Similarly to the previous case, putting these optimized values into the formula describing Inventory Cost Line, we obtain analogically optimized value of CoI* as a function of *p* and *u*:

$$CoI_{(SC)}^* = p_{(Qi)}Q_{i(SC)}^* + p_{(Ti)}T_{i(CS)}^*$$
$$= p_{(Qi)}H_{Qi}(p_{(Qi)}, u_{(S)}) + p_{(Ti)}H_{Ti}(p_{(Ti)}, u_{(S)}) = m_{(SC)}(p_{(Qi)}, p_{(Ti)}, u_{(S)})$$

Applying again the analogy from the Theory of consumer[61] , this function may be named Inventory expenditure function. Using the standard optimization tools, the Lagrange function can thus be defined further as follows:

$$L(Q_i, T_i, \mu) = p_{(Q_i)}Q_i + p_{(T_i)}T_i + \mu(u^0_{(S)} - u(Q_i, T_i)$$

And the first-order conditions for optimized solution are:

$$\frac{\partial L(Q_i^*, T_i^*, \mu^*)}{\partial Q_i} = p_{(Qi)} - \mu\frac{\partial u(Q_i^*)}{\partial Q_i} = 0$$
$$\frac{\partial L(Q_i^*, T_i^*, \mu^*)}{\partial T_i} = p_{(Ti)} - \mu\frac{\partial u(T_i^*)}{\partial T_i} = 0$$
$$\frac{\partial L(Q_i^*, T_i^*, \mu^*)}{\partial \lambda} = u_S^0 - u_S(Q_i^*, T_i^*) = 0$$

[61] In the Theory of consumer, such function is called Expenditure function

Analogically to the situation when Sales was driving the S&OP, solving of these equations would lead to similar results, i.e. that in optimum, the ratio between marginal utility of Qi and Ti for equals to the ratio of $p_{(Qi)}$ and $p_{(Ti)}$:

$$\left.\frac{dT_i^*}{dQ_i^*}\right|_{CoI\ const.} = -\frac{p_{(Qi^*)}}{p_{(Ti^*)}} = \left.\frac{dT_i^*}{dQ_i^*}\right|_{u(SCF)=u(SCF^*)} = -MRS_{QT} = \frac{\frac{\partial u(Q_i^*)}{\partial Q_i}}{\frac{\partial u(T_i^*)}{\partial T_i}} = \frac{MU_{(Qi^*)}}{MU_{(Ti^*)}}$$

2.3.3.4. Set-up of S&OP and its impact on the PA and CoI

Based on the outcomes of previous chapters it might seem, that it does not make any difference from the view of the optimal level of Q_i^* and T_i^* and thus of PA and CoI, whether the main decision making power in S&OP is Sales or Supply Chain. However, this difference will become visible:

a) when we examine the impact of changes of prices $p_{(Qi)}$ and $p_{(Ti)}$ on optimal choice of Q_i and T_i or

b) when we look at the setting of constrains for optimizations.

Changes in prices – Sales owning the S&OP process

As mentioned above, for any given combination of prices reflected in the inventory holding costs (CoI) and for any given preference ordering representing specific product availability (PA) and thus utility for Sales, certain optimal combination of Q_{i1}^* and T_{i1}^* could be derived. This optimal combination would be the same irrespective of application of Marschallian or Hicksian demand functions known from the Theory of consumer. Thus in optimum:

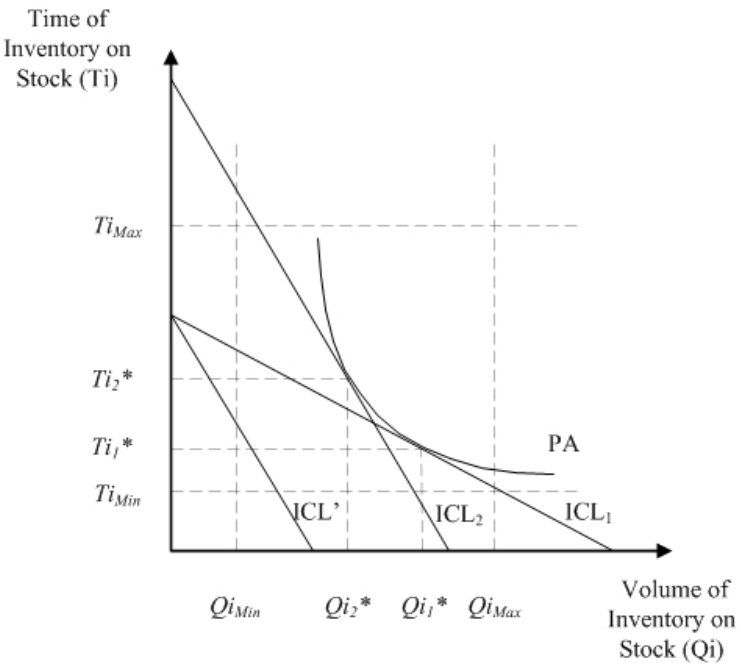
$$H_{Qi}(p_{(Qi)}, u_S) = Q_{i(SC)}^* = Q_{i(S)}^* = D_{Qi}(p_{(Qi)}, CoI)$$

$$H_{Ti}(p_{(Ti)}, u_S) = T_{i(SC)}^* = T_{i(S)}^* = D_{Ti}(p_{(Ti)}, CoI)$$

However, as outlined on Figure 12, with the change of any of the prices (on the example the increase of $p_{(Qi)}$ and thus the rotation of ICL_1 to ICL'), with no

change in the level of required $u_{(S)}(PA)$, the Inventory cost line will slice up[62] on the indifference curve from ICL_1 to ICL_2.[63]

Figure 12: Changes in prices – PA Fixed



Source: Author

Although the new optimal combination of Q_{i2}* and T_{i2}* brings the same utility for Sales – the new optimum lies on the same indifference curve represented by unique level of PA – the total costs of inventories have changed. This situation would occur if Sales would be the dominating function in the S&OP process in the firm, so that despite the changes of price constrains, it would still be able to justify the need for unchanged level of total product availability.

In the specific example displayed in the Figure 12, the increase of $p_{(Qi)}$ that could be a consequence for example of the increase of unit storage costs, should result in the relative substitution of volume (Q_{i2}* < Q_{i1}*) for timing inventory flexibility (T_{i1}* < T_{i12}*).

[62] In case of the decrease in price $p_{(Qi)}$, the ICL would slice down the PA*.
[63] The slope of ICL_2 is given by the ration of $p_{(Ti)}$ to $p_{(Qi)}$ and is the same as the slope of ICL'.

Applying the microeconomic Theory of consumer again, the precise calculation of the change of optimized expenditures on inventories $m_{(SC)}(p_{(Qi)}, p_{(Ti)}, u_S)$ with the price change can be made by using Shephard's lemma[64] as follows:

$$\frac{\partial m_{(SC)}}{\partial p_{(Qi^*)}} = H_{Qi}(p,u) = Qi^* \qquad \text{for the change of } p_{(Qi)} \text{ or}$$

$$\frac{\partial m_{(SC)}}{\partial p_{(Ti^*)}} = H_{Ti}(p,u) = Ti^* \qquad \text{for the change of } p_{(Ti)}.$$

Application of Shephard's lemma may serve also as a practical tool for analysis and can be interpreted as follows: the necessary additional expenditures for inventories to keep the original level of desired PA* after the increase of $p_{(Qi)}$ or $p_{(Ti)}$ represents such an increase of targeted CoI, that would enable the company to keep the same amount of *Qi* and *Ti* as before the price change.

Practical application of Shephard's lemma: Let's assume that the company has contracted a storage capacity of100 units of product (Q_i) for 50 EUR/unit ($p_{(Qi)}$) and the warehouse provider increased the prices related to storage volumes by 10%, i.e. to 55 EUR ($\Delta p_{(Qi)}$ = 5 EUR). Company optimizing cost structure while still keeping the same level of PA, would reduce the volume related flexibility in favor of timing related flexibility and would contract less space for longer time periods.

According to Shephard's lemma, it may be estimated in rough calculation that the increased costs necessary to keep the original level of PA (utility for

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64

Proof:

$$\frac{\partial m_{(SC)}}{\partial p_{(Qi^*)}} = \frac{\partial (p_{(Qi)} H_{Qi}(p,u) + p_{(Ti)} H_{Ti}(p,u))}{\partial p_{(Qi)}} = \left[p_{(Qi)} \frac{\partial H_{Qi}(p,u)}{\partial p_{(Qi)}} + p_{(Ti)} \frac{\partial H_{Ti}(p,u)}{\partial p_{(Ti)}} \right] + H_{Qi}(p,u)$$

As $Qi^* = H_{Qi}(p,u)$; $Ti^* = H_{Ti}(p,u)$ and from the first order conditions in optimum:

$p_{(Qi)} = \mu \frac{\partial u(Qi^*)}{\partial Qi}$; $p_{(Ti)} = \mu \frac{\partial u(Ti^*)}{\partial Ti}$ and as *u* is set as constant, we get the following equation:

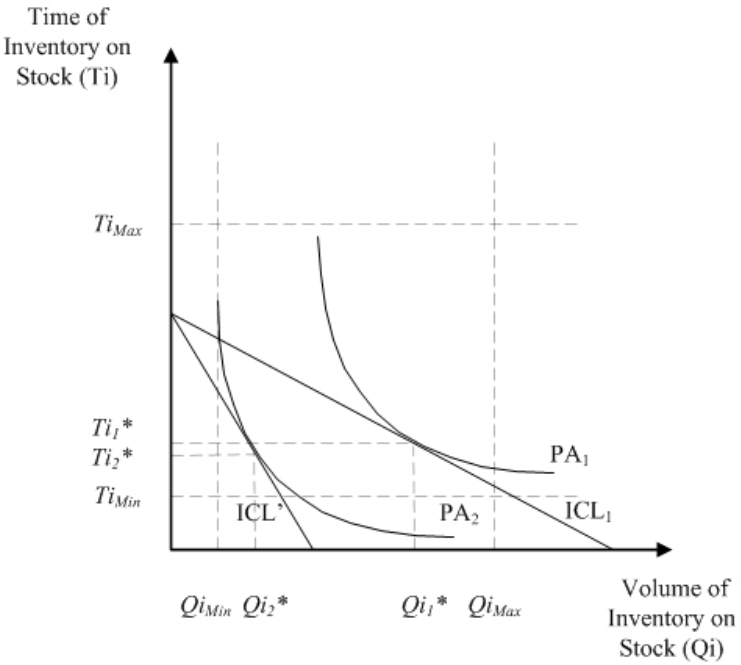
$$\frac{\partial u(Qi^*)}{\partial Qi} \frac{\partial H_{Qi}(p,u)}{\partial p_{(Qi)}} + \frac{\partial u(Ti^*)}{\partial Ti} \frac{\partial H_{Ti}(p,u)}{\partial p_{(Ti)}} = 0 \text{ and thus } \frac{\partial m_{(SC)}}{\partial p_{(Qi^*)}} = Qi^* \text{ and } \frac{\partial m_{(SC)}}{\partial p_{(Ti^*)}} = Ti^*$$

Sales) corresponds to such increase of expenditures that would enable the company to keep the goods in the warehouse for the same period of time (T_i) in the same amount (Q_i) after the price change. The estimated cost increase would thus be $\Delta CoI^* \simeq Q_i * \Delta p_{(Qi)} = 100 * 5 = 500$ EUR[65].

Changes in prices – Supply Chain owning the S&OP process

Different situation would occur in case that Supply Chain would be the leading function in the S&OP process. In such case, for the same price change but with keeping the constant level of CoI, the new optimal mix of Q_{i2}^* and T_{i2}^* would lead to the same level of CoI. However, PA and the respective utility for Sales determined by it would decrease respecting the preference ordering of Sales as displayed on Figure 13. This situation would represent the second optimization problem outlined in the previous chapter.

Figure 13: Changes in Prices - CoI fixed (1/2)



Source: Author

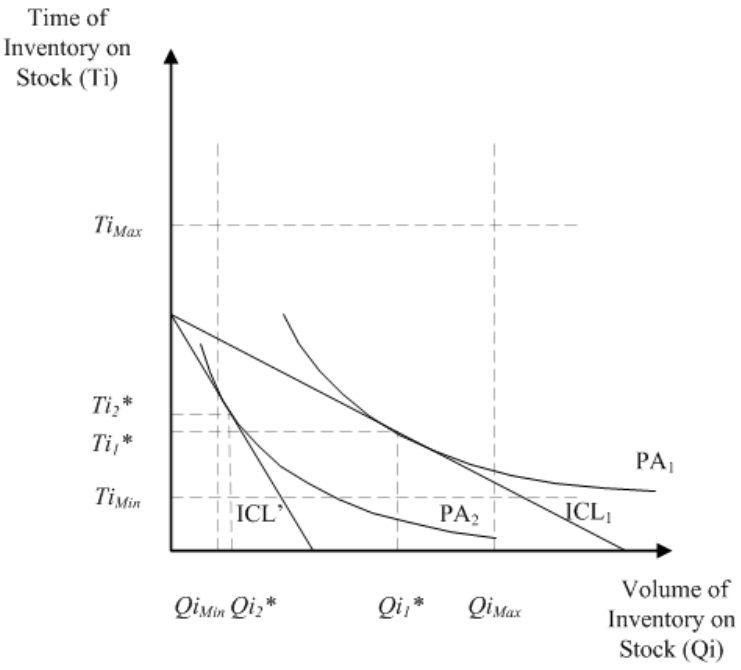
[65] In order to keep the same level of utility for sales would be for marginal changes in prices needed lower change of expenditures due to concave characteristics of expenditure function.

Practical implication: If the fundamental prerequisite would be to keep the cost of inventory holding constant irrespective of the effect on the potential decline of PA, increase of price related to volumes of inventory holding would according to the example outlined on Figure 13 lead to relatively more significant drop of volume related flexibility and minor decrease of timing related flexibility. In other words, Sales would have to sacrifice certain volume portion of their safety stocks.

The split of impact on volume and timing flexibility would depend on the particular preferences relation of Sales in relation to Q_i and T_i, i.e. on the slope of indifference curve(s) representing the level of PA.

In case of different preference settings, e.g. when Sales would favor timing flexibly much more than volume flexibility, the increase of volume related inventory holding costs (increase of $p_{(Qi)}$) could result in relatively higher decrease in volume flexibility and potentially even the increase of timing flexibility comparing to previous example. This situation is outlined on the as shown on the Figure 14.

Figure 14: Changes in Prices - CoI fixed (2/2)



Source: Author

Changes in the constrains

Probably even more than with external changes in prices related to inventory holding, the differences in the "process ownership set-up" of S&OP and their impact on chosen PA and CoI are visible when dealing with changes in initial constrains of required CoI or PA. In case when Supply Chain would drive the process, in general, it will tend to set the CoI so that it will lead to lower levels of Q_i and T_i focusing on costs aspects of inventory holding. Contrary to that, in case when Sales would be the main decision making party, it will tend to set the PA level as high as possible even at the higher costs.

This has a rationale in different target and incentive setting described in the previous chapters. Thus in the most extreme case, Supply Chain would set CoI on the level of Qi_{min} and Ti_{min} and Sales on the level of Qi_{max} and Ti_{max}.

However, in most cases the optimal solution would be subject to negotiations between the two functions and would lie somewhere in between the two extremes within Operational area shown previously on Figure 9.

The difference in costs directly related to inventories by having solely Sales or solely Supply Chain deciding about the level of PA or CoI can be calculated as follows:

$$\Delta CoI = p_{(Qi)}(Q_{i(S)}-Q_{i(SC)}) + p_{(Ti)}(T_{i(S)}-T_{i(SC)})$$

Assuming that:

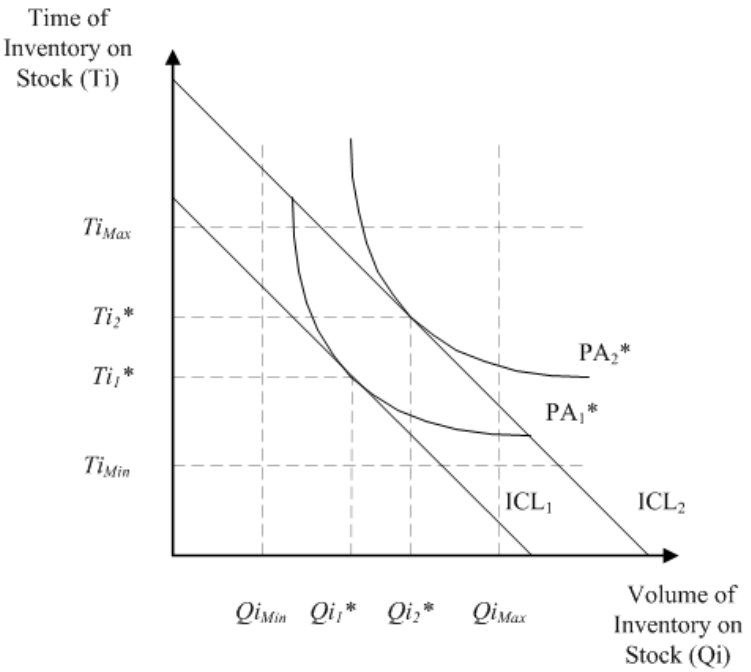
$$0<Q_{iMin} \leq Q_{i(SC)} \leq Q_{i(S)} \leq Q_{iMax}\ ;\ Q_i \in R^+$$

$$0<T_{iMin} \leq T_{i(SC)} \leq T_{i(S)} \leq T_{iMax}\ ;\ T_i \in R^+.$$

Practical implication: In praxis, the higher the difference in the understanding of the optimal levels of inventory flexibility between Sales and Supply Chain, the higher are the potential risk and costs implications in case that one of the two functions would completely own the decision making within S&OP process. In such case, keeping external factors as prices constant, the change (in the shown

case increase) of required PA by Sales[66] would lead to the change in Q_i^* and T_i^* as shown on Figure 15. This could be an example the result of deteriorating forecast accuracy or new product launch. In such cases, less accurate planning reflecting more uncertainty regarding future sales demand would be reflected in the need of maintaining relatively higher levels of inventory flexibility, i.e. safety stocks. The increase of CoI represented on the Figure 15 by the shift on ICL would follow. Such case with full impact on costs would be applied if Sales would be the dominating decision making power in inventory decisions.

Figure 15: Change in PA



Source: Author

If Supply Chain would be the leading function within S&OP process and the situation with the need of CoI reduction would appear, analogically, the full impact will be beard by Sales in form of deterioration of their product availability.

Following the described examples, similarly to the case with changes in prices, it is possible to apply the tools of microeconomic analysis to calculate:

[66] i.e. as a result of management decision do decrease the service levels towards customers in order save capital costs (no that much product "on hand" needed).

1. the impact of the change in desired PA by Sales on the inventory holding costs, i.e. the impact of the change in $u_{(S)}$ on $m_{(SC)}(p,u)$ as follows[67]:

$$\frac{\partial m_{(SC)}(p,u)}{\partial u_{(S)}} = \mu^*$$

This feature is telling us, that the rate of the change of minimized expenditures on inventories with the change of desired utility equals Lagrange multiplier μ^* from the cost minimization exercise described in Chapter 2.3.3.3.

2. the impact of the change of target CoI by Supply Chain on the utility for Sales, i.e. the impact of the change in CoI on vS(p, CoI) as follows[68]:

$$\frac{\partial v_{(S)}(p,CoI)}{\partial CoI} = \lambda^*$$

The rate of the change of maximized utility for Sales with the change of target CoI equals Lagrange multiplier λ^* from the utility maximization exercise described in Chapter 2.3.3.3.

The examples above clearly demonstrate that the set-up of S&OP process from the perspective of empowerment of different stakeholders in terms of decision making might have significant impact on product availability and thereof derived inventory holding costs. Moreover, the varying financial effects of such set-ups are evident also during the changes of companies' external price conditions[69] or internal factors as cost budgets.

---

[67] Proof:

$$\frac{\partial m_{(SC)}(p,u)}{\partial u_{(S)}} = \frac{\partial (p_{(Qi)} H_{Qi}(p,u) + p_{(Ti)} H_{Ti}(p,u))}{\partial u_{(S)}} = p_{(Qi)} \frac{\partial H_{Qi}(p,u)}{\partial u_{(S)}} + p_{(Ti)} \frac{\partial H_{Ti}(p,u)}{\partial u_{(S)}}.$$

$Q_i^* = H_{Qi}(p,u)$; $T_i^* = H_{Ti}(p,u)$. From the first order conditions in optimum: $p_{(Qi)} = \mu \frac{\partial u(Q_i^*)}{\partial Q_i}$;

$p_{(Ti)} = \mu \frac{\partial u(T_i^*)}{\partial T_i}$. By substituting it to the first equation we receive:

$$\frac{\partial m_{(SC)}(p,u)}{\partial u} = \mu \left[\frac{\partial u(Q_i^*)}{\partial Q_i} \frac{\partial H_{Qi}(p,u)}{\partial u} + \frac{\partial u(T_i^*)}{\partial T_i} \frac{\partial H_{Ti}(p,u)}{\partial u} \right] = \mu^* \frac{du}{du} = \mu^* \text{ (in optimum)}$$

[68] The proof is analogical to the previous case.

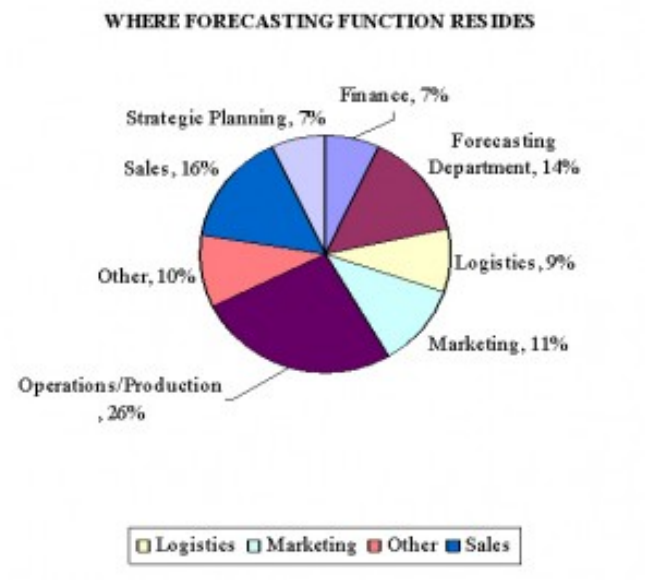
[69] We assume that the company does not significantly influence the development of $p_{(Qi)}$ and $p_{(Ti)}$.

2.3.4. Ideal set-up of S&OP ownership

Considering different implications of the volume and time aspects of safety stocks and thereof derived product availability as well as the resulting impact on inventory holding costs, there is no direct clear cut answer on who should be the leading function and formal owner of the traditional S&OP process in the firm. Although we can expect to achieve direct savings on costs related to inventories as a result of shift of the main decision making power to Supply Chain, we should not forget the contra effect of losing product flexibility for Sales. This may eventually lead to the indirect loss of sales and thus reduction or even full elimination the positive impact of savings on the bottom line performance of the company.

The dissidence in opinions are clear also from business forums dedicated to the topic of forecasting and planning and the outcomes of the surveys amongst companies' executives bringing diverse outcomes as outlined on the Figures 16 and 17.

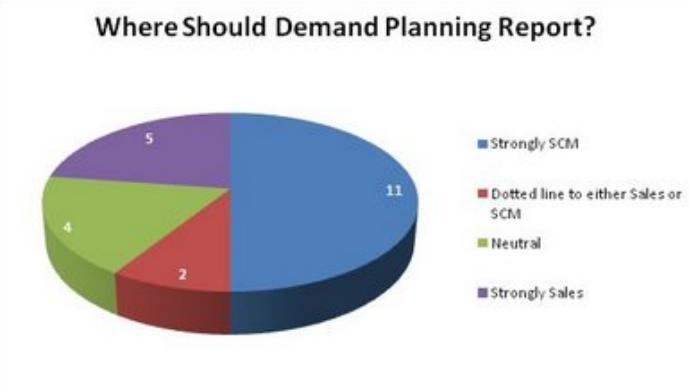
Figure 16: Residence of forecasting function



Source: Institute of Business Forecasting and Planning[70]

[70] Source: Institute of Business Forecasting and Planning (http://www.demand-planning.com)

Figure 17: Target group for demand planning reports



Source: Supply Chain Edge[71]

The decision about who should be the owner of the S&OP process would also depend on the nature of industry (gross margin or cost driven) and company's cultural and historical background (the position of Sales/ Supply Chain/ other functions in the company from historical perspective, etc.). As will be analyzed in more detail in the following chapters, it is more likely that business selling more innovative products by which they are able to realize higher profit margins will rather have the decision making power shifted more towards commercial functions, i.e. Sales or Marketing. Contrary, commodity businesses with string cost focus would most likely have the process favoring Supply Chain as the process owner.

Application of microeconomic theories and modeling enables us to better understand the specific incentives of individual parties involved within S&OP process. The optimization analysis helps to reveal the function-specific bias as well as to quantify the impacts of the changes in internal or external conditions on financials of the firm. One of the solutions of how to avoid or at least reduce this bias seems to be the establishment of independent department focusing of production planning and sales forecasting. However, this solution is feasible only within bigger companies that can afford to dedicate resources specifically to such function. A reasonable alternative for smaller companies could be setting of

[71] Source: Supply chain edge: http://scmedge.com/

neutral common goals and rewarding both Sales and Supply Chain also based on their achievement. As will be demonstrated in the following chapters of this work, further advancements of the traditional S&OP concept towards Integrated Business Planning represent the feasible combination of both approaches that is independent on the company size.

This chapter showed that the knowledge of microeconomic theories and related optimizing method can be successfully applied to explore the efficiency of setting of business processes. With the focus on one of the most important processes related to the operations of the company, the Sales and Operations Planning, it was demonstrated how important is appropriate split of the decision making power and process ownership in case that more parties with different interests and incentives are interacting. Even though the optimization tools do not directly provide with the clear cut answer in the problem of optimal setting of S&OP process, knowledge of the outcomes and impact of different alternatives can help firms to tailor the solution to their individual needs and specific conditions.

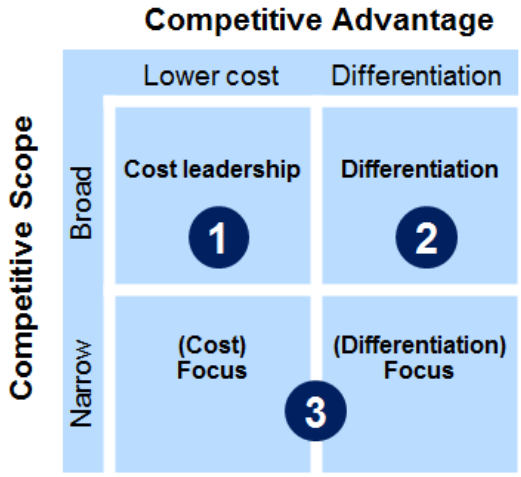
It is clear, that for the most of the business, ideal set-up of S&OP from the perspective of process ownership would lead somewhere between two extreme points described in previous chapters. In order to find out what set-up of the S&OP process makes the most sense from the business perspective, the analysis will be extended for the impact of company's strategy described in the following chapter and for the impact of different S&OP set-ups applied on the concept Value Based Management in Chapter 2.5.

2.3.5. S&OP set-up and company's strategy

Another perspective that should be taken into account when deciding about optimal set-up of S&OP and its ownership, is the general strategic focus of the firm. Porter in his classic work *Competitive Strategies* identifies three main strategic options open to any organization that wishes to achieve a sustainable

competitive advantage: cost leadership, differentiation and focus as displayed on the following figure.[72]

Figure 18: Porter's Generic Strategies



Source: Porter (2008)

Adopting Porter`s generic strategies view, three various the S&OP set-ups can be derived, each differing from each other from the key emphasis and ownership:

- Cost leadership
- Product differentiation
- Customer (relationship) focus.

Cost leadership

Businesses that follow cost leadership as strategy, managing supply plays the major role and the objective of the company is to supply the demand at the lowest possible costs. This corresponds more to the traditional approach to S&OP process, where Supply Chain had the dominant role in the decision making. The priorities in planning are set to eliminate the forecasting bias and improve the forecast accuracy. Other critical success factors include discipline in execution and control of operations, elimination of waste, continuous

[72] Porter (1998), p.34

improvement and reduction of layers in the organization. A single set of planning numbers in such environment represents an important pre-requisite to achieve effectiveness and efficiencies. Executive leadership in the process is in hands of Operations and possibly Finance. The main key performance indicators complementing forecast accuracy are focused on customer service, assets utilization and costs of inventories.

Product Differentiation

Company operating in a business environment where strategic focus is product differentiation, key role in S&OP process is held by Strategic marketing, Product management or Research & Development functions. Support from Sales, Finance and Supply Chain is important but secondary. Decisions being made within S&OP process are focusing on volume and margin growth and understanding further opportunities and risks. Scenario planning consisting of range of planning figures is thus more common that “one number principle”. Further emphasis is put on strategic marketing, success of new product launches, filling of pipelines, minimization of obsolescence and portfolio management. Supply Chain is expected to deliver high levels of responsiveness and flexibility due to the presence of higher forecast uncertainty and generally lower forecast accuracy levels. Key performance indicators are focused primarily on customer service, profitability, brand health and market shares.

Focus on customer relations

Customer Relationships are of strategic focus for the businesses where it is believed that customer segmentation and tailor made products and services are critical to success. In such cases, sales represented by key account managers with the main focus on revenue growth should be the key driver of S&OP process with the strong support of Marketing, Finance and Supply Chain. Similarly to product differentiation, understanding of risks and opportunities is important and it is leading to scenario planning, rather than focus on one set of numbers. Emphasis is further put on promotional activities and timely introduction

of product line extensions. High levels of customer service and responsiveness at minimum cost are standard expectations. Principal targets include customer retention, customer penetration, revenue and profit by customer/channel.

The following table summarizes the key elements and characteristics of S&OP for each of the generic strategies.

Figure 19: S&OP ownership following different strategic focus

Generic strategy	Focus	Leading business function	Key Performance Indicators
Cost Leadership	• One number principle for supply • Volume • Costs • Inventory minimization	• Supply Chain/ Operations • Finance	• Forecast accuracy • Redution of forecast bias • Inventory turns • Asset ustilization
Focus on customer relations	• Sales planning • Impact of promotions • Customer segmentation • Risk and opportunities management • Revenue growth	• Sales • Supply Chain/ Operations	• Customer retention • Customer revenue/ profitability • Inventory turns • Delivery reliability
Product/ Service Differentiation	• Scenario planning • Product development • Portfolio management • Risk and opportunities management • Profit growth	• Marketing	• Profitability and revenue growth from new products • Brand value and health • Time-to-market • Inventory obsolence

Source: Author

Understanding the general strategic focus of the company is critical before embarking on S&OP implementation. Getting this clarity will prevent the adoption of “one-size-fits-all” concept where by default the strategy is misrepresented by operational excellence. Especially for businesses utilizing customer focus or product/service differentiation as main strategies, there will be lack of motivation for Marketing, Sales, Finance or Business management to spend their time and efforts to discuss volume and cost implication for value and margin driven businesses.

Even in many companies today, strategy is represented by operational excellence. However, operational excellence is not really a strategy; it’s a

necessary discipline and an important element of cost leadership. Improving operational effectiveness is necessary to achieving superior profitability, but in general it is not sufficient.

2.3.6. From traditional S&OP to Integrated Business Planning (IBP)

In the past four decades, challenges brought by increased complexities resulting from ongoing globalization of economy and rising competitive pressures forced companies to abandon the traditional view of "independent planning processes". These conventionally existed in parallel in the organizations, were owned by different business functions and were lacking structured reconciliation and alignment.

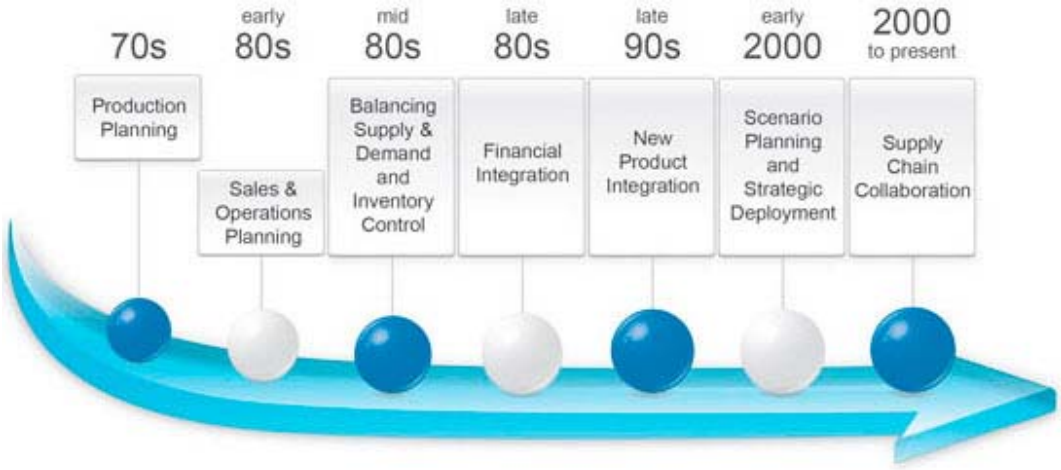
Although the first concepts of structured production planning appeared as early as in the beginning of 1960's when Joseph Orlicky[73] studied the Toyota's Manufacturing Program and developed a Material Requirements Planning (MRP) and later MRP II[74] , it was the concept of S&OP came out as a first significant step forward in terms of alignment of planning activities cross multiple key business functions.

It is difficult to assign clear ownership of the concept to any single company as many firms started to experiment with the concept in response to growing operational challenges. However, the main credit should probably to consultancy firm Oliver Wight that summarized their experiences and best practices into structured S&OP concept in early 1980's. Since the last decades of previous century, however, business environment has changed what created additional pressures on companies to streamline their internal processes. As a result, S&OP has evolved over the last 30 years from industry best practice to industry standard practice and reshaped its content and focus from predominantly production planning to a company-wide management process, recognized today more and more often under the term Integrated Business

[73] See.: Orlicky (1975)
[74] Bringing also master scheduling, rough-cut capacity planning, capacity requirements planning and other concepts to classical MRP

Planning (IBP) or Integrated Business Management (IBM). Figure 20 outlines the development path of S&OP over the past four decades.

Figure 20: Evolution of Integrated Business Planning[75]



Source: Oliver Wight

According to Oliver Wight, a properly implemented IBP process routinely reviews the current and projected business performance starting with the review of strategy, updated portfolio changes, updated customer demand, required supply resources and resulting financial effect.[76] The traditional view of S&OP as the process merely balancing supply and demand is thus long obsolete.

Oliver Wight further defines the following points that differentiate IBP from traditional S&OP[77]:

- More robust financial integration
- Inclusion of strategic plan and strategic initiatives
- More robust product and portfolio review
- Improved simulations and modeling of scenarios
- Improved operational risk visibility and management

[75] Adopted from Oliver Wight (2010), p.1. http://www.oliverwight-eame.com/en-GB/integrated-business-planning/transition-from-sop
[76] IBP/S&OP: An executive level synopsis, Oliver Wight white paper series, http://www.oliverwight-americas.com/proven_path/papers_null.htm
[77] Adopted from Oliver Wight presentation on Integrated Business Planning Summit, IE Group, Zurich, March 2011

- Gap identification
- Improved decision making
- Easy and effective translation between aggregate and detailed level
- Improved trust across entire management team

According to Aberdeen Group, "the key difference between S&OP and IBP is that IBP involves extensive collaboration between the various roles of the organization and enables the unification of business goals and strategies rather than just being a functional supply chain process".[78]

According to Ling and Goddard, there are the following three major barriers of top executives that are hampering effective management of S&OP process[79] and thus shifting towards IBP - bias towards one department, fear of detail and lack of understanding.

Bias towards one department

As displayed in previous chapters, bias towards one department have and dominating position if one function within the process has significant implications on the management of product flexibility impacting the top as well as the bottom financial line of the company. Moreover, any biases instantly breed resentment and divisive atmosphere which are guarantees that the planning process will be short-circuited.

This shortcoming can be also overtaken by proper split of roles and responsibilities of different business functions within the process and via the set-up of proper incentive system. Typical deficiency that occurs in many companies is the misalignment between the expected role of each function in the process and in the split of individual targets. As example, commercial functions that are supposed to be the key input driver of the S&OP/IBP process are commonly being evaluated purely on the basis of sales performance, with Supply Chain function being responsible for forecast accuracy measures. As a result, Sales will

[78] Aberdeen Group (2008), p. 4
[79] Adopted from Ling, Goddard (1995), p.46

have the tendency to overestimate the demand to be sure it has enough flexibility of products on hand, while the forecast manager (Supply Chain) is being later "punished" for low demand forecast accuracy levels.

Fear of detail

Top management prefers the summarized data and the information being handled within S&OP process are being handled as too detailed. This is the typical shortcoming of traditional S&OP that can be overcome by effective set-up of monthly IBP process that is discussed in more detail further in Chapter 2.4.2.. Similarly to the previous situation the idea behind IBP is to assign clear roles and responsibilities for different part of the process to different business functions according to their core competencies. Top management is involved within the final stage of the monthly review cycle when it is being presented with key outcomes of the previous, more detailed evaluation of company's historical and future sales development. It is than the task of management to sort out key disputes or decide on the major trade-offs or scenarios.

Lack of understanding of the process

Some general managers never really understand the benefits of proper S&OP because they haven't taken the time or initiative to learn about its individual mechanics, let alone the process as a whole. Sadly, they will neither be able to gain full control over the business nor manage the change. Understanding the benefits of IBP and the involvement of key decision makers in the company in the process is the key prerequisite for IBP implementation that will be further discussed in Chapters 2.6 and 3.

Another way of capturing the evolvement of IBP from S&OP has been proposed by Aberdeen Group.[80]

[80] Aberdeen Group Research Brief on Maturity levels of S&OP, May 2011, www.aberdeen.com

It describes various maturity levels of executive S&OP as outlined on the Figure 21.

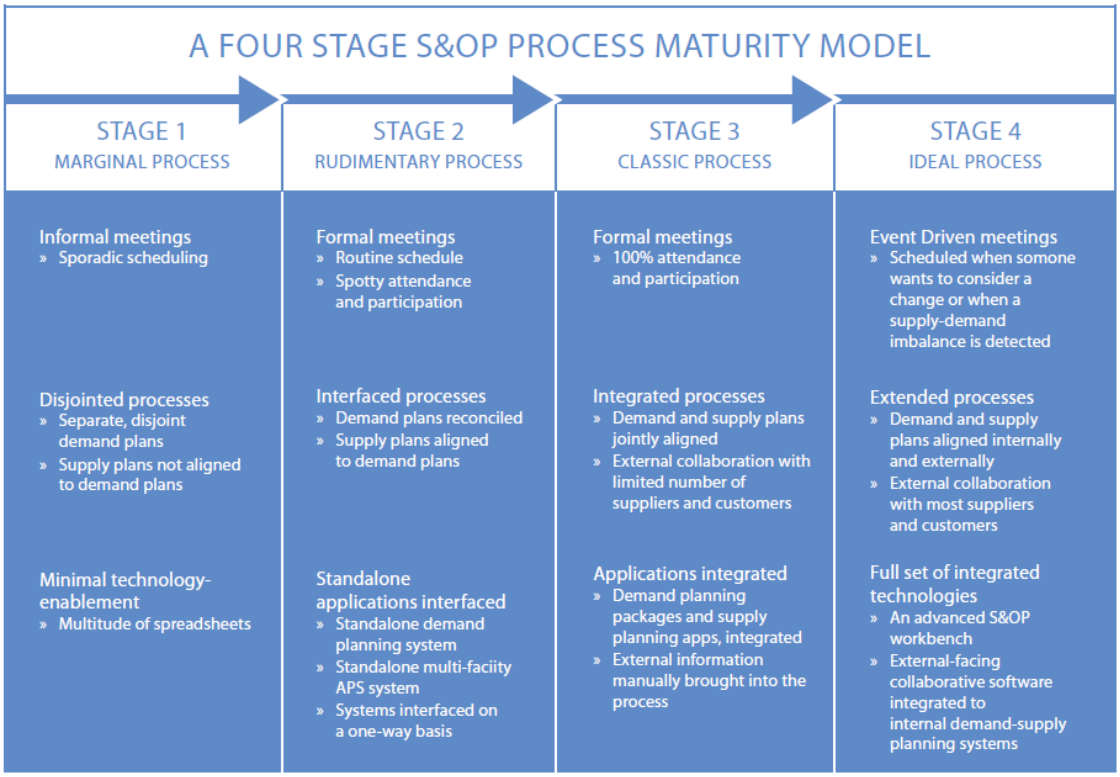
Figure 21: Executive S&OP levels of maturity by Aberdeen

	Level I	Level II	Level III (IBP)
Process	S&OP process is ad-hoc, with disparate data sources and there is not a single demand number based on which the company performs. Top-down forecast is not tied to the plan and there is no formal process.	S&OP process is more refined with some level of data synchronization and organizational mandates to arrive at a single demand number out of which company executes.	It is true integrated business planning process where all the organizations involved work collaboratively to arrive at a single demand number out of which the company executes. Margin and revenue focus.
Organization	S&OP process is non-standardized across different departmens – no clear ownership of the process.	S&OP process is standardized across different departments with one of the departments taking process ownership.	Collaborative balanced cross-functional team takes ownership of the IBP process. Finance organization is playing a more leadership role in the process.
Knowledge	Pockets of information known at different departments. No sharing of information across departments.	Some level of sharing information across departments, however there are still internal barriers to overcome like corporate politics and lack of cross functional focus.	Information available instantaneously to all parties with corss-functional interdepartmental focus.
Technology	Usage of spreadsheets for enabling S&OP process or non-integrated technolgy tools.	Individual demand and supply planning modules not integrated to each other.	Executive-level what-if analysis capability along with integrated supply and demand planning modules with ability to optimize on financial metrics.
Measurement	Basic measurements like forecast accuracy, capacity utilization owned by individual departments.	More advanced measurements like forecast accuracy at individual SKU level, family level, lead-times measured and owned by individual departments but shared with organization.	Cross functional metrics like order fill rate, supply/demand match, gross margin measured and monitored as part of S&OP process.

Source: Aberdeen Group

Figure 22 outlines the evolution of concept from traditional S&OP towards IBP on the example of four stage S&OP maturity model developed by Lapide.[81]

Figure 22: S&OP maturity model according to Lapide



Source: Lapide (2005)

Viswanathan[82] further recognizes between the following five main areas that differentiates S&OP from IBP – Business objective, Process, Technology, Frequency and Focus – as displayed on the Figure 23.

The main distinguishing factor between traditional S&OP and IBP is that the objective of the planning process has moved from qualitative measures and focuses on the deeper evaluation of value, i.e. the financial implications on hand hand and that it extends the internal collaboration also for external customers and suppliers on the other.

[81] Lapide (Spring 2005)
[82] The Technology Strategies for Integrated Business Planning Benchmark Report, Nari Viswanathan , Aberdeen, July 2006

Figure 23: Differences between S&OP and IBP according to Aberdeen Group

Area	Traditional S&OP	Integrated Business Planning
Business objective	Supply/ demand balancing	Not simply about matching demand and meeting customer needs. Considers several plan alternatives and chooses one that best represents the business drivers. Objective is revenue and profit
Process	Rigid and prescriptive	Process is more rules and exceptions based
Technology	Weak and non-integrated	Technology enables the processes through workflows
Frequency	Monthly or quarterly	Still monthly in lot of cases but with ability to rapidly handle exception situations
Focus	Inward focused	Collaborative and outward focused

Source: Viswanathan (Aberdeen Group)

2.4. Integrated Business Planning

As mentioned earlier, it is difficult to separate the concept of Integrated Business Planning (IBP) from advanced S&OP. Even within business praxis there is not a clear-cut line where the concept of advanced S&OP ends and IBP starts. Moreover, both concepts are being reviewed and fine-tuned on ongoing basis within companies worldwide reacting on increasing pressures on high levels of operational excellence. Generally it could be said that the concept of S&OP have gone through such significant changes in the past three decades that its “rebranding” to IBP is more for practical purpose to distinguish the latest S&OP best practice from the traditional “supply-demand balancing” concept.

The ideas of process optimization via simultaneous planning across various business functions have started to appear in the specialized literature with more frequency over the past decade. However, not many practical enterprise-wide applications can be found and relatively few integrated corporate

financial models have been implemented so far.[83] Moreover, even the existing ones are more focused on the short-term optimization of operations rather than having a mid-term focus of S&OP. As a few examples, Applequist et al. highlight the importance of integration of the production aspects with strategic business and financial decisions.[84] According to Shapiro, linkages among the three classes of decisions (supply chain, demand, and corporate finances) should be evaluated when modeling a supply chain[85]. Shah also states that combined financial and production-distribution models should be considered in the area of supply chain management.[86] Srinivasan remarks that academic research in cash management has been focusing more on the specific decision types and paying less attention to a broader integrated objective, based on how to use and interconnect the set of decisions necessary for simultaneous production and financial management.[87]

It is believed that one of the main reasons while many companies are still struggling with adoption of truly integrated decision making process as a next step of S&OP improvement is lying in the old legacy of traditional S&OP. Historically, this process has been viewed primarily balancing the volume supply and demand, thus primarily the "matter of supply chain". Top-managers as well as other functions that were not really part of "Sales" and "Operations" like Marketing and Finance have been having hard time to position themselves within S&OP under this view.

As will be shown in Chapters 2.6. and 3., switch from "independent" to "integrated" planning is in the first place the change management process and the biggest obstacles in adoption of truly integrated cross-functional approach to planning are the mindset blocks. Management and individual functional leaders are often afraid of losing their positions after being more transparent and more integrated. As a result, rebranding of S&OP to Integrated Business Planning or Integrated Business Management might seem to be a trivial detail on one hand,

[83] Shapiro (2001)
[84] Applequist et al. (2000)
[85] Shapiro (2004)
[86] Shah (2005)
[87] Srinivasan (1986)

but important pre-requisite for changing the mind-set of management on the other.

Examples of S&OP definitions in Table 1 in Chapter 2.3.1. showed that there is currently no unified definition of advanced S&OP process existing. Author further defines the following main aspects that could be summarized as key characteristics of advanced S&OP, or IBP:

1. IBP as key platform for operational management of the company
2. IBP as structured gap management process
3. IBP as linkage between company's strategy and operations

2.4.1. IBP as key platform for operational management of the company

IBP process should be understood as key process for operational management of the company. It should not complement, but replace the multiple planning processes that are often running in the business organizations in parallel. Furthermore, it should not be understood as only "planning", but mainly as management "decision-making" process. One of the key goals of IBP adoption should always be the increase of efficiency in decision making for management.

The question of the ownership should no longer focus on which individual business function should dominate the process, but rather on how to orchestrate the efforts of all functions into single integrated process. These goes hand in hand with alignment of incentives and individual target setting. As stated by Sheldon, the overall accountability for the process should thus be assigned to highest ranking manager in the facility, where IBP process is exercised.[88]

2.4.2. IBP as structured gap management process

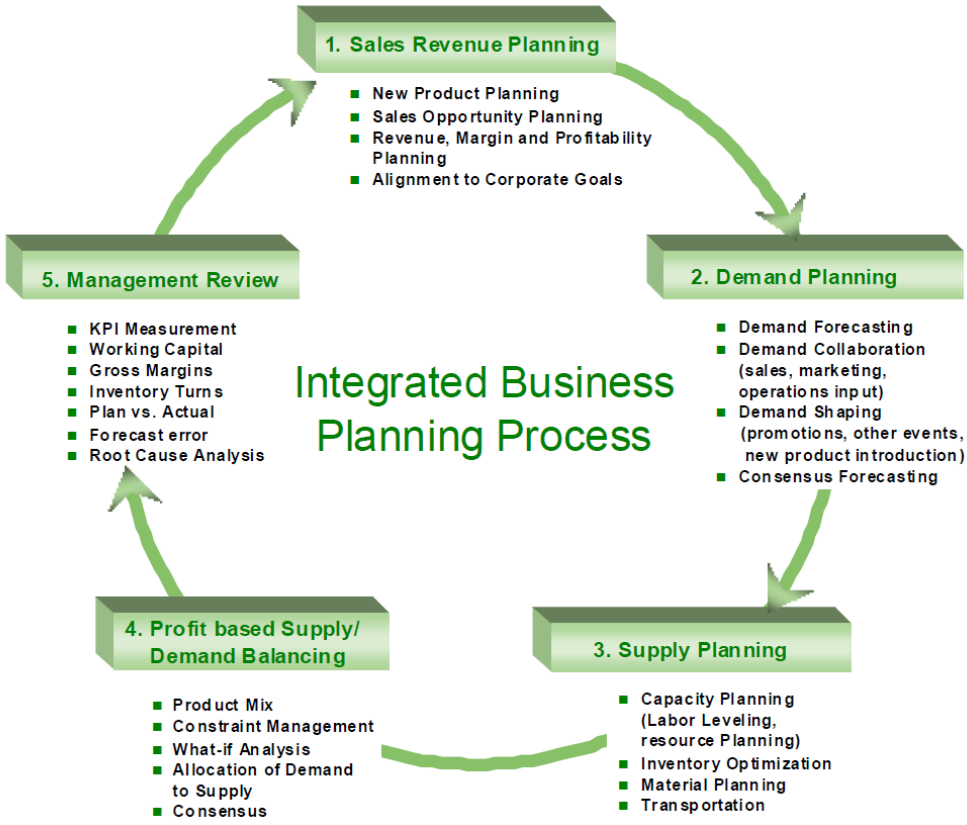
The second proposed distinguishing feature between S&OP and IBP is the understanding of IBP as structured gap management process. This characteristic encompasses both the format and content of IBP.

[88] Adopted from Sheldon (2006), p.16

Format of IBP: a structured process

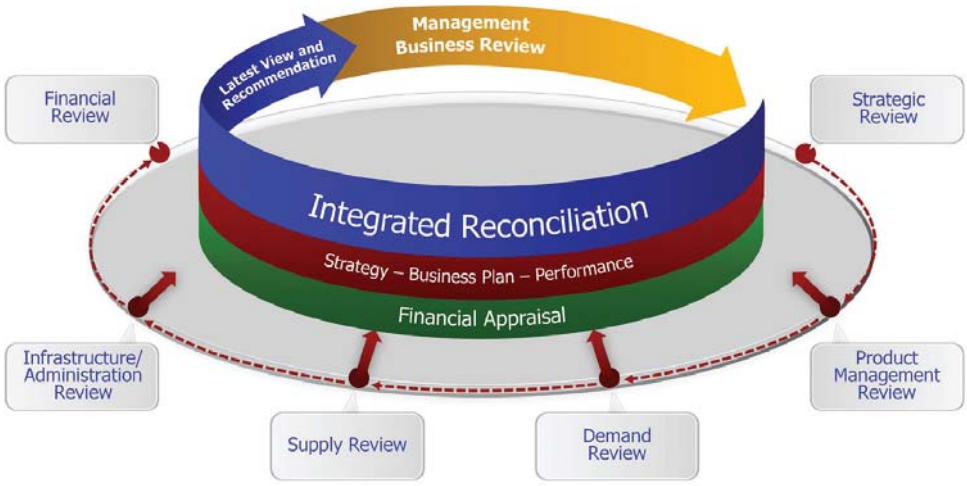
Integrated business planning should in the first place be viewed as a business management process, i.e. as a structured set of mutually related activities realized within certain framework of internal business policies with pre-defined form and content leading to specific expected outcomes. In other words, it cannot be exercised as ad hoc reactive step that occurs as soon as problems emerge, which is often the case for less mature organizations. Similarly to the definition of S&OP, the optimal set-up of IBP process also depends on author, researcher respectively consulting company. Figures 24 – 26 below are displaying possible set-ups of IBP process with its main attributes as proposed by various authors and specialized consultancy companies.

Figure 24: IBP process according to Aberdeen Group



Source: Aberdeen Group (2008)

Figure 25: S&OP / IBP (Palmanier & Crum (2010))



Source: Palmantier & Crum (2010)

Figure 26: Summary of steps within S&OP process (Dougherty & Gray (2006))

Data gathering and review	Demand planning	Supply planning	Partnership meeting	Executive meeting
▪ Customer orders and lead times ▪ Sales in $ and units ▪ Production ▪ Inventory ▪ Costs ▪ Market data ▪ New product development data	▪ Performance review (plan vs. actual) ▪ Determination of future customer needs ▪ Update of forecast ▪ Proposal of changes in inventory targets	▪ Review of performance (planned vs. actual) ▪ Review of capacity plan (planned vs. demonstratedl) ▪ Update of supply plan ▪ Proposal of changes to inventory targets	▪ Agreement on issues and problems ▪ Review of customer needs, plans and assumptions ▪ Formulation of new plans and analysis of risks ▪ Indentification of alternative approaches and contingency plans ▪ Prioritization, reach of consensus, preparation of proposals for critical issues ▪ Preparation of fnal numbers, highligts and proposals for Executive meeting	▪ Review of key metrics ▪ Review of decisions ▪ Resolution of key disputes, achievement of consensus ▪ Cear decision making ▪ Approval of final plans

Source: Dougherty & Gray (2006)

As the recommended process set-ups proposed by Aberdeen group and Dougherty and Gray do not includes neither financial nor strategy review steps, it can be said that Oliver Wight (Palmanier & Crum) illustration on Figure 25 is proposing the concept that is closest to the current best practice understanding of IBP.

Despite the differences in details of process set-ups, there are the following four characteristics of process format that are identifiable as common for any properly executed Integrated Business Planning process:

1. Positioning

- *Linkage between Strategy and Operations* – in respect to positioning within various internal processes, IBP should represent the key linkage between high-level strategic and detailed operational planning as displayed on Figures 6 and 7 in Chapter 2.3.1.

2. Frequency and timing

- *Monthly cycles* – IBP is recommended to be exercised within monthly planning cycles. In general the frequency of IBP cycles should be set so that it is able to react with sufficient flexibility on the changes in market place.
- *Closed loop* – the outcomes of one planning cycle is the starting point for the consecutive one.

3. Completeness

- *Inclusion of all critical review steps* – the exact sequence of different process steps is of secondary importance contrary to their completeness. In other words, the way that different review and "gap reconciling" steps succeed each other can be adjusted for specific business environment. The more important part is, that all of them occur throughout the single planning cycle as analyzed in more detail on the following chapter.

4. Participation and Ownership

- *Roles and responsibilities* – clear definition of roles and responsibilities of different business functions participating on IBP process is the key pre-requisite for its efficient operation. As mentioned in previously, the overall accountability for the process should be assigned to highest ranking manager in the facility, where IBP process is exercised.

Content of IBP: Gap management

Where proper business process format constitutes the sufficient condition for effective planning, it is its content that is necessary for its efficiency.

Typically, as different planning processes are under ownership of different business functions or departments, the lack of consolidation amongst their outcomes is resulting into existence of gaps. There are the following common types of gaps or misalignments that IBP is trying to address and manage.

Misalignment in the structure of planning data

This gap should be understood as the discrepancy between the number and mix of product planned within strategic, operational and financial planning processes. The higher is the level of detail, i.e. granulation from product families to single article or stock keeping units, the higher is usually the gap. The most common inefficiencies resulting from the missing reconciliation amongst product structures used within different independent planning process are inaccuracies in financial forecasts or wrong production mix reflected via production and distribution planning resulting ultimately into deterioration of customer service levels.

The alignment of article structures used within different independent planning processes is one of the key pre-requisites for successful implementation of IBP.

Planning horizon misalignment

Another common characteristic of misaligned short-to-midterm planning processes is the difference in planning horizons. It is not uncommon, that while the financial forecast primarily focuses on the current fiscal year, operational plan should span at least over the horizon covering the cumulative lead time which is the total time required to produce a product or make a part assuming there is no stock of any of its components available. Such planning time horizon should also include the time necessary to purchase all required components or raw materials.

Operational planning might thus face the challenge, where in the short-term, financial sales or demand plan serves a more accurate basis for production and supply planning, but if it does not extend over sufficient time horizon covering the total lead times, derivation of mid-to-long term strategic plan needs to be taken into account instead. If these are not aligned, there might be misalignment over different time parts of operational planning horizon resulting in production inefficiencies.

Planning method misalignment

The last but not least of common types of misalignments between individual plans or forecasts resulting from independent planning processes is different planning method and the level of detail used. Typically, business plan is developed on product family group, is non-calendarized and on full year basis. Financial / sales forecast is granulated to article/SKU level and often aims on the full year forecast without the calendarization on article/SKU level. To complete the picture, operational plan needs to be on article/SKU level, calendarized and on rolling basis to keep the sufficient planning horizon. Without proper alignment of planning methods in terms of level of detail, full year view/calendarized view, rolling/non-rolling, there will always be gaps and intransparencies resulting in further inefficiencies.

Volume gap(s)

While closing of the previous gaps forms more the pre-requisite for effective functioning of IBP, it is the management on volume, and corresponding value gap that constitute the true core of IBP.

There are various common reasons for misalignment in planned volumes amongst different planning types. Existence of independent planning processes, owned by different departments with the lack of plans reconciliation is the most obvious one. However, there exist also differences which are naturally resulting from various objectives of different planning types. Moreover, differentiated

targets of individual department could also contribute to creation of these types of gaps. Following are the three of the most common types of volume/value gaps:

- *Marketing vs. Sales*
  This misalignment can be also redefined as gap between long- and short-term commercial view on the business, or between top-down market (segment) view versus bottom up customer and “sales rap” view. Whilst Marketing is often trying to project the best-case, optimistic scenario that would lead to fulfillment of ambitious strategic targets like certain market-shares, Sales are generally trying to plan with rather conservative assumptions especially if their compensation is based on exceeding certain given sales targets or budgets.

- *Supply Chain/Operations vs. Commercial functions (Marketing/Sales)*
  Demand plan, where the main input provider should be commercial functions is generally unconstrained consensus demand between Marketing and Sales. Often, especially for highly volatile markets with longer product lead times, the projected demand plan might exceed available production capacity or material availability on supply side. These are the cases where unconstrained forecast meets Supply Chain restrictions and constrained demand plan have to be projected respecting such limitations.

- *Finance/Controlling and “the others”*
  Even if consensus demand plan is agreed between commercial functions and consequently supply restrictions are put in place, the resulting volumes when valued in financial terms may be insufficient to meet financial targets or budgets. In such cases either the sales plan is revaluated with corrective actions make to push the sales, or the financial forecast needs to be adjusted accordingly. This type of gap can also be refined as value vs. volume gap or alternatively forecast vs. budget, respectively reality vs. target. It is only after deeper financial review where impacts on anticipated sales and

profits are evaluated. Especially the Supply Chain's focus is often almost purely volume driven.

Timing gaps

Likewise volume gap, timing gap can be also partially resulting from inefficiencies of the planning process set-up, but can be also inherent to IBP. Almost exclusively, timing gaps are occurring while analyzing short-to-mid-term horizon[89] of Sales and Operations planning and the reasons are generally twofold:

- *Assurance of sufficient product availability and flexibility for Sales*
  As described in Chapter 2.3.3. discussing on theoretical basis the incentives of Sales within S&OP process, as a result of limited forecast accuracy, Sales is often trying to build in certain timing buffer when providing information about planned demand to operations. The reason is to avoid potential product shortages in case that the sales demand would occur for different reasons earlier than anticipated. This is especially relevant for seasonal products. Product shortages are often perceived as major competitive disadvantage as customers prefer suppliers with reliable product deliveries.

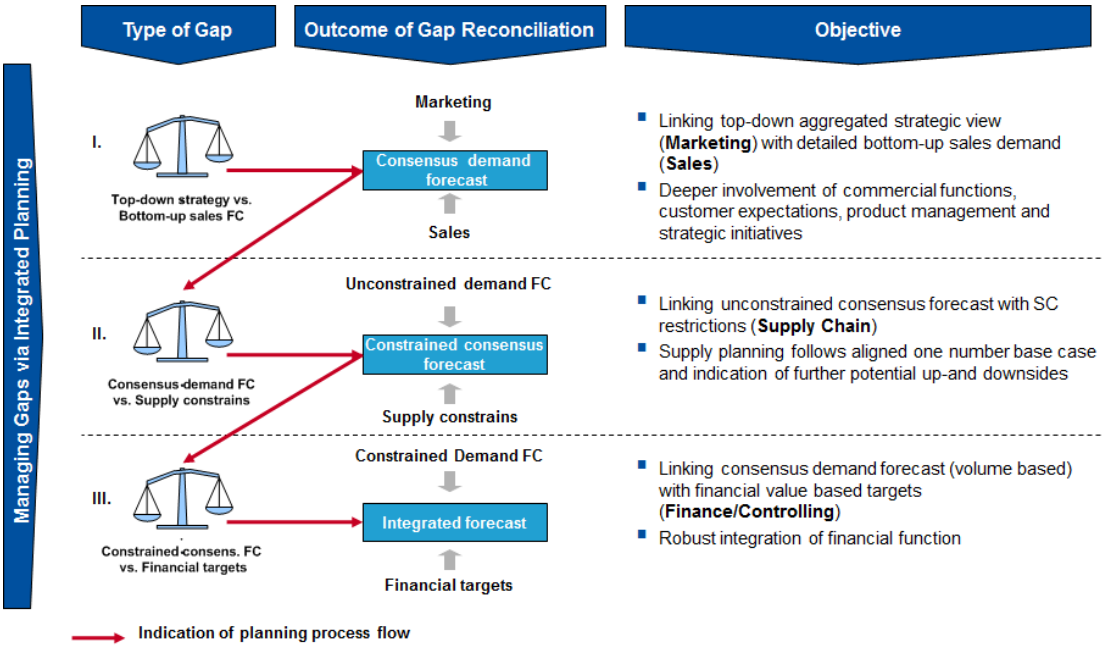
- *Planning system requirements*
  Another situation where certain limited timing gap between financial sales forecast and sales demand plan is the set-up of planning systems supporting these two processes. As an example, financial planning system may recognize sales at the time when the sales are legally recognized. These might be e.g. when goods are delivered to customer or when customer invoice is issued. On contrary operational planning may plan demand based on so called "customer requested delivery dates", that may differ from invoicing date

[89] As it is only one type of planning that spans over long-term horizon - strategic business planning, there is nothing to compare it with and therefore no gaps occurs.

significantly, when there exists significant delivery time between goods issue from warehouse and goods receipt at customer premises.

All the above mentioned gaps or misalignments can be to certain extend attributed to the lack of structural gap reconciliation, or in other words to missing "integration" of individual planning processes. The following figure demonstrates one of the possible set-ups of IBP considering different rounds of gap reconciliations.

Figure 27: Integrated Business Planning as structured gap management



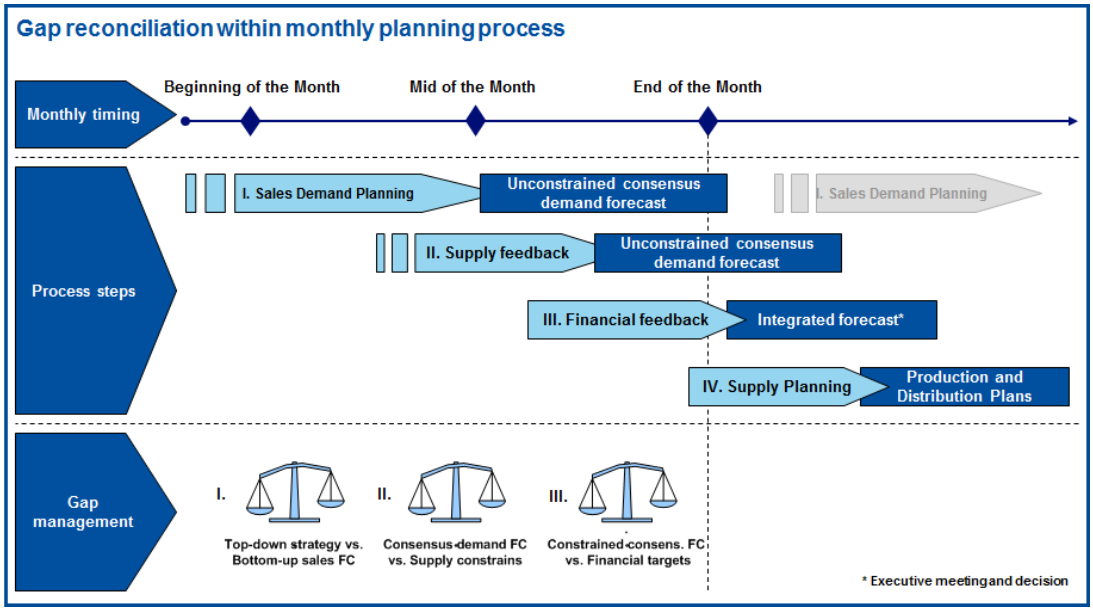
Source: Author

Putting individual steps into the timeline, we receive one possible example of IBP process set-up as displayed on the Figure 28.[90] As can be seen from this example, IBP process is established so that it gradually identifies and manages different types of gaps. Throughout three gap reconciliation rounds, the organization develops an integrated "one-number" sales demand forecast that

[90] Figure 27 displays one of the multiple alternatives of how IBP process can be structured within the organization. FC stands for Forecast.

reflects bottom-up customer view of Sales balanced out with top-down strategic view of Marketing, reviewed from feasibility perspective by Supply Chain and from financial point of view by finance. This base case forecast is often accompanied with scenarios reflecting various alternations of underlying assumptions.

Figure 28: Example of IBP set-up



Source: Author

However, also if IBP is successfully implemented, certain volume a timing gaps in plans may be occur and be even desirable despite the efficient set-up of planning process. These result from the limitations in forecasting inaccuracy and from the existence of uncertainty factor in forecasting.

In simple terms, due to market and demand volatilities that are predictable only up to certain extend, company should plan their production generally on higher volumes than are the financial commitments or sales targets. In general, the lower the forecast accuracy the higher the safety inventory buffer should be planned and vice versa. The resulting topic of product flexibility management and safety stock is discussed in more detail in Chapter 2.5.5.

2.4.3. IBP as a linkage between company's strategy and operations

The previous two sub-chapters focused on the definition of position of IBP in the structure of company's planning processes, respectively described the key characteristics of its form and content. It's the third key feature – its link to business strategy that completes the distinction of IBP from traditional S&OP.

As noted by Palmantier & Crum, "focus of attention on S&OP has been shifting towards a better understanding of the external environment as well as ensuring alignment and synchronization among the internal functions of the company, which was originally S&OP's primary objective. The shift toward strategic management is a key driver in the transition to Integrated Business Planning (IBP). As Sales and Operations Planning has become more driven by strategy, understanding and using the business drivers in planning is becoming more clearly understood. In addition to the traditional attention to supply chain management, the use of Business Intelligence (BI) has begun to enable a company's S&OP process to be more about the "Essence of the Business".[91]

Although both operational effectiveness and strategy are essential to superior performance of the business, they work in a very different ways.[92] It was once said that strategy without tactics is the slowest route to victory, but the tactics without strategy is the noise before defeat.[93] The high performance operating processes are necessary but not sufficient for enterprise success.[94]

2.4.3.1. System approach vs. process approach to strategy implementation

Despite the myriad of strategy development and implementation tools that has been filling business literature in the past decades, organizations are still often failing in successful execution of their strategies. It is proposed that one of

[91] Palmatier & Crum (2010) p.3
[92] Adopted from Porter (1996)
[93] Anonymous, adopted from Kaplan, Norton (2008)
[94] Adopted from Hammer (2006)

the main reasons for this phenomenon is the lack of integration and effective structured cooperation amongst different business functions in strategic planning and execution. As IBP is aiming primarily for improvements of one of the core management functions – planning, it can be implemented into already existing process structure in the firm. Thus, contrary to some complex strategy implementation systems, it can serve as relatively easy to achieve, efficient and sustainable way of linking strategy with operations.

In the past decades lots of improvements have been achieved on the field of development of strategy execution tools. Balanced scorecard has become probably the leading approach towards comprehensive management of company's performance, followed by systems based on the management of quality (Baldrige Criteria, TQM, six sigma, European foundation for Quality Management, etc.) or financial management (economic value added).[95]

According to Kaplan and Norton, strategy execution is placed 1st by a in the comprehensive global survey on the top-executives' priorities performed by The Monitor Group in 2006. Further on, The Conference Board in its 2007 survey reported that executive's number one priority was "excellence in execution". After the number two priority, "sustained and steady top-line growth" strategy execution again appeared as priority number three, "consistent execution of strategy by top management". It is evident, that placing a high priority on effective strategy execution can be traced to the considerable and well-documented problems most companies have experienced when attempting to execute their strategies. Moreover, various surveys over the past two decades indicate that 60-80 percent of companies fall far short of the targets expressed in their strategic plans. Finally, according to authors companies generally fail at implementing a strategy or managing operations because they lack an overarching management system to integrate and align these two vital processes".[96]

[95] Lawson, Desroches, Hatch (2008)
[96] Adopted from Kaplan, Norton (2008)

Another study conducted by Kaplan and Norton in 2006[97] about the state of strategy execution revealed, that approximately 40 percent of reviewed organizations did not have formal systems to help them execute their strategies, over 70 percent reported average or below average performance of their strategies.

As a response to issues identified in the surveys mentioned above, Kaplan and Norton as leading capacities in strategy development and execution in the past decades defined a comprehensive and integrated management system that links strategy formulation and planning with operational execution as outlined on the Figure 2[98] in Chapter 2.2.1. They claim that companies can benefit from taking this approach to linking strategy and operations through implementation of the described close-loop management system.

Failing to successfully implement the business strategy may be often grounded in insufficient integration, collaboration, communication and incentive setting amongst different business units and functions in the "strategy-to-operations" cycle.

As practical implications of missing integration are for example multiple IT systems and tools used for planning and reporting by individual business functions. Furthermore, insufficient gap reconciliation between these systems and lack of understanding in differences leads to "surprises" for management. For example, Marketing with strategic mid-to-long term horizon focus has not receiving structured feedback from Sales on how market really reacts on their proposed strategic initiatives. On the top, Finance with their strong value orientation is focus on fulfillment of bottom line commitment defined in budget without too much interest in real sales volumes mix that is on the other hand crucial for the operations. The communication silos are not uncommon and as incentives across the organization are not aligned towards common targets, each stakeholder of the planning process is not truly motivated for any deeper cooperation with the rest of the organization.

[97] Adopted from Kaplan, Norton (2008)
[98] Kaplan, Norton (2008), p. 8

In most of the cases, implementation of such complex approach towards strategy execution as proposed by Kaplan and Norton would require the employees of the company to adopt and manage relatively complex set of initiatives on the top of their current responsibilities. As a result, strategy implementation as a whole might hit the resources constrains as well as change management related hurdles.

The question than is, how to set effective approach towards strategy execution, that would minimally interfere with current “daily” activities of the firm and tasks of the employees. In other words, how to integrate strategy execution into existing core management processes so that it becomes integral part of business operations instead of being the one-off action that is being repeated once in a while when the strategy is reviewed.

Concept of Integrated Business Planning provides the answer on the above mentioned questions. Comprehensive integration of the planning processes across the organization and structured management of the gaps between different plans represents the efficient consensus between top-down strategy execution and direct bottom up feedback from the marketplace. This approach can be implemented into planning philosophy of the firm and thus serve as constant and sustainable way of executing strategy and monitoring of its fulfillment.

2.4.3.2. Strategic portfolio management translated into IBP

On the following pages of this chapter it is demonstrated how different strategic options represented by various portfolio models can be reflected in IBP process and enable the company to effectively link its strategy with operations.

Generally, future product portfolio of the company defining its revenue streams consists of the following four segments:

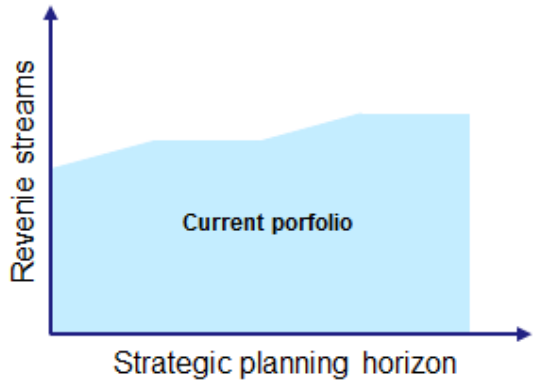
- current product line(s)
- extensions and promos of current product line(s)
- products new to the company but known in the market
- products new to the company and market

Various combinations of these portfolio segments are further defining several main portfolio models that have different impact on the set-up of IBP. Understanding of how will the expected future market and portfolio situation differ from the presence and past is a key pre-requisite for managing change when translating strategy into operations.

Portfolio model 1 – managing current portfolio

IBP process set-up in Portfolio model 1 would follow the traditional S&OP structure, focused primarily on supply and demand balancing. As the planning will deal predominantly with standard products, the emphasis will be on forecast accuracy and single number planning approach for supply. This model appears generally for business dealing with commodity-like products, e.g. core chemicals and the strategy to be chosen for such cases is Cost leadership. The key role in planning should be held by Supply Chain/Operations and Finance. This is the only portfolio model, where classical S&OP would be still sufficient.

Figure 29: Portfolio Model 1

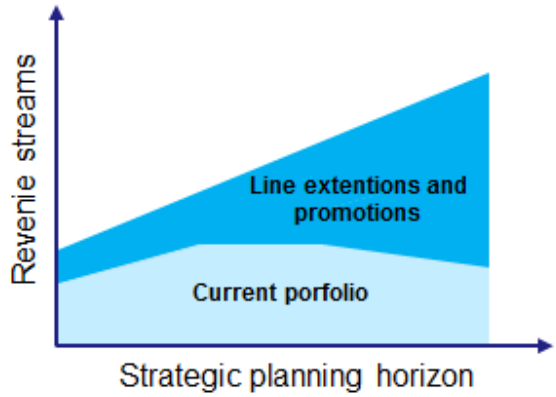


Source: Author

Portfolio model 2 – growth through line extensions and new products

The second portfolio model outlines the situation, where future revenue streams are generated predominantly by line extensions and promos of current product portfolio, but more importantly by the introduction of new products.

Figure 30: Portfolio model 2



Source: Author

Where existing portfolio may follow the “cost leadership” strategy, the strategic focus on the new products would need to be differentiation or superior customer relations focus, which would justify higher profit margins. Strategic portfolio management gains on importance within IBP process, and the leadership within this process is shifted from Operations to commercial functions. In case that the growth through the products new to the company is realized via the acquisition of competitor having such products already in portfolio or by the purchase of respective patent, Finance will play significant support role in the process. For the cases when the new product line results from the in house development, Research and/or Product development function might of significant importance.

Portfolio model 3 – growth through brand new product lines

The portfolio model, where the most of the expected future revenues are generated by products that are either new for the company or for the whole market, represents the most challenging situation for traditional view of S&OP. Such situations are common in growing business segments that are driven by technology changes and very short product life-cycles. For these cases, strategic portfolio reviews represents one of the most important steps in IBP process.

Figure 31: Portfolio model 3

Source: Author

The traditional S&OP model of demand and supply balancing are of limited relevance to executives in this environment. 'Uncertainty' incorporated in planning for multiple scenarios and the importance of simulation and its impact on profitability have enormous consequences. Measurements such as 'time to market' and 'time to profit' are of key importance. Standard S&OP software with its functionalities like statistical forecasting are of little value. Typical examples of industries following this portfolio model are manufacturers of mobile phones, electronics, computers and software. Typical generic strategy utilized for such industries is product or service differentiation.

If the business is characterized by product portfolio structure similar to models 2 or 3, implementation of conventional "demand-supply balancing" process such as the traditional S&OP would not be insufficient. IBP with the strong focus on strategic product management represents the most appropriate and effective approach to planning in such business environments.

Understanding the business strategy is essential to understanding how IBP should be set. In the previous lines it was discussed how different strategic portfolio models impacts the key focus within planning process. Strategies are about choices and tradeoffs, and each business needs to understand the principal strategy it is following. It is not unusual to find that some organizations

might have different business units following different strategies. A principal goal of the business pursuing a particular strategic direction is 'Differentiation from Competition' leading to competitive advantage. A business guide to IBP showing different nuances and choices can be very helpful, whereas a one-size-fits-all universal checklist for IBP is not appropriate.

2.5. Analysis of IBP impact in the framework of Value Based Management

Within this chapter, the concept of Value Based Management (VBM) is used to demonstrate how the set-up of planning process influences the financial performance of the firm and thus contributes to generation of value for company's shareholders. Identifying and focus on the main drivers of value creation is one of the main targets of the concept of VBM.

According to CIMA[99], VBM is an approach to management whereby the company's overall aspirations, analytical techniques and management processes are aligned to help company to maximize its value by focusing management decision making on the key drivers of shareholder's value.[100]

2.5.1. Value Based Management (VBM) concept in general

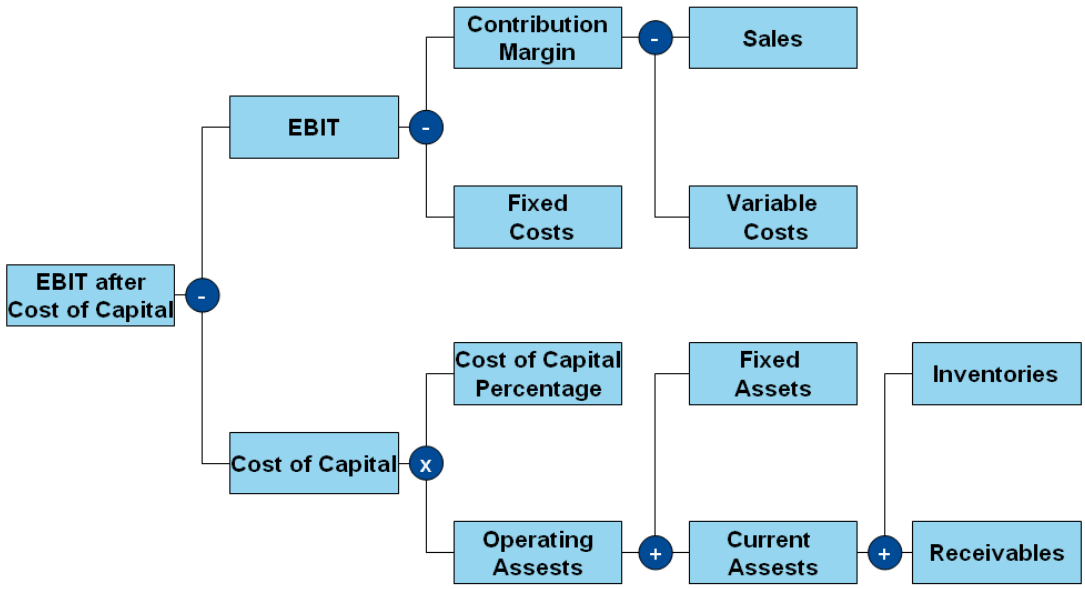
The thinking behind Value Based Management (VBM) is quite straightforward. As the value of a company is determined by its discounted future cash flows, company is creating additional value only when returns from invested capital exceed its costs. VBM concept further extends this idea and analyzes how to effectively use the capital within both strategic and everyday operating decisions. Properly executed, VBM is an approach to management that aligns a company's overall aspirations, analytical techniques, and management processes to focus management decision making on the key drivers of value.[101]

[99] Chartered Institute of Management Accountants (CIMA) is the world's largest professional body of management accountants. www.cimaglobal.com
[100] Scarlett (2001), p.2
[101] Koller et al. (2010), p. 87

VBM can not only help explaining the methods of business steering and controlling of the company, but it also provides guidance to employees in both daily and strategic decisions while keeping the focus on the overall success of the organization. VBM shout thus not apply only to corporate controlling and senior executives, but it should count for all employees in their day-to-day business.

On the Figure 32, the typical “value driver tree” decomposition is used to demonstrate how different P&L and balance sheet positions interact together to get one of the core indicators of financial performance of the company – EBIT after Cost of Capital.

Figure 32: Value driver tree

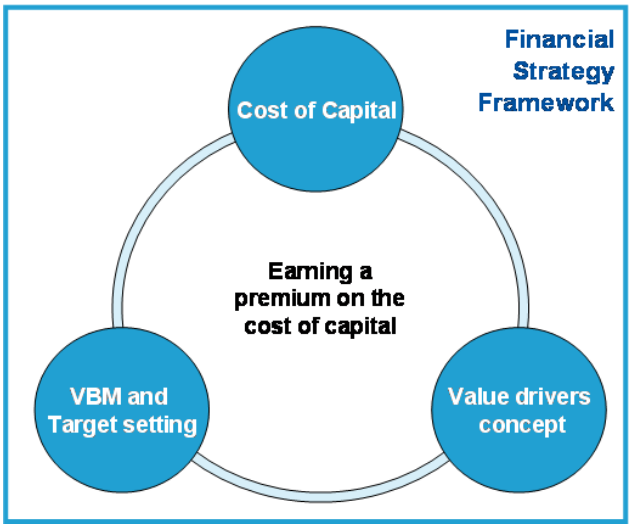


Source: Author

Only those companies that consistently earn profits in excess of the costs of equity and debt capital they employ can be successful and survive in long-term. The VBM concept, through the definition of specific KPIs for each single factor (value driver), uses the value driver tree to demonstrate how different business functions and also individual employees can contribute to value creation.

The ultimate goal of the company is to generate value for its stakeholders, in other worlds, earning a premium on the cost of capital. One of the ways how to successfully implement the principals of VBM into corporate strategy is outlined on the Figure 33.[102]

Figure 33: Pillars of Value Based Management concept



Source: Author, Internal Expertise – Agrochemical company

To support this target, three main elements have been created that represents the closed-loop approach of VBM.

Element 1: Cost of Capital

Cost of Capital concept is used in order to define the level of return that needs to be generated in order to meet the expectations of investors on capital.

Cost of capital is defined as the expected return on a portfolio of all the company's existing securities. It is the opportunity costs of capital for investments in the firm's assets, and therefore the appropriate discount rate for the firm's average-risk projects.[103] Weighted average cost of capital represents the

[102] Adopted from Corporate strategy 2015 of the chemical company analyzed in empirical part of this thesis - Chapter 2.
[103] Brealey et al. (2011), p. 214

opportunity costs that investors face for investing their funds in one particular business instead of other with similar risk.[104]

Element 2: Value driver concept

Value-driver concept is used to examine and identify how the value can be created by influencing selected factors (value drivers) in alignment with the strategic goals of a given business unit.

Specific Key Performance Indicators (KPIs) for each important value drivers should be developed to steer planning and pursuing the intended changes. KPIs and value drivers are the main instrument of control for value based management and thus for strategic control of a given business unit. In order to use KPIs for planning, managing and controlling, these KPIs should meet at least the following main criteria:

- Ideally, it should be possible to calculate the KPI using independent individual parameters.
- Changes in the business process result in a perceptible change in the KPI.
- The basic data for the KPI can be determined relatively easily.
- Business measures have an immediate impact on the KPI.

Element 3: Value based management and target setting

VBM can be successfully implemented and used for company's planning only if it is well grounded and realized on a consistent basis. Fostering entrepreneurial thinking and action among all employees is a criterion for successful company-wide VBM. According to this concept, performance review goals for the employees should be alignment with the strategic targets of each business unit. Additionally, educational measures to teach the whys and wherefores of value based management should be provided to all levels of management.

[104] Koller et al. (2010), p.231

The following criteria apply to VBM targets:

- The target must have an impact on profitability.
- There must be a predefined criterion or key performance indicator (KPI) that is measured at least once a year.
- Evaluation of target achievement should not be solely dependent on assessment by the direct superior.
- A given unit must be able to directly influence the target.
- It must make sense to exceed the target.

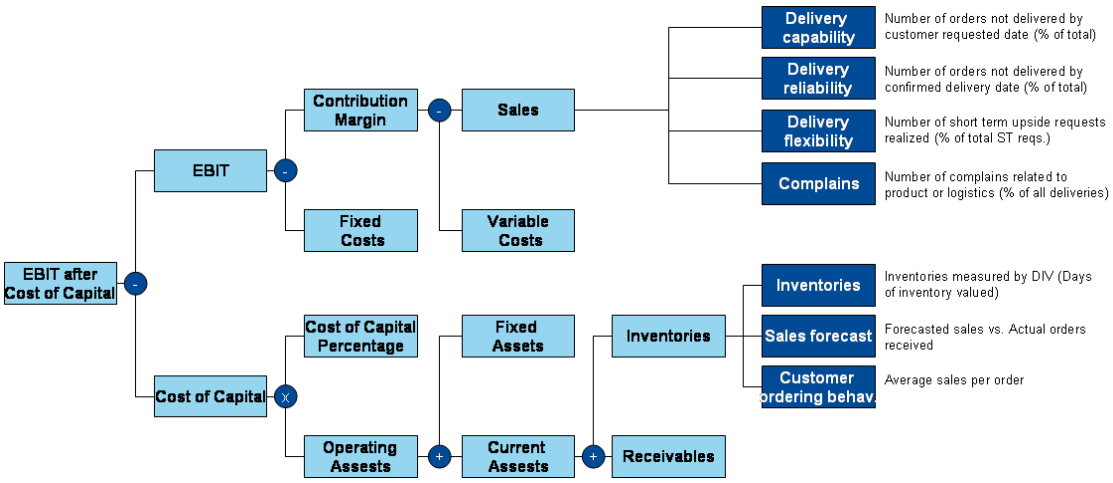
2.5.2. Financial implications of planning process set-up

In order to demonstrate how the quality of planning can be reflected in the final EBIT after Cost of Capital, we have to examine how it influences the individual value drivers, or even more precisely, how it impacts the KPIs that are assigned to these drivers. Specific value drivers closely linked to planning performance can be identified and their impact on overall bottom line performance of the firm measured.

As discussed also in Chapter 2.3.3., the benefits of optimized planning process can affect the bottom line performance of the company directly two-fold.[105] Firstly, via enabling sales – this can be done through accurate and timely meeting supply with demand as well as via realizing sales upsides by having the right amount of safety stock available at the right time. Secondly, the bottom line is positively impacted by better inventory management, i.e. via elimination of excess inventories.[106] Figure 34 shows the value drivers that are essential for supply chain management related to planning quality[107], supplemented with examples of some most frequently used KPIs.

[105] There is also important intangible benefit from improved communication and cross functional cooperation, but this is out of scope of this section. These will be discussed in more detail in Chapter 3.
[106] Apart from the impact on revenues and inventories, there might be also application of especially wrong business planning on the variable costs, e.g. through usage of air-freights as a sub-optimal reaction on product shortages in some cases, but this analysis is out of scope of this thesis.
[107] There are also multiple other value drivers related to supply chain with effect mainly on fixed costs or variable costs (e.g. logistic costs or lead times), but these are not directly impacted by quality of business planning, therefore are out of scope of this thesis.

Figure 34: Value driver tree – Supply Chain KPIs



Source: Author

As can be seen, reaching high levels of supply chain capability, reliability and flexibility, with its direct link on logistics related customer complaints are the key prerequisite for enabling the sales. Although it might be quite difficult to measure how the increase of delivery capability, reliability or flexibility leading ultimately to the reduction on customer complains related to supply chain performance impacts company's revenue, the direct inventory impact is directly measurable via the level of inventories.

Bower, following his experience with a diverse cross industry mix of clients defines the following list of opportunities from successful IBP implementation[108]:

- Improved forecast accuracy
- Reduced inventory
- Reduced obsolescence
- Improved customer service/revenue creation
- Improved portfolio management/New product introductions

Using real business experience, unless supply chain shows persistent high performance levels, sales and marketing will always be reluctant to showing transparently their most realistic sales forecast and will always be biased either

[108] Adopted from Bower (2006)

towards earlier production or to overestimation of operations planning in order to secure their sales flexibility. This adverse motivation of different business functions towards sales and operations planning and thereof resulting inventory management were explained in more detail in Chapter 2.3.3..

If there is not enough transparency in planning and each business functions is running its independent planning processes without proper reconciliation, it hits back negatively the overall efficiency of operations and consequently also financial performance. Other way round, in case there is sufficient level of transparency and all parties within planning processes are fully aware of the forecasted figures, clear facts and underlying assumptions behind them as well about the future expectations communicated via concept of scenario planning and risk and opportunities management, organization as a whole is able to pro-actively and more effectively allocate their flexibility and thus meeting the demand volatility with appropriate levels of safety stock.

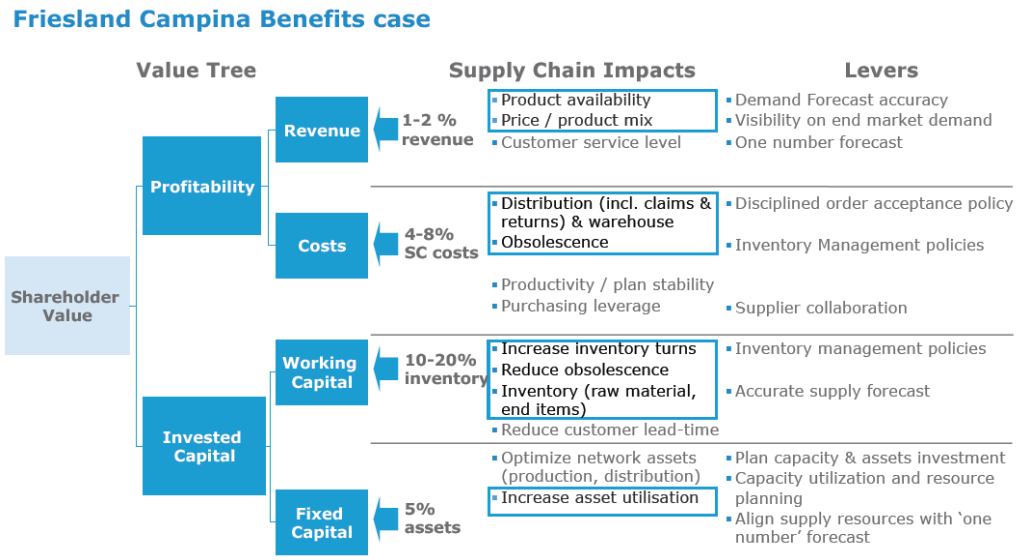
As discussed in previously, there are certain constrains for practical application of theoretical optimization models as described in Chapter 2.3.3. One of the alternative ways of how to approach the optimal set-up of business planning process is to analyze how its quality contributes to generation of value for company's shareholders. Identifying and focus on the main drivers of value creation is one of the main targets of the concept of Value Based Management.

Efficient set-up of Integrated Business Planning process have potential to deliver benefits across the entire value driver tree. The Figure 35 shows the example of the dairy products company Friesland Campina.[109]

Furthermore, according to consulting firm Accenture, benefits out of efficient set-up of planning processes can be even more significant as outlined on the Figure 36.[110]

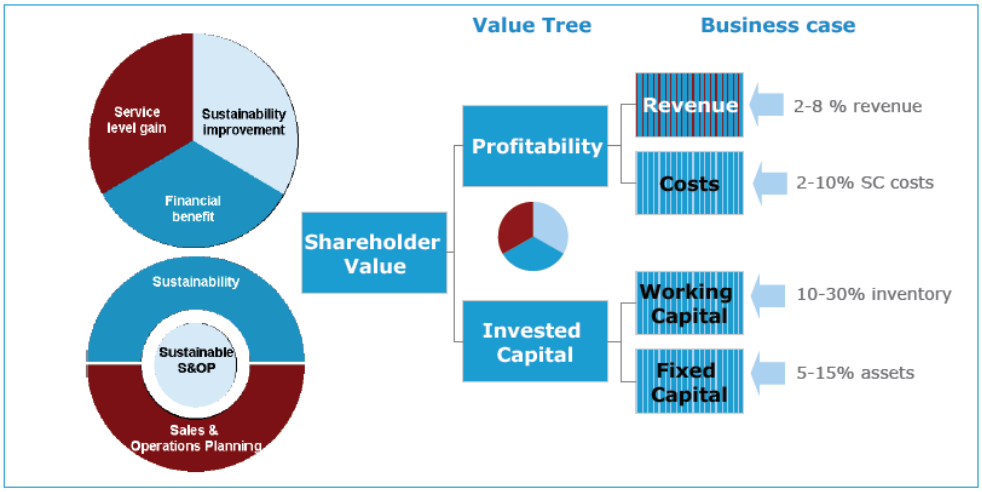
[109] Royal FrieslandCampina is a multinational dairy with ingredients are sold all over the world and sales amounting to nearly 9 billion euros in 2010. (www. www.frieslandcampina.com);
Source of Benefits Case: "Cost leadership and effective S&OP" presentation by the Head of Planning and Logistics - Butter division of FrieslandCampina; Integrated Business Planning Summit in Zurich, IE Group 10-11.3.2011 (http://theiegroup.com/Europe)

Figure 35: Benefits of effective planning process set-up - FrieslandCampina



Source: FrieslandCampina

Figure 36: Benefits from effective planning process set-up - Accenture



** Sustainability is Long-term economic and brand value, driven by strategies that positively impact the environment and the social community in which a business exists (Accenture 2008)*

Source: Accenture (2008)

[110] "Cost leadership and effective S&OP" presentation by the Head of Planning and Logistics - Butter division of FrieslandCampina; Integrated Business Planning Summit in Zurich, IE Group 10-11.3.2011 (http://theiegroup.com/Europe)

2.5.3. Decision about optimal level of inventories

Also in case of aligned incentives resulting from having the common targets of forecast accuracy or average inventory levels adopted by both Sales and Supply Chain, there is a need for a decision basis on whether the additional unit of product should be made available. This extra unit of production may support potential sales on one hand or burden the capital costs in case it is not being sold on another. This is especially valid for the Make-to-Stock operational set-up, where the production is triggered by anticipated or forecasted demand, not by actual confirmed orders.

Generally, product should be made available for sales, if the potential gross profit gained from its sales is higher than costs in case that it would not be sold, i.e. if:

$$p(GP_m) - (1-p)(COGS_m) > 0,$$

where:

p……..likelihood that product will be sold

(1-p)……...likelihood that product will not be sold

GP_m……....Gross Profit of product m

$COGS_m$……..Cost of Goods Sold for product m

After simple numerical adjustment we get:

$$p > COGS_m/(COGS_m+GP_m)$$

$$p > COGS_m/Sales_m$$

$$p > COGS_m \text{ margin}$$

$$(1-p) < 1\text{-COGS margin}$$

$$(1-p) < \text{Gross Profit margin}$$[111]

This easy example can serve as “rule of thumb” method for the decision regarding acceptance or rejection of additional requirement of Sales for an upside production: it is on average more profitable to produce extra unit of product if the likelihood of its sales is higher than its cost of goods margin.

[111] COGS margin = 1 – Profit margin as

The finding also supports the argument that the more profitable is the product (i.e. having higher GP margin thus lower COGS margin), the lower the likelihood of potential sales is required to justify additional production.

This effect is even more obvious in case that the product can be resold later, i.e. for the case of seasonal products with more than one season of shelf life. Than the costs related to not selling the product will be limited only to the costs of capital bounded in form of inventories for the time till the product is sold. The adjusted formula for such case would be as follows:

$$p(GP_m) - (1-p)(COGS_m)xCC > 0,$$

where CC stands for Costs of Capital bounded in form of inventories.

2.5.4. Safety Stock definition and management

As mentioned before, in order to understand how planning quality influences the bottom line financial performance, it must be understood how it affects different KPIs that measure the performance of specific relevant financial indicators. This chapter examines what are the prerequisites of effective operations that would support reaching high performance levels of specific supply chain KPIs, mainly of delivery capability, reliability and flexibility.

The general idea behind keeping certain amount of safety stock is quite straightforward. As the demand for most of the products is more or less volatile, it is necessary to keep certain portion of the finished goods as buffer stock to protect against these demand fluctuations. From Sales and Marketing perspective, safety stock represents the flexibility in reaching the financial targets.

The optimal amount of safety stock is typically calculated by using the statistical safety stock formula[112] which takes into account the demand variation, required customer service level and the replenishment lead time. It is normally the level of safety stock, its structure and physical allocation that allows supply chain to react effectively on the changes in the demand and thus enable sales.

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[112] $SafetyStock = k * \sqrt{STDEV^2 * AverageLeadTime}$; k is a management factor and the rest is lead time adjusted volatility.

On the other hand, the higher the safety stock level, the higher the costs related to inventory holding. Therefore, the goal of the organization in relation to safety stock should be to minimize the level of inventories down to the level that would be just sufficient to delivery committed customer service levels. Reaching this ambitious target requires full understanding and management of all factors influencing the safety stock set-up.

There exist three main influences on the factors of safety stock calculation. First one - agreed customer service level[113] is purely managerial decision and has nothing to do with planning quality directly. The other two – disruptions in supply chain and uncertainty in expected demand can be directly influenced via company's planning efficiency.

Issues related to the reliability of supply chain including variability in lead times, delayed deliveries of ordered or forecasted items, etc. can be pro-actively tackled once there is comprehensive information flow regarding capacity bottlenecks and potential up- and downsides between Product management or Sales and Supply Chain. Similarly, issues related to uncertainty in expected demand like seasonal influences or competitor situation can be again effectively approached via improved business planning.

Process of Integrated Business Planning through reconciliation of sales and operational plans serves as a great tool for effective allocation of safety stock, and thus supporting high levels of supply chain flexibility, capability and reliability with positive impacts on company's sales performance.

2.5.5. Demand Forecast Accuracy

In the previous sub-chapter, the indirect influences of the quality of business planning on company's "top line" results via supply chain performance were outlined. There is of course also a direct link between the outcomes of

[113] The agreed service levels should be set so it balances out customer expectations and requirements on one hand, and costs for the company of holding excess inventories that would have to be kept with increasing service level requirements, e.g. 98% service level means that on average in two out of hundred cases, company will not be able to deliver the product upon request due to stock out, i.e. 2% of stock out risk would be accepted.

planning process and the “bottom line” impact and that is via total inventory levels. If we assume that what will finally stay left over as access overstock is the difference between what was actually sold and what was planned to be sold and thus manufactured[114], the importance of the Integrated Business Planning becomes obvious. Only through comprehensive, regular, well-structured and pro-active approach to analyzing the marketplace supported by sufficient management attention, the company can be persistently reaching high accuracy in forecasting the future demand for its products.

If this is then properly communicated and translated into operations plans, the production outcome will meet actual sales demand without the necessity of keeping excessive safety buffers and ending up with aging inventories. Reaching high levels of demand forecast accuracy is therefore a key pre-requisite for effective planning and thus should be also reflected properly in the personal targets of all business planning stakeholders.[115]

2.6. Implementation of Integrated Business Planning

2.6.1. Introduction

As being said that the strategy is only as good as its implementation, the same might be used also for the conceptual development of approaches to operational excellence. Company is able to transform them into competitive advantage only after they are implemented in a sustainable way. The following sub-chapters describe the key aspects and challenges of IBP implementation.

2.6.2. Key general aspects of IBP implementation

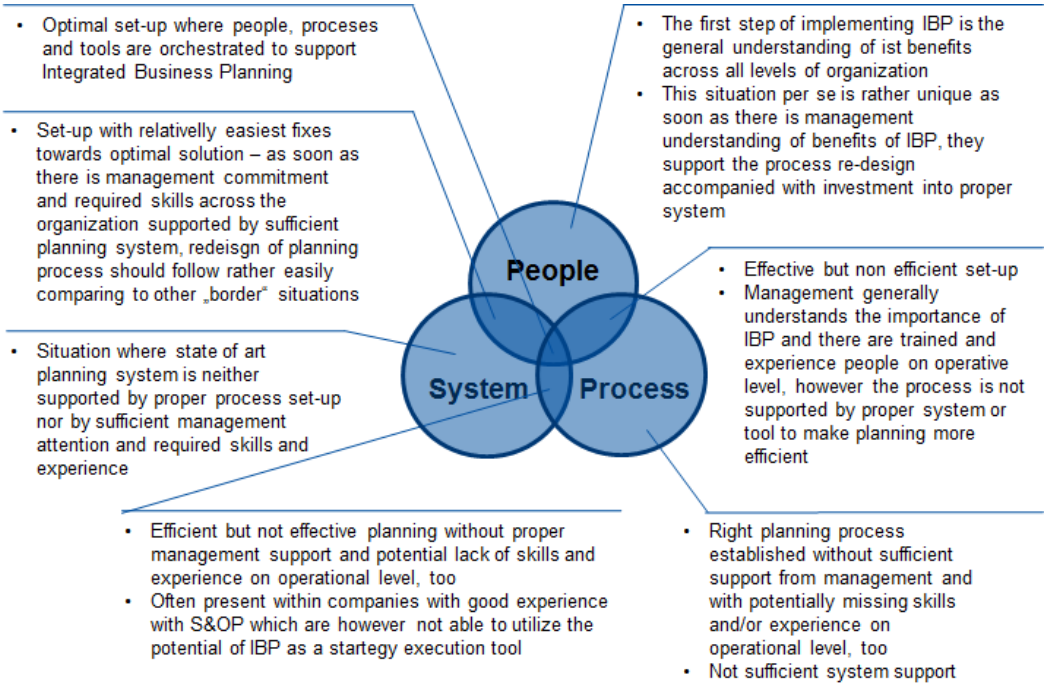
Similarly to other business excellence oriented initiatives, implementation of Integrated Business Planning is a change management project having three

[114] For illustrative purposes, the example is made for typical manufacturing company, however the Integrated Business Planning approach is fully applicable also for distribution or service oriented companies. In that case, manufacturing and operations planning would just be replaced by planning of purchases for further distribution or by planning of service provisions.

[115] With short-to-mid-term focus for Ssales, and mid-to-long term for Product management or Marketing. Supply chain and Finance/Controlling should be challenged equally across the entire planning horizon.

main aspects in focus – Systems or Tools, Processes and People. The relation between those three can be summarized within the view of improvement of effectiveness and efficiency in planning outlined on Figure 37.

Figure 37: People, Process and Tools in IBP Implementation



Source: Author

Generally, it can be said that while effectiveness is about “doing the right thing”, efficiency is about “doing it in the right way”. Applying those two concepts on IBP, it is clear that for example while having the best IT systems can make the planning more efficient, leading e.g. to less manual workload, without the proper management attention and skilled people, business forecasting would be like navigating a Titanic – the right tools would be leading to wrong direction.

Quality of the systems and planning tools on hand is thus creating important pre-requisite for efficient business planning, buts is not sufficient for granting effectiveness. On contrary it’s the people, starting from the commitment from top-management towards training of the IBP concept for people actually

executing plans that makes the planning effective. People aspect thus represents the sufficient condition for effective IBP.

Systems/Tools

With fast development in the field of information and communication technology in the past decades, systems have become integral part and backbones of the companies. Complexity of the business environment, demand for fast processing of large amount data and requirements for on-line overviews and reports supporting business decision making became a must for any company that wants to sustain market competition.

Any attempts to introduce IBP in the company have to encounter the topic of developing a system or tool that would support this process. Although IBP would be possible also without it, it would most likely turn out to be very time-consuming and human resource and cost intensive exercise lacking efficiency. The System also represents the interface between People and Process aspect of IBP and it is thus its key enabler. Design of user friendly tool facilitating the decision making following the gap management structure of IBP is an important facilitator of the planning process.

There are the following most common systems related challenges that the firms have to solve out when implementing the concept of IBP:

- *Various planning and reporting systems for various independent planning processes*

  As described previously, companies are often running multiple parallel planning processing in the ownership of various business functions. Each of these processes is very often supported by tailor-made tool serving well to specific purposes of Marketing, Sales, Supply Chain or Finance, but with limited possibility cross-functional usage.

- *Not unique source of master data*
  In case of existence of multiple planning systems, it is not uncommon that these systems are working with different master data. Typical outcomes are e.g. the absence of certain products or varying characteristics like base units of measure of the same products in various planning systems. The bigger is the misalignment on the master data level, the more difficult is the analysis of volume and value gaps between the planning data in different systems. Setting-up the link to one common source of master data is the key pre-requisite for efficient gap management.

- *Difficult translation of data between different aggregation levels and different planning views*
  As various business functions are having different information needs within their planning processes, they use planning figures in different contexts. Typical examples is the need for calendarized monthly of weekly volume based demand plans needed on individual stock keeping unit level for Operations vs. full year market demands in value and volume views on product group level for Marketing. Translations between different levels of aggregation or eventually contexts of various plans in order be able to compare them is often a challenging task.

- *Different technical platforms used*
  Last but not least mentioned are the varying technical platforms used for different planning systems. They differ commonly from rather simple in-house or externally developed MS Office based solutions towards more sophisticated databases running on MySQL, SQL Server or Oracle based platforms.
  Comparison of the planning data from such diverse system infrastructure requires often lot of manual effort.

Process

The improvement of the process – in this case planning process represents the main subject of IBP implementation. This part was from theoretical standpoint captured in detail in Chapter 2.4.2. and examples of individual process mapping are further outlined further in the Chapter 3.3.2. of this thesis.

People

People represent the key enabler of any process oriented implementation. Therefore it is the People aspect that should be of utmost importance and in main focus. Paradoxical, this area tends to be often omitted or its importance in underestimated. In the change management initiatives like implementation of IBP, sufficient amount of time and related resources need to be considered for training people on the new concept and tool across all levels of organization. Explanations leading to understanding of benefits for each of the project stakeholders will enable getting their buy-in into the concept and makes the whole implementation and mindset change much smoother.

Moreover, keeping reasonably large amount of people involved, at least to some extent, in the IBP concept development, gives them a certain felling of ownership. This may be realized simply e.g. via providing the different IBP process stakeholders representing various business functions with a chance to review and comment on interim agreements. As a result, it than contributes positively to acceptance of change.

3. Applied research - Business Case: Implementation of IBP in a multinational company

"Planning is an unnatural process; it is much more fun to do something. The nicest thing about not planning is that failure comes as a complete surprise, rather than being preceded by a period of worry and depression."

Sir John Harvey-Jones (1778 – 1852)
British Army officer and Lieutenant Governor

This part of the dissertation summarizes author's unique practical experience from leading the global implementation of Integrated Business Planning in multi-billion Euro sales division of multinational chemical company, for which he was responsible as project manager from October 2010 to August 2012.[116]

3.1. Description of the company

Business in the analyzed chemical company is generally structured into six segments. One of those segments is Agricultural Solutions, which consists of the operating unit Crop Protection.[117] In this business segment, the chemical company generated sales of 4,165 million € in 2011 compared to 4,033 million € in 2010. Sales outlook for 2012 is close to 4,900 million €.

Agrochemical company develops, produces and merchandises innovative active ingredients and formulations for the improvement of health and harvest of crops. Thereby, the main focus is on agriculture where it helps farmers and agricultural specialists in their everyday work by offering them products and services. In doing so, it has to deal with constantly changing environment where agricultural companies are growing and getting professionalized, competition is getting stronger and merchandising takes place globally. Moreover, agricultural

[116] The company's details are due to confidentiality reasons provided upon individual request.
[117] For the purposes of this thesis, the operating unit Crop protection of the analyzed chemical company will be further referred to as Agrochemical Company.

enterprises are commonly still family owned and the basis of success is often based on confidence in their business partners – both suppliers and customers. With this in mind, Agrochemical company has to concentrate on the customer focus and the development and preservation of mutual trust in their strategic direction.

The product portfolio of Agrochemical company comprises fungicides, insecticides, herbicides and seat treatments, covering in total more than twenty thousand actively selling articles which makes it one of the leading suppliers in the agricultural sector globally. Products in non-agricultural businesses like mosquito nets for the prevention of Malaria are offered as well. These are summarized under Pest Control Solutions unit and they aim at protecting food, health, homes and water.

The business of Agrochemical company is geographically structured into four regions, North America, Europe including Africa and Middle East, Asia including the Pacific region and Latin America.

3.1.1. Main challenges for planning in general

Operating business on global scale within the environment of high seasonality and demand volatility brings lot of challenges for planning. The main issues the company has been facing can be split into two main parts:

- general market driven challenges defined by nature of the business environment and
- company specific challenges defined by concrete organizational and process set-up of analyzed firm.

The following main characteristics forms the general market based challenges for Sales and Operations Planning in business with agrochemical products.

High complexity of business environment globally

The level of development of agricultural markets differs significantly following different geographical areas. Developed markets in Europe and

Northern America, where agriculture contributes to total GDP of countries only marginally, are characterized by high level of machine automation with minimal portion of labor. On contrary, in developing markets of Asia, Africa or South America, agriculture represents significant share of local economies giving employment to large portion of population.[118] Where the first group of countries is characterized by professional farms of large scale and rather consolidated distribution channels, the second is formed by large amount of small farms sometimes on even individual/family level. These differences require diversified approaches in "go-to-market" strategies with impact on planning. Global supply-chain set-up of the company needs to meet with the challenges of diversified local requirements.

High seasonality and volatility of sales demand

Demand for agrochemical products is characterized by high seasonality as it is generally concentrated around a few weeks during the main crop spraying seasons. In order to maintain constantly high utilization of production assets over time, part of the production needs to be realized significantly earlier than planned sales. Considering negative relationship between the level of forecast accuracy and the time lag for which forecast is done, operations are constantly challenged on meeting imprecisely forecasted demand long time in advance with product supplies.

The demand for agrochemical products is further heavily influenced by the expectations of the price development of agricultural commodities, which are as such difficult to predict. Under high commodity price expectations, farmers are willing to make higher investments into the crop protection assuming higher harvest yields and thus higher realized sales and profits.

In shorter term, the demand especially for fungicide products is influenced by the level of disease pressure on the crops which results mainly from weather conditions, i.e. generally defined by the combination of rainfalls and temperature.

[118] For more detailed information of GDP decomposition in countries globally see e.g. The World Fact book published e.g. at: https://www.cia.gov/library/publications/the-world-factbook/fields/2012.html

As an example, longer rainy period would cause that farmers would need to perform multiple applications / product spraying campaigns in order to protect the crops from fungi. This again immediately impacts the demand agrochemicals.

Strong regulatory aspect

Especially in developed countries, agro chemistry is heavily regulated area due to its impacts on human and animal health and environment. Sudden restrictions posed on certain own or competitors' products may thus have negative influence on the supply of impacted products and thereof also on demand for its substitutes.

Furthermore, the following challenges to planning are linked primarily to the specific organizational and process set-up of the analyzed company.

Functional and organizational split between demand and supply planning

In the analyzed Agrochemical company, there is an organizational and functional split of responsibilities for supply and demand planning. Demand planning is realized mainly by forecast managers located in individual countries. They report to the business head of respective market. This set-up follows the basic logic that demand plan should be realized as close to the final customer as possible to capture the latest trends in expected market and thus also in sales development.

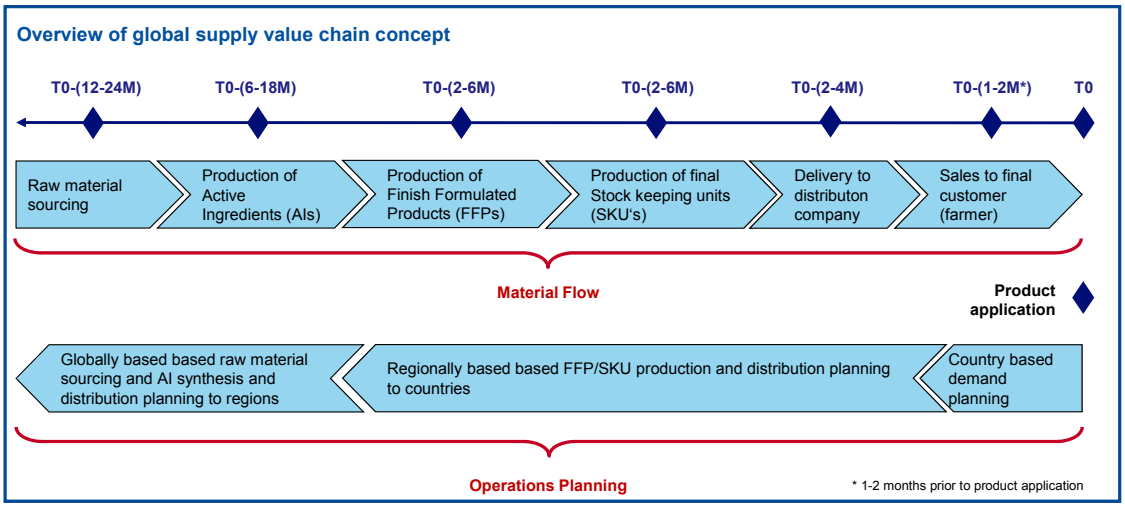
On contrary, supply planning is organized on regional and global level due to specific complex set-up of global operations. The issue of often misaligned incentives leads to the problems in planning and especially inventory management outlined in Chapters 2.3.3. and 2.5.4. of this thesis. The operations planning in general is described in more detail in Chapter 2.2.2..

Complex supply value chain

This point following on previous one is visualized on the Figure 38. The flow of planning data starts bottom up from country level, where demand forecast

is initially generated on the level of anticipated demand for final product, i.e. on the SKU[119] level. This forecast is than consolidated on the regional level to so called FFP[120] level and finally it is aggregated on so called AI[121] level globally.

Figure 38: Overview of Global Supply Value Chain Concept



Source: Author, Internal Expertise – Agrochemical company

The material flow, on contrary follows the reverse direction. AI synthesis is managed on global level. Produced active ingredients are afterwards supplied to the regions, which are responsible for consequent step of formulating the final products. The FFP's are than filled into packaging material, labeled and supplied as final SKU's to the countries, where it is than being finally sold to the customers.

Matrix organization

As most of the global multinational companies, also the studied Agrochemical company was characterized by the matrix organization. The main axes denominating the three dimensional matrix organization are: geography, function and business community. Based on geography, there are four

[119] Stock Keeping Unit represents Finished Formulated Product (FFP) in concrete package size and country specific labels.
[120] Finished Formulated Product (FFP) represents the final product without specification of package size and country of destination.
[121] Active Ingredient (AI) is the core substance of pesticide. It is biologically active and has desired properties that are protecting plants from diseases.

hierarchical levels of organization – *countries*, consolidated over *sub-regions* to 4 main geographical *regions* forming the *global* organization. Furthermore, there is cross-functional split going across all geographical levels covering: Communications, Human Resources, Marketing, Operations, Planning, Controlling & IT, Product safety and registrations, Project management and site services and Research and development. Moreover, cross regions and functions the following communities are established: Branding, Commercial, Global Controlling, Good Laboratory Practice, Product Stewardship, Online and web content, Public and Governmental Affairs and New business development.

Misaligned and independent planning processes

The biggest internal challenge, in fact the main purpose of why the IBP project was kicked-off, was the existence of misaligned planning processes, mainly those of Supply Chain, Marketing and Controlling. The Figure 38 briefly outlines the misalignments between them, which is in further described on higher level of detail on the following chapters.

3.1.2. Main challenges of IBP implementation

On the top of the above mentioned challenges for the IBP concept implementation that were given either by the nature of the industry or by the organizational set-up of the company, there are the following further issues identified, which affect the IBP implementation from project management perspective.

Benefits from intransparency in planning for certain business functions

Although the general benefits to the organization defined by more efficiency in decision-making resulting for higher quality and transparency of planning data are indisputable, there are certain business functions that percieve negative effects of the change. The reason is in the misalignment between set-up of incentives and performance targets. Theoretical basis of this phenomena have

been analyzed in detail in Chapter 2.3.3. of this thesis. In such cases, commercial functions tends to incline to over-forecasting and building in artificial timing and volume buffers in demand plans as this would ensure them more product flexibility via higher safety inventory. In the presence of independent financial/sales and operational/demand planning processes, it would not be uncommon to sand-bag[122] in financial planning and pile up safety inventory via demand planning that served as a basis for production and distribution plans.

Moreover, in Sales driven organizations dealing with products with high profit margins, it is even more difficult to apply the argument of higher inventory costs. Here, the benefits from production of extra sales upside, if it is materialized, will always prevail to higher capital cost bounded in form of inventories.[123]

To sum-up, the intransparency between financial and operational plans combined with disproportional set-up of incentives is often beneficiary for certain business directors that could misuse it for low financial commitments but high safety inventory requirements.

One concept fitting all

The goal of the Integrated Business Planning project was to implement the planning concept that would fit into extremely diverse and complex environment comprising of more than hundred local/country sales organizations differing significantly in size (from almost 1 billion USD yearly sales to few tens of thousands), maturity of processes, people and systems employed. One of the main challenges of the IBP implementation project was to define the concept on sufficient level of detail that would lead to standardization of approach to planning and would be understandable and implementable for every country organization on one side, but at the same time still allow for certain flexibility within which countries could operate. From the early beginning of the project it has been clear that the concept of Integrated Business Planning in analyzed Agrochemical

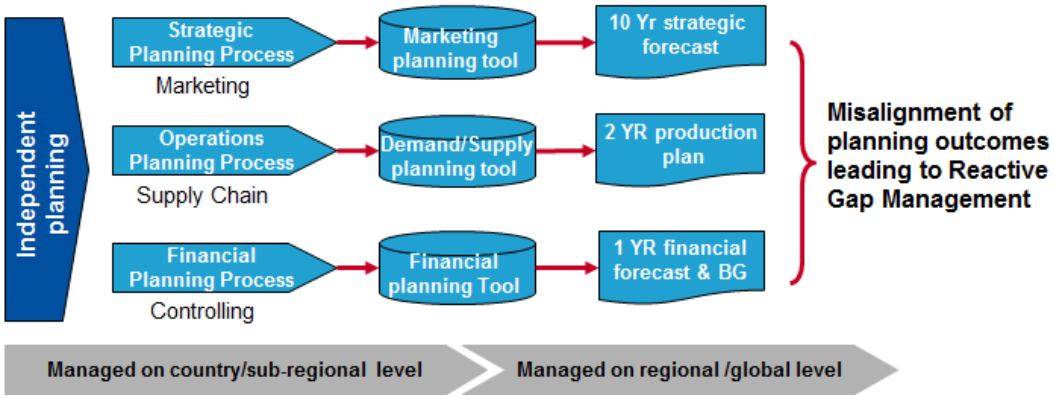
[122] Being artificially too conservative in committing to certain financial targets via submitting sales forecast especially in the cases when the incentive system favors actual overachievement of these sales targets rather that overachievement of actual past performance.
[123] For more information on how to set-up the break-even point see Chapter 2.5.3.

company would have to be defined as certain framework described by a few leading key elements, rather than the detailed rigid planning process description.

3.2. Status prior to IBP implementation: Independent planning

Before the implementation of the concept of Integrated Business Planning, there have been three main planning processes running in parallel in the Agrochemical company. These processes were owned by different business functions, serving different purposes and thus having different informational needs, spanning over different time horizons, using different tools and mainly lacking structured reconciliation amongst them. The as-is situation prior to IBP implementation that could be described as “Independent Planning” as opposite to desired to-be Integrated Business Planning is summarized on the Figure 39.

Figure 39: As-Is planning situation before IBP implementation



Source: Author, Internal Expertise – Agrochemical company

The conceptual, process and output data misalignment was leading to the existence of gaps, whose reconciliation was costing lots of efforts and manual workload. Moreover, intransparency in planning data led to confusion across the organization and limited the effectiveness of business decision making. The natural outcome of such set-up of planning processes was the “Reactive Gap Management”. In such environment, the analysis of gaps between different planning systems capturing the outcomes of various independent planning

processes was performed with significant time lag after the planning cycle was closed. Only after the planning data get consolidated in core systems, it was possible to analyze them on higher level and alternatively challenge back the organizations generating them afterwards. Such time and workload intensive process often resulted in the situation, that once the inconsistency or gap was discovered and understood, it was too late for any meaningful action as resulting production plan has already been executed and finished goods were delivered to country according to indicated demand plans. Moreover, the inconsistency in master data and gaps in product structures over which the planning in different systems was realized hampered even the identification of volume of timing gaps. As an example, some products whose demand was planned in production planning system did not have corresponding sales or marketing plan in financial or strategic planning systems making the gap-analysis impossible.

The following individual key planning processes in analyzed Agrochemical company were relevant for S&OP prior to IBP implementation.

Strategic planning

In the analyzed Agrochemical company, due to long lasting product registration process and complex regulatory environment, the time horizon for strategic planning of Marketing was span over ten years. Within this process called “10 year forecast”, on the platform of tailor made marketing planning tool, the underlying market assumptions were reviewed annually for the period of upcoming decade.

From planning process perspective, Global Marketing unit was sending out their forecasts assumptions through regional organizations to countries and those responsible in the countries were reviewing the 10 Year Forecast on more detailed – product group level. Once countries entered their product forecasts in the tool, these were consolidated over the sub-regions and regions to a global level, where the Global Marketing held an overall coordinating function.

The main purpose of the strategic 10 Year Forecast in Agrochemical company was to provide a basis for key strategic decisions like portfolio analyses

or long-term capacity and supply decisions. Moreover it served as a basis for the strategic controlling and the strategy development for the company.

Operations planning

As mentioned in previous chapter, from an organizational perspective, Operations planning in Agrochemical Company was split up into two main parts: demand and supply planning. Each of these two parts was pursuing different targets. On the one hand, the supply chain organization covering the production and distribution of products was trying to achieve high supply reliability under a given time and product availability and production capacity restrictions. On the other hand, the demand planners were focused on forecasting the future customer demands based on the input primarily from commercial functions as precisely as possible, expecting the forecasted quantities to be available in their respective countries in desired quantities and on time.

System-wise, both supply and demand planning within Agrochemical company has been realized on the SAP based platform called Advanced Planning Optimizer (APO). Architectures of APO Demand Planing (DP) and APO Supply Network Planning (SNP) were used for the purpose of entire demand, supply and distribution planning.

From process perspective, local demand planners in the countries forecasted within monthly planning cycles on calendarized 24 months basis the anticipated sales demand volumes on an SKU level within APO DP. These data were afterwards consolidated over a regional to a global level before their transfer to APO SNP, where supply planning took place. APO SNP offered a set of functionalities for the development of plans which consider the whole supply chain including starting from raw material procurement, through production to distribution planning for a time bucket of months, weeks or days.

Supply planning in Agrochemical company was further divided organizationally into FFP and SKU planning realized on a regional level and on AI planning being executed on a global level. This is related to the material flow in the global supply value chain concept outlined on Figure 38 .

Financial planning

The financial planning belonging to the group of operational planning processes was in the Agrochemical company in the responsibility of controlling function. Within this process, third-party sales, gross profits and market bottom line performance as well as the allocation of costs was planned and consolidated within basic financial statements across multiple group legal entities.[124]

The sales planning process was realized on monthly basis on the platform of web-based information system, which was a tailor made solution for planning, reporting and data analysis used by all business controllers of Agrochemical company globally.

Controllers in individual countries were responsible for compiling a financial sales plan, which was similarly to other two previously mentioned planned afterwards consolidated over a regional to a global level. Sales were forecasted on full year volumes and values for the current year on individual article (SKU) and market level. The main purpose of sales planning was to provide internal and external stakeholders with the information about the latest development of the expected revenues (and ultimately profits) and thus manage the expectations about the planned full year result on regular basis.

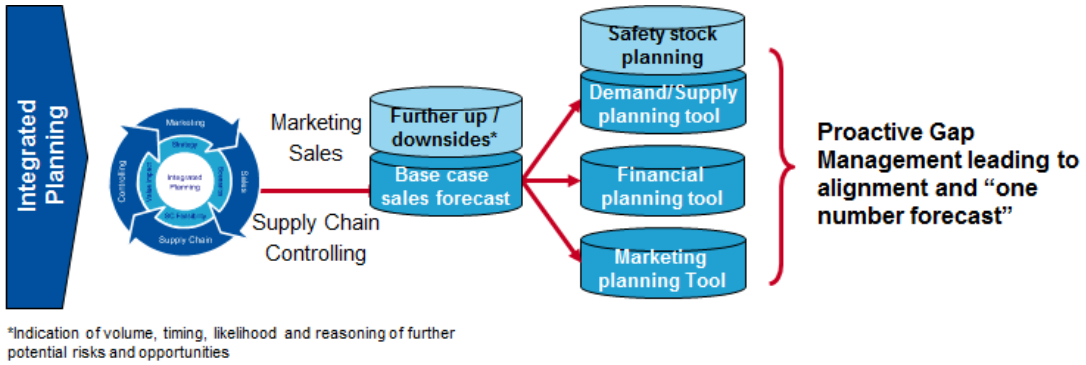
3.3. Status after IBP implementation: Integrated planning

Despite being one of the largest and most profitable companies in the market with agrochemical products, the constant pressures on the increase of operational effectiveness forced management to review the way of how Sales and Operations Planning was structured.[125] Taken into consideration the inefficiencies of the independent planning process set-up existing prior to IBP implementation, the main driver behind the change was primarily based on the need of shifting from reactive, towards proactive gap management and decision

[124] With regards to the goals of this thesis, further focus will be placed only on forecasting of sales to third parties.
[125] For more information on the IBP implementation project see Chapter 3.4.

making mode. The proposed IBP approach for Agrochemical company is outlined on the Figure 40.

Figure 40: To-Be planning approach after IBP implementation



Source: Author, Internal Expertise – Agrochemical company

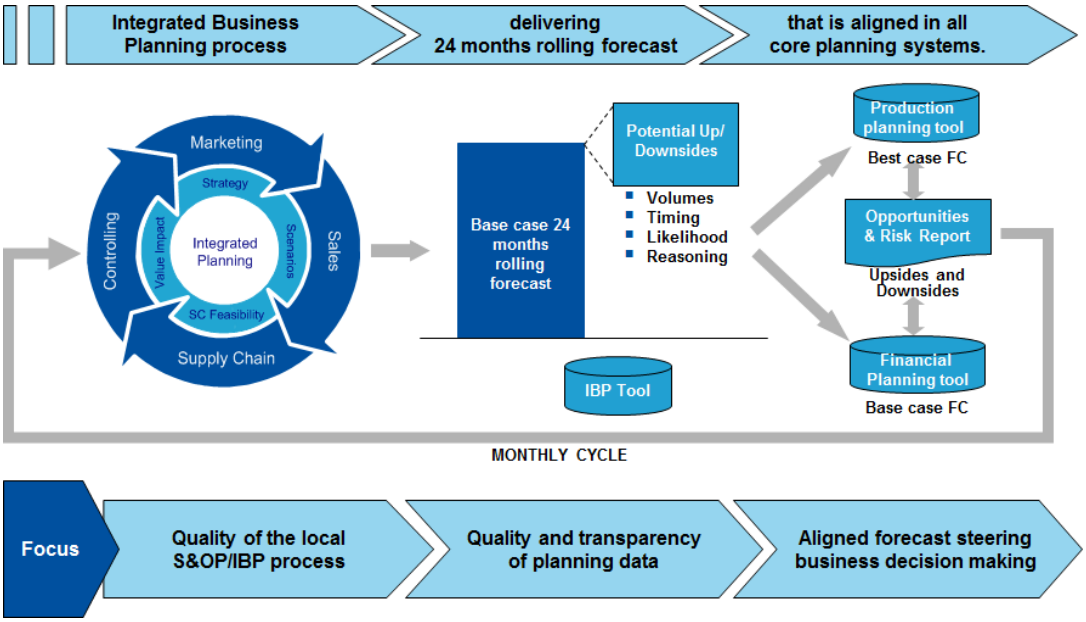
The basic idea lied in the fundamental redesign of approach to planning, starting from on lowest hierarchical level of organization – generally country. The mindset change was supposed to be realized in such a way, that the outcome of monthly IBP process would result in the single base case sales forecast, accompanied with indication of additional potential sales upsides and downsides reflecting further business opportunities or risks. This "one number" base case forecast, replacing the multiple misaligned plans of former individual planning processes, should have been than used within all core systems of the Agrochemical company. In other words, the concept of pro-active gap management was supposed to be established already on country level. Its outcome – the planning data reviewed within monthly planning cycles – should have been aligned bottom-up prior to their consolidation over to regional and global levels.

The idea as such is relatively easy to understand, however rather challenging to bring into life considering all the issues mentioned in previous chapters. Considering the complexity of analyzed Agrochemical company, one of the biggest challenges of global IBP implementation was to define the concept

that would be implementable globally, but still enable for sufficient flexibility that was required to capture at least the main local differences.

On one hand side, the conceptual framework had to be defined on sufficient level of detail to serve as effective implementation guideline globally, but still general to cope with organizations varying from few people to hundreds, and yearly net sales altering from few tens of thousands of US dollars to almost one billion US dollars for largest markets. The high level overview of IBP concept implemented globally in the Agrochemical company is outlined on the Figure 41.

Figure 41: Overview of IP Concept in Agrochemical company



Source: Author, Internal Expertise – Agrochemical company

In the forefront was the improvement of local country based S&OP process. Its content was meant to be formed by structured gap management discussions and mutual agreement amongst all relevant business functions within their defined roles and responsibilities. The outcome of a monthly planning cycle was the base case sales forecast covering the horizon of at least 24 months[126] accompanied with the indication of further sales upsides or downsides

[126] For practical purposes the forecast covers two - three full calendar years so the requirement on at least 24 months of forecast is covered.

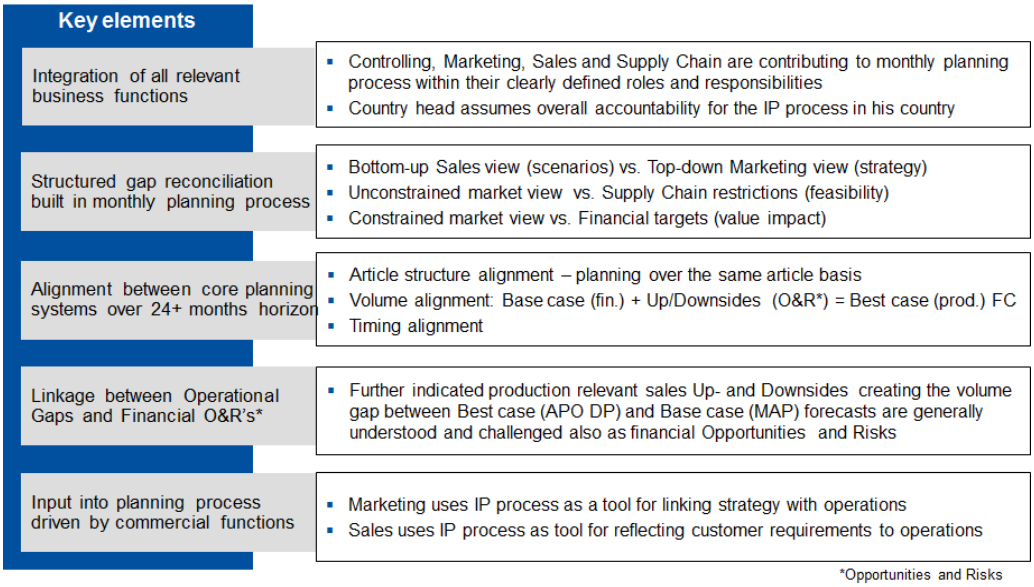
reflecting additional business opportunities and risks. Finally, these figures would be loaded in aligned way for all core planning systems of the company – financial, operations and marketing.

3.3.1. Key elements of IBP concept

As mentioned earlier, the scope of IBP must have been set on the level of principles or framework to be implemented, not detailed and rigid process maps.

Within initial project phases, the concept was shaped following the detailed discussions and workshops with representatives covering all geographical areas, functional communities and seniority levels. Finally, author defines the following the five key elements outlined on the Figure 42 as critical for successful implementation of IP concept in the Agrochemical company.

Figure 42: Key elements of IBP Concept in Agrochemical company



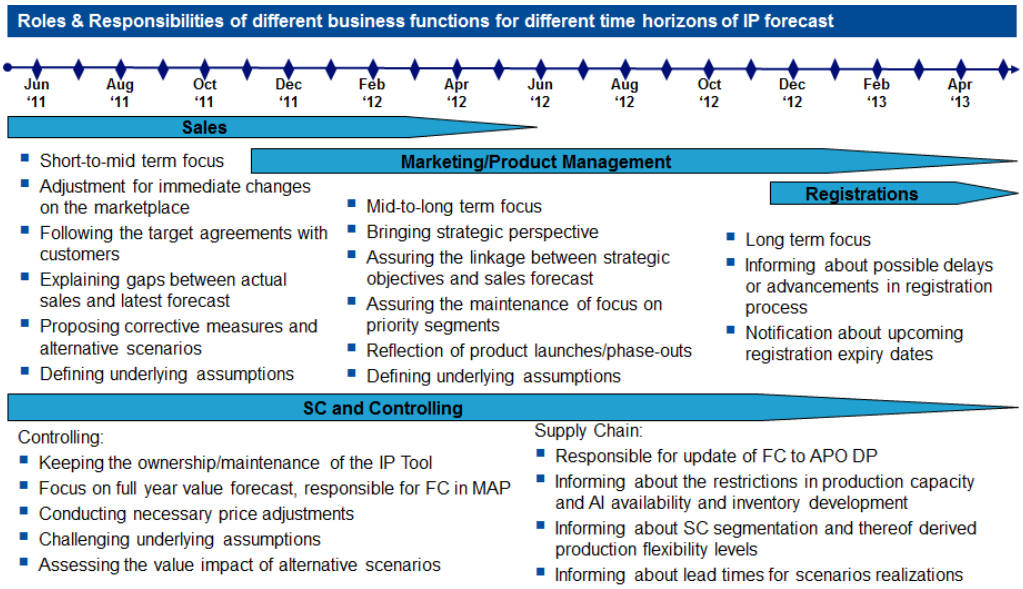
Source: Author, Internal Expertise – Agrochemical company

Integration of all relevant business functions within monthly update of business forecast was the key underlying element. Understanding the benefits of bringing Marketing, Sales, Controlling and Supply Chain round one table to

discuss underlying assumptions of sales forecast and their impact on planning broke the organizational silos and steered cross functional communication.

Proper change management was the main critical success factor in achieving this goal. Buy-in on the IBP concept and its benefits for the organization by the few key decision makers in the Agrochemical company was a key enabler and driver of consecutive overall mindset change. Furthermore, the specific roles and responsibilities of each of the participating business functions had to be clarified upfront. In summary, these are outlined on the Figure 43.

Figure 43: Roles and responsibilities within IBP process



Source: Author, Internal Expertise – Agrochemical company

3.3.2. IBP process

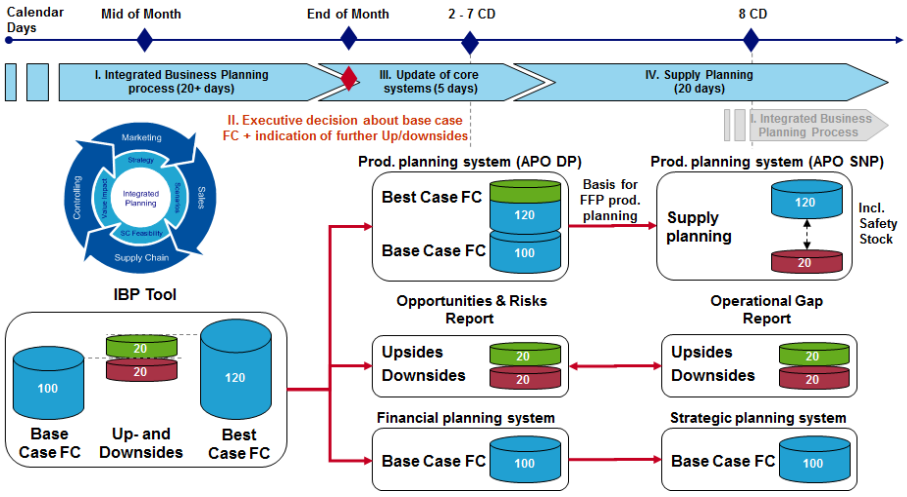
The five key elements of IBP concept defined the general framework, within which the IBP process was designed. Individual country based organizations of Agrochemical company were given certain freedom in the way they set-up their internal IBP process, unless they followed these core principles. The detailed examples of how the planning process was structured and adjusted

to meet individual requirements, complexities and specifics for selected pilot countries are further described in Chapter 3.3.2.2..

3.3.2.1. General overview

The general overview of implemented IBP process is showed on Figure 44.

Figure 44: IP process in Agrochemical Company



Source: Author, Internal Expertise – Agrochemical company

The detailed examples of how the planning process was structured and adjusted to meet individual requirements and specifics of selected pilot countries are further described in the following chapter.

The timing of the individual process steps were restricted by the following corporate deadlines for closing dates of core planning systems:

- 2nd working date: deadline for submission of financial sales forecast
- 7th calendar date: closing of operational demand plan
- 5th working date: final booking of actual sales of previous month.

From the above mentioned deadlines it is clear that the monthly planning process had to be realized within the period starting from when the actual sales are booked and ending before the load of data into core planning system with earlier closing date.

As outlined on the Figure 44, the IBP process can be generally split into the following four key stages. They follow-up on each other and define the monthly planning cycle implemented within Agrochemical company.

Integrated Business Planning process

The first and the most important part of the entire planning process practically covers the entire essence of IBP concept.

Monthly cycle of the integrated planning process starts as soon as the actual sales of the previous months are booked. After this time, analysis of variance between the assumptions about sales related to previous month and actual sales reached that month can be done. The main input to clarification of these differences is brought in by Sales. They are expected to understand and explain, whether the identified variance is driven by timing shift of demand without the change of total expected seasonal or yearly demand, or whether the whole anticipated demand changed.

Afterwards these differences are clarified and short-term measures for closing the gaps defined, the focus is shifted to mid-term future demand. Individual functional representatives within their given roles and responsibilities reviews and discuss forecast data on different level of detail, for different time horizons and different focus and via the process of structured gap management described in previous chapter agrees. In the end, they agree on three basic sales scenarios – Base case, Best case and Worst case. The last two are generated by the arithmetical combination of Base case forecast and further indicated production relevant sales Upsides or Downsides.

Potential issues or topics for further resolution are than accompanying general executive overviews for the main executive S&OP/IBP meeting towards the month end.

Executive S&OP/IBP meeting

Integrated planning process culminates with the executive management meeting. The purpose of this meeting is, apart from conflict and issues resolution,

to present the country management with sales forecast development in order get their final approval prior to loading the planning data into official financial and operations planning systems of Agrochemical company.

Base case forecast representing the most realistic sales plan, which is ultimately transferred into the financial planning system, is also viewed as certain form of sales commitment of local country management to regional and consequently global management team. Therefore, is it the interest of the country head to review the key outcomes of the planning process prior to communicating the revised expected sales forecast.

Updating of core systems

When the country management team approves the proposed changes in the forecast data during the executive S&OP/IBP meeting, these data representing new official financial and operations plans are being further loaded into the core planning system within which they get consolidated to higher hierarchical levels of organization.

The general rule is that the Base case forecast is used in financial planning system, representing the most realistic sales scenario for the country to date. Best case forecast, consisting of Base case forecast and further indicated production relevant sales upsides is loaded into operations planning system and is used as a basis for consequent production and distribution planning.

The reason that the “one number principle” is not followed literally and production is generally aiming for higher volumes than included in financial forecast or management commitment is twofold. Firstly it is the general nature of the business with high volatility of demand resulting in relatively low forecast accuracy. As a result, higher supplies of product where further sales upsides are the most likely should offset potential drops of demand for other products that were over forecasted. The key idea, however, is that the production of upsides is steered by the indication from the units closest to the selling markets and that these upsides forming the operations gaps are also recognized and challenged as further financial sales opportunities, i.e. there is a direct linkage between

operations gap management and financial sales risk and opportunities management.

The second reason for having generally higher number steering production planning is given by the internal nature of business in analyzed Agrochemical company. As it is selling high-end innovation driven product portfolio backed-up by huge investments into R&D, it is realizing more significant profitability margin comparing e.g. to generic companies. As a direct financial implication, in most cases even the low likelihood of additional sales that should be backed up by product supply will be sufficient to outweigh potential additional capital costs of inventories in case the sales opportunity is not realized and the product is kept on stock for the upcoming sales campaign. The more detailed analysis of this aspect is provided also in Chapter 2.5.4.

Supply planning

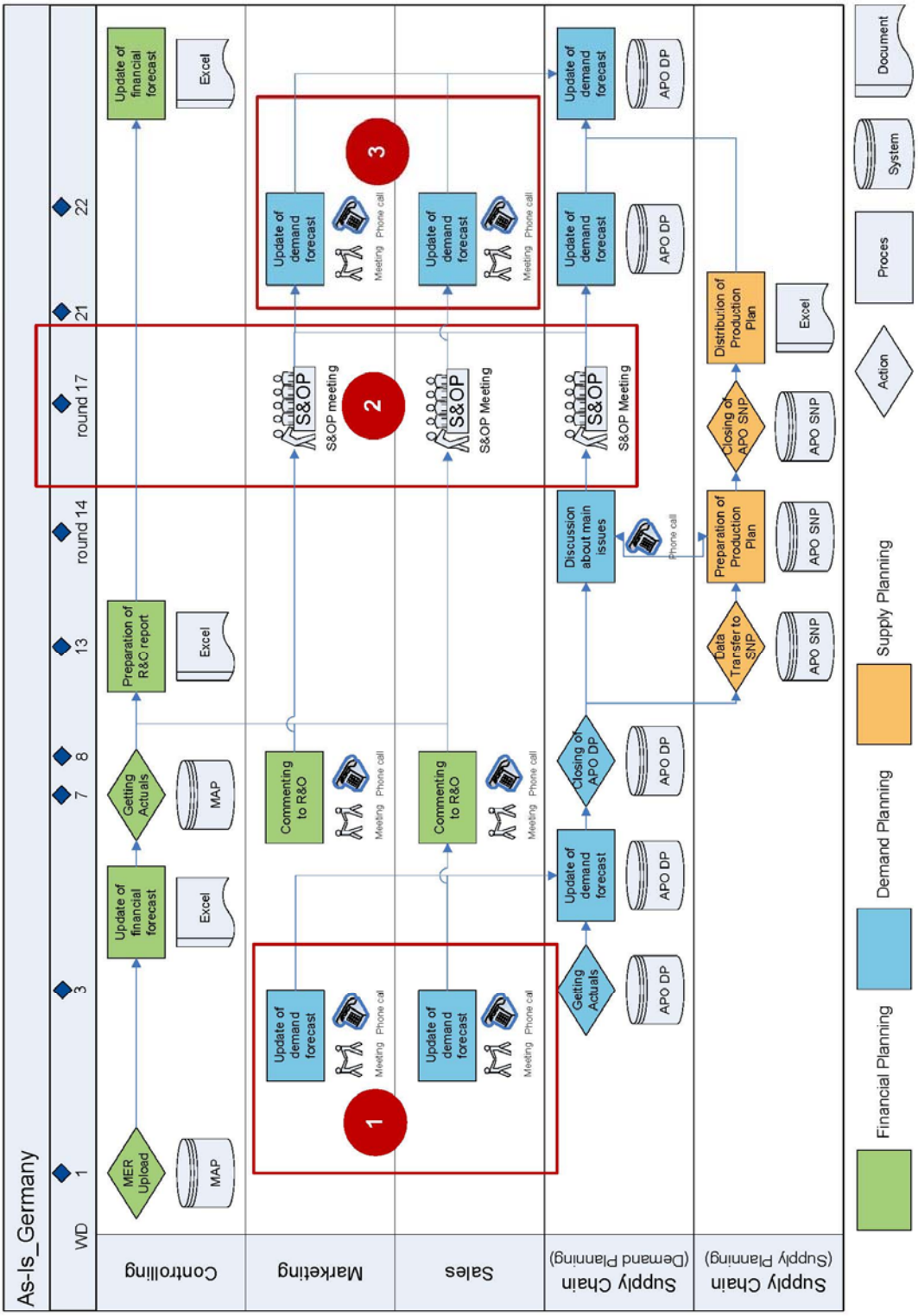
As soon as Best case forecast is loaded into the respective demand planning module of operations planning system and thus the sales demand plan is closed within monthly planning cycle, the detailed supply planning starts. For more information regarding all the consecutive steps included in the detailed operations planning and execution please see Figure 5 in Chapter 2.2.2.

3.3.2.2. Examples of individual countries

On the following pages, the examples of S&OP process set-up of four countries that were used as pilots for testing of IBP concept within the IBP implementation project are described in more detail. On examples of Germany and India, the As-Is situation prior to IBP implementation is compared with the To-Be post-implementation status. The three main issues related to planning are depicted to demonstrate their solving throughout the implementation of IBP Concept. Consequently, another two examples of Brazil and Italy demonstrate how the key elements of IBP were implemented into the local S&OP processes.

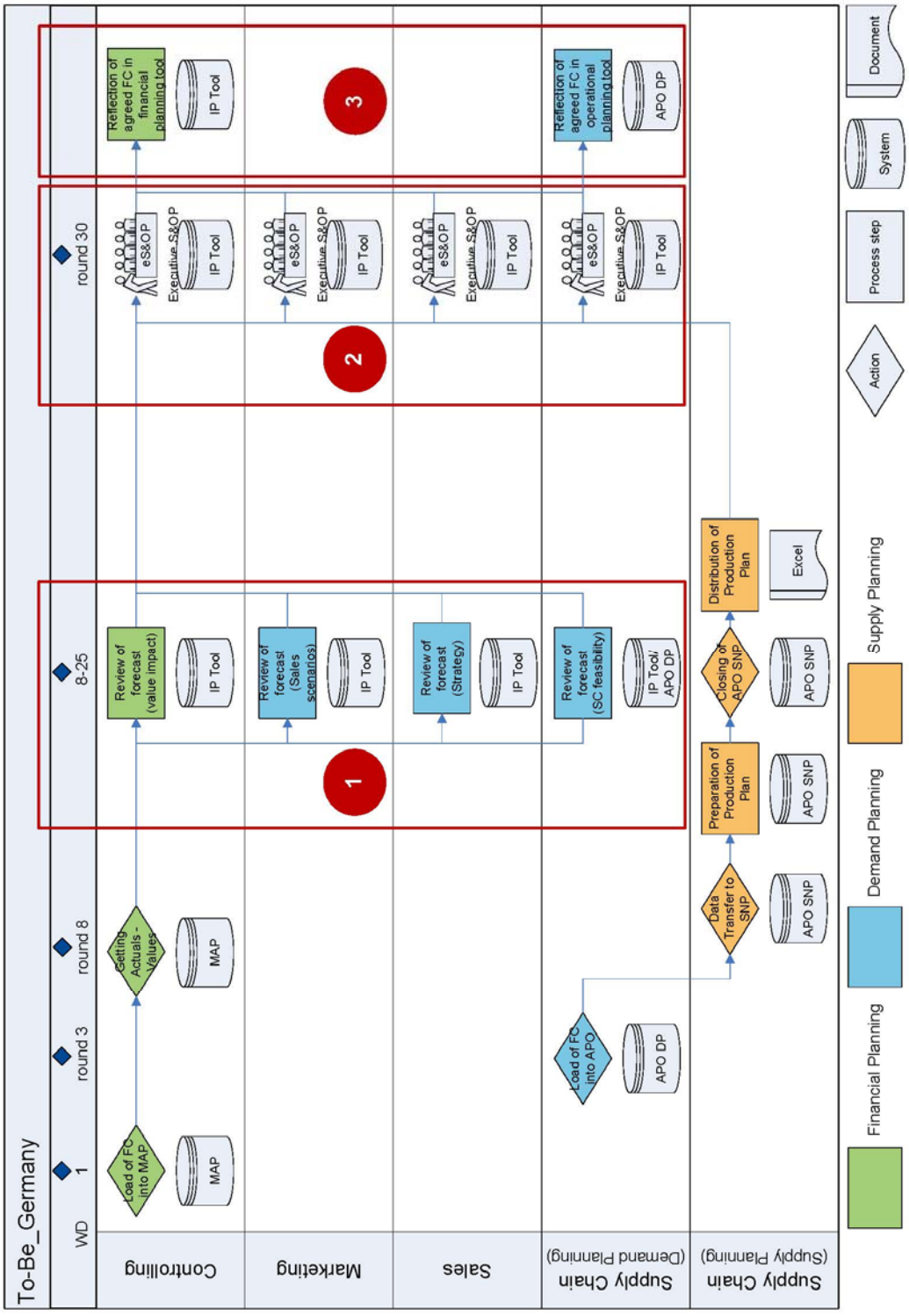
Germany

Figure 45: As-Is planning process - Germany



Source: Author, Internal Expertise – Agrochemical company

Figure 46: To-Be planning process - Germany



Source: Author, Internal Expertise – Agrochemical company

On the Figures 45 and 46, the following inefficiencies of the former "independent" planning process set-up are outlined:

1. *Unstructured information flow*

   Prior to IBP implementation in Germany, the information flow within local planning process was in general rather unstructured, consisting of random and independent calls of Marketing and Sales people to Controlling or Supply Chain demand planner, who were reflecting them in their own excel spreadsheets.
   As a result, there was significant misalignment between product structure used in the financial and operational planning systems making the gap analysis overwhelmingly difficult.
   Establishment of IBP process and its recognition by local management as the key platform for operational management of the business helped to streamline information flows and gave them concrete structure and form. All the information about the market and sales development are now reflected in so called IBP Tool[127], where the planned can get direct feedback regarding the implications for financial and operations forecast. As mentioned by the Head of Controlling, Strategy and Processes for Germany, Benelux, Austria and Switzerland: "After the implementation of integrated business planning process and tool, we finally have the platform for structured discussions. As we can immediately asses the value impact of all the volume based proposals, the previously endless discussions about possible sales scenarios were replaced by very efficient decision making process."

2. *Incomplete S&OP meeting in the middle of the month*

   The key S&OP meeting prior to IBP implementation was more the discussion with hardly recognizable structure and format between Commercial functions and Operations. Controlling/Finance has not been

[127] For more information on IBP Tool see Chapter 3.5.

present and it was not generally recognized as a key business decision making meeting of country management. Moving the executive S&OP/IBP meeting towards month's end enabled to translate the most recent information from the market into the financial and operations plans simultaneously. With proper attention of the entire management team and inclusion of key representatives from all business functions, the quality and weight of the process and its outcomes increased significantly.

3. *Constant changes of data*

   As a combination of point 1 and 2, the forecast was under constant review without creating additional confusion in the organization. In general, there was no point in time where if the consensus on one set of numbers would be reached across the management team it would be consistently used in steering financial and operations planning simultaneously.

India

On the Figures 47 and 48 below, the following inefficiencies of the old "independent" planning process set-up are outlined:

1. *Split between value based planning of Controlling and volume based planning of Operations*

   One of the key inefficiencies of the monthly planning process of India prior to IBP implementation was the split between value and volume planning. Despite the fact, that also the sales planning of Controlling having the financial value in forefront should have been based on quantities to be sold for respective prices, these quantities very often did not correspond to the volume based operation plan that was steering production planning. As a result, there was significant volume gap existing between the two plans causing confusion mainly outside the local organization. Structured inclusion of Controlling function in relatively well established operational planning process helped to align the plans, bring more realism into

volume part of financial sales planning and thus also improved financial forecasts via more precise product split. Moreover, Controlling with their value view became important business partner for commercial and demand planning functions during decision making within IBP.

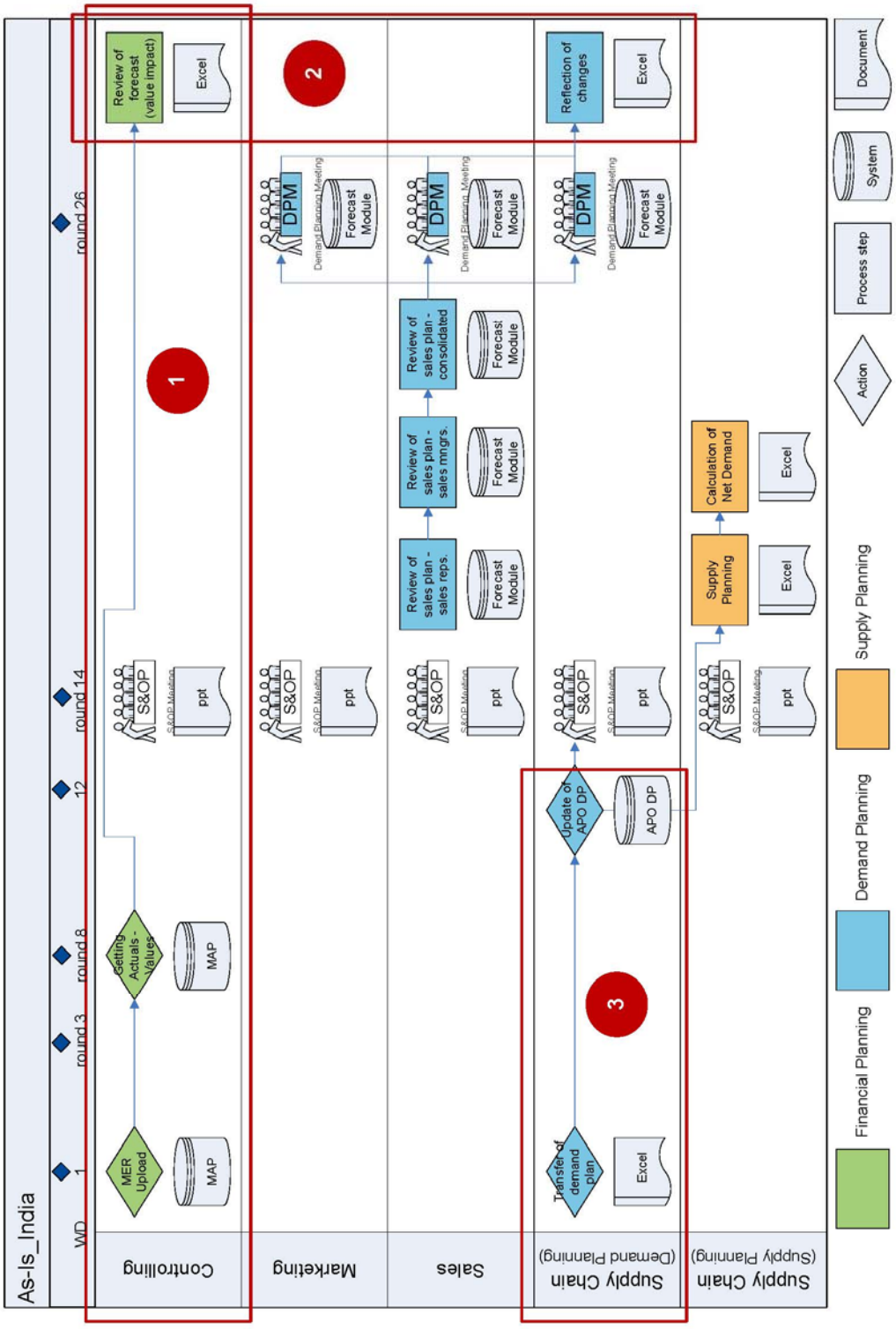
2. *Misaligned financial and operational forecasts ´*

   Similarly to the case of Germany and as a result of point one, there was misalignment between financial and operational forecast. As Controlling was not part of final demand review meeting that included commercial and demand planning functions, financial sales forecast has not been updated for the most recent changes on the market place.

3. *Long timing gap between decision is made core systems are closed*

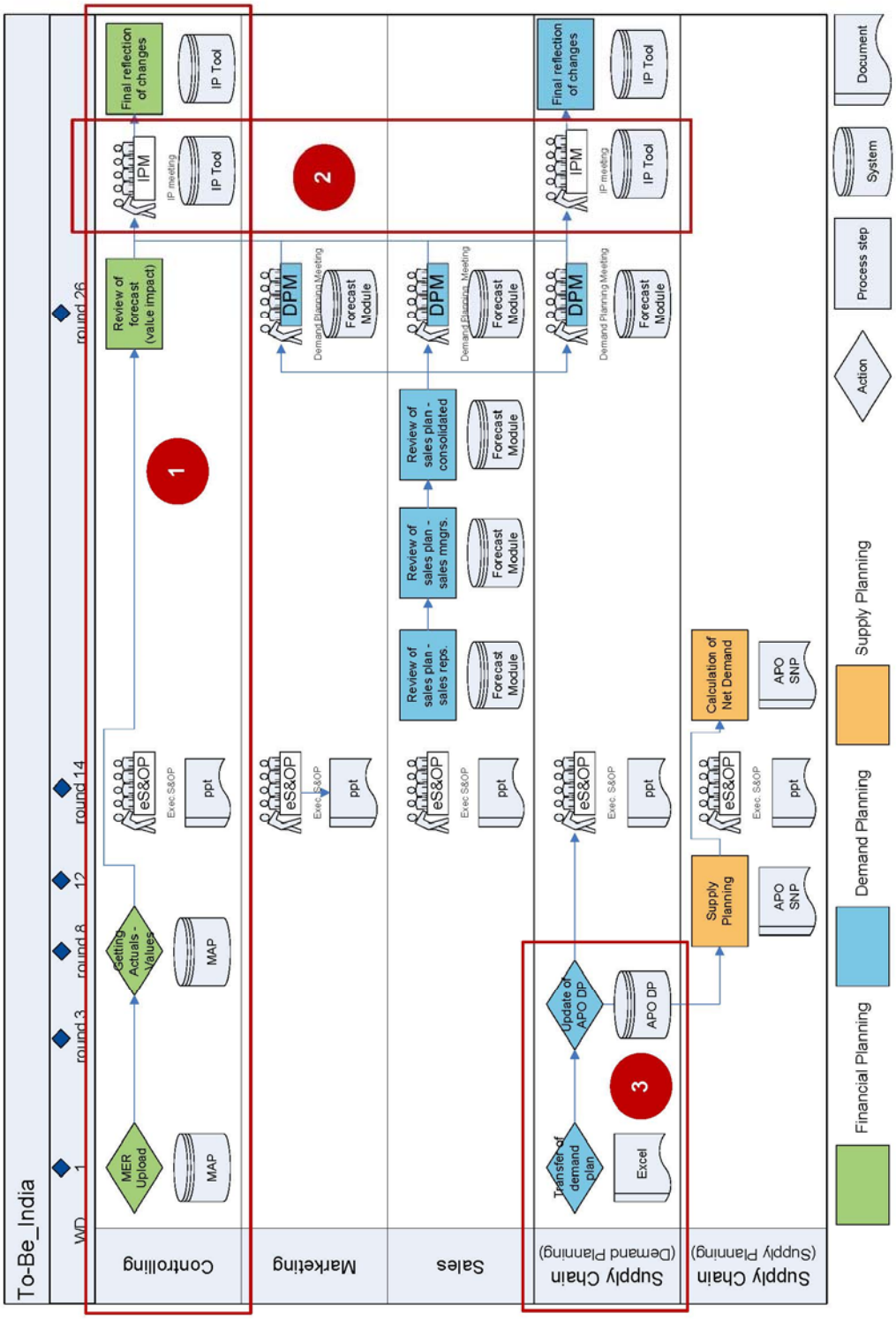
   One of the main issues that had to be solved within IBP implementation in analyzed Agrochemical company was relatively long time gap between the closing dates of financial and operations planning systems. As a result, in case the decision was made prior to the first closing date of the two systems and one number principle should be obeyed, the other system which closing followed some ten days afterwards could not reflect this most recent information. Therefore, as a result, either the first system would work with outdated information at the time the second of the systems was closed, or there will be misalignment in data, although each system would reflect the most accurate at the time of its closing.
   The solution brought by IBP implementation was shifting the closing of the second, operational planning system as close as technically possible to the first, financial planning system and thus closing the timing gap. As a result, after the executive decision was made towards the month's end, both systems could have been updated with the most recent and accurate information about planned sales forecast scenarios.

Figure 47: As-Is planning process - India



Source: Author, Internal Expertise – Agrochemical company

Figure 48: To-Be planning process – India



Source: Author, Internal Expertise – Agrochemical company

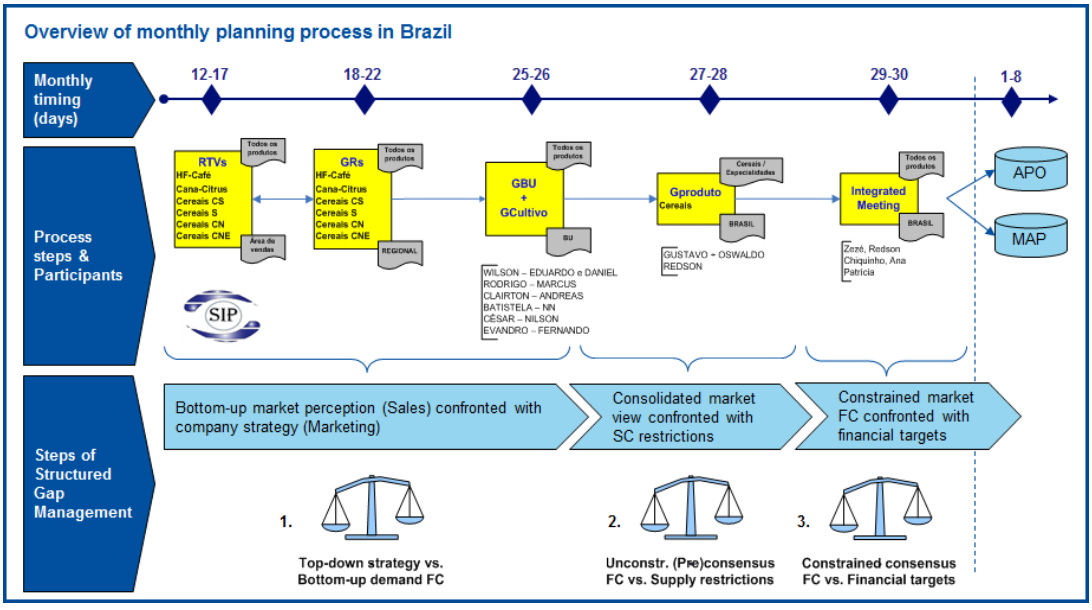
Brazil

On the example of to-be planning process set-up after IBP implementation in Brazil is showed, how the structured gap management described in theoretical part in Chapter 2.4.2. was set in praxis.

Brazil represented one of the biggest and most complex markets for analyzed Agrochemical company. Due to the size of the organization, the update of forecast cannot be “run from one table” following the discussion of a few people as for the case of smaller countries. It is organized via multi-step process aggregating and consolidating the information throughout several levels of organization.

As can be seen from the Figure 49, the deadlines for the closing of core planning systems were defined centrally for the first week of the month; therefore the planning cycle had to be organized throughout previous month leading to final executive decision in the month’s end.

Figure 49: Example of structured gap reconciliation - Brazil



Source: Author, Internal Expertise – Agrochemical company

The planning cycle was adjusted to start roughly in the middle of the month with the update of forecast from Sales. Sales representatives in different areas of Brazil updates their expected sales forecast on product/customer level for the current year.

Throughout the third week of the month, this Sales forecast was consolidated bottom-up over different areas and regions up to full market level, where it met the top-down view of Marketing. It was also the marketing who reviewed the forecast over the planning period beyond current year. Roughly on the 25th calendar day, the discussion between the head of Marketing and Sales resulted in the agreement on so called "pre-consensus unconstrained forecast.[128] Consequently, this market view was confronted with restrictions from Supply Chain and identified gaps were closed resulting in the agreement on "pre-consensus constrained forecast". The last, third level of gap management came into place when so far predominantly volume based sales plan got the value perspective through the review of pricing assumptions and it was compared with financial targets.

The purpose of the final "Integrated meeting" in the month's end was to resolve potential issues that came out of the three gap reconciliation rounds in order to achieve the consensus on the "one number" forecast across the entire organization.

Italy

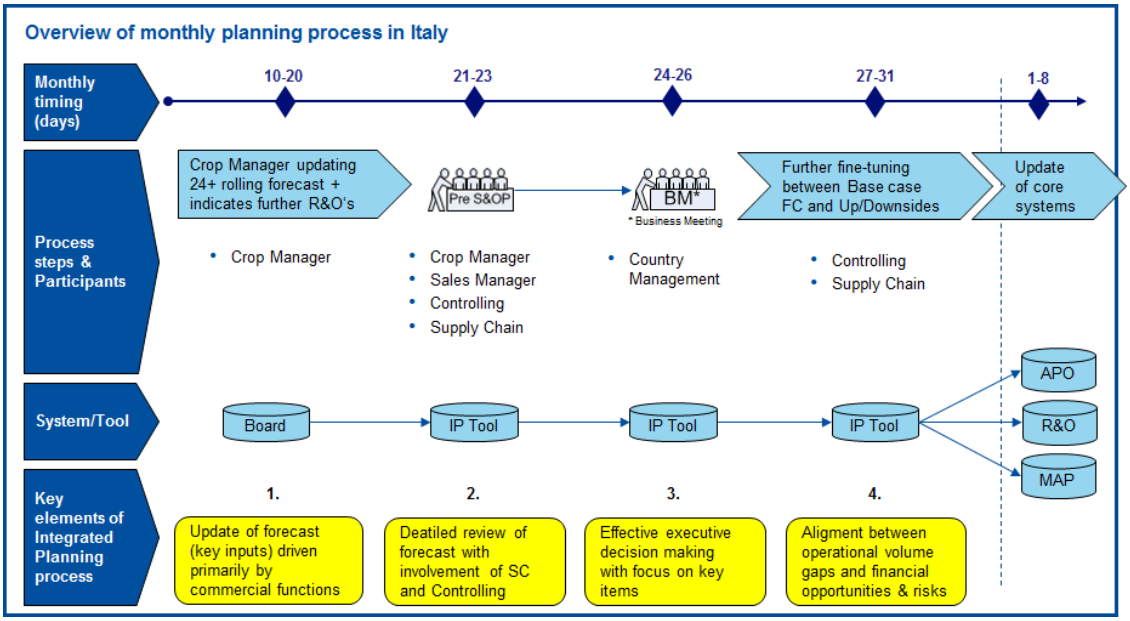
On the example of to-be process set-up implemented in Italy, the key elements of IBP concept are described. Similarly to all other countries, corporate deadlines on the closing of core planning systems forced the planning cycle to be realized within the time frame of calendar month with executive decision aimed towards its end.

As outlined on the Figure 50, during the second third of the month, product manager representing the operational marketing was updating the forecast on

[128] Pre-consensus as it has not yet been approved by country head, and unconstrained as it has not yet been confronted with supply restrictions.

the product full year level for the period covering the next 24 months. Thus the requirement, that it is the commercial functions responsible for updating of sales forecast was met.

Figure 50: Examples of key IP elements built in the planning process



Source: Author, Internal Expertise – Agrochemical company

This detailed update was further followed by the pre-S&OP/IBP meeting, where the data were reviewed and the feedback from other business functions was provided. Sales were reflecting the target agreements with customers, Supply chain the production limitations and Controlling the value impact. The higher level overview together with potential issues is than presented on the consecutive main executive S&OP/IBP meeting.

This set-up supports the requirements of IBP concept aiming at the efficiency of the process, i.e. that the forecast should be reviewed in more detail prior to executive meeting, where only the key issues are presented and resolved.

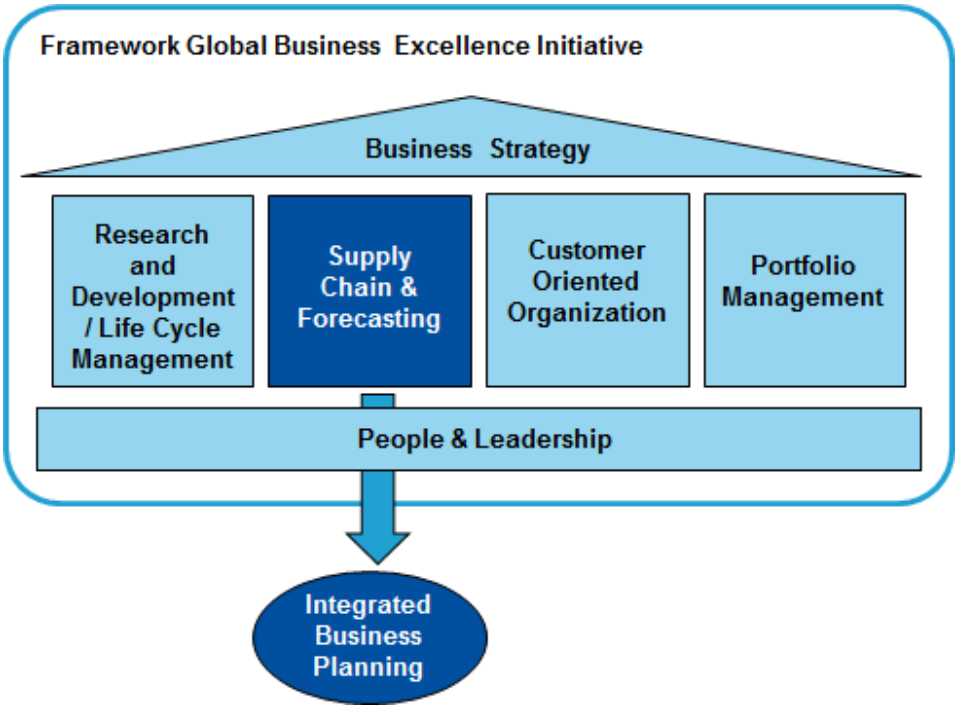
In case any adjustments are proposed during the executive S&OP/IBP meeting, they will be further reflected simultaneously in the detailed financial and operational plans before loading into core systems. Another important element of IBP – the alignment of forecasts is thus respected.

3.4. Project of IBP implementation

The project “Integrated Business Planning” came out as one of the implementation work streams of broadly defined business excellence initiative under patronage of president of Agrochemical company and his global executive management team.

Within this initiative, most of the extended management team members of the company were interviewed in order to identify the key issues and bottlenecks for business excellence of the company. The overview of the key pillars of initiative is depicted on the Figure 51.

Figure 51: Business excellence initiative as a basis for the IBP project



Source: Author, Internal Expertise – Agrochemical company

The global business excellence initiative was realized under the umbrella of the overall company’s strategy with five additional blocks covering the most important areas for each of the core business functions. Based on the general cross functional topic of People and Leadership, Research and Development

functions sponsored the module covering the life-cycle management, Supply chain and Controlling were focused on forecasting, Sales on customer orientation and Marketing on portfolio management.

3.4.1. Implementation set-up

Due to the challenges given externally by general characteristics of agrochemical market as well as inherent organizational set-up of the company described above, the two-step approach was applied for the implementation of IBP concept. In the first round, concept was tested in selected pilot countries in order to simulate the complexity and diverse maturity of planning processes, tools and people across the four global regions. After concept roll-out in pilots, collected feedback was used to further fine-tune the process set-up and tools used for the consecutive global IBP roll-out.

The following countries were selected for piloting phase: Germany, Italy, US, India and Brazil. Under the sponsorship of Head of Global Controlling, Head of Global Operations and head of one regional business unit representing the commercial side of the business.[129]

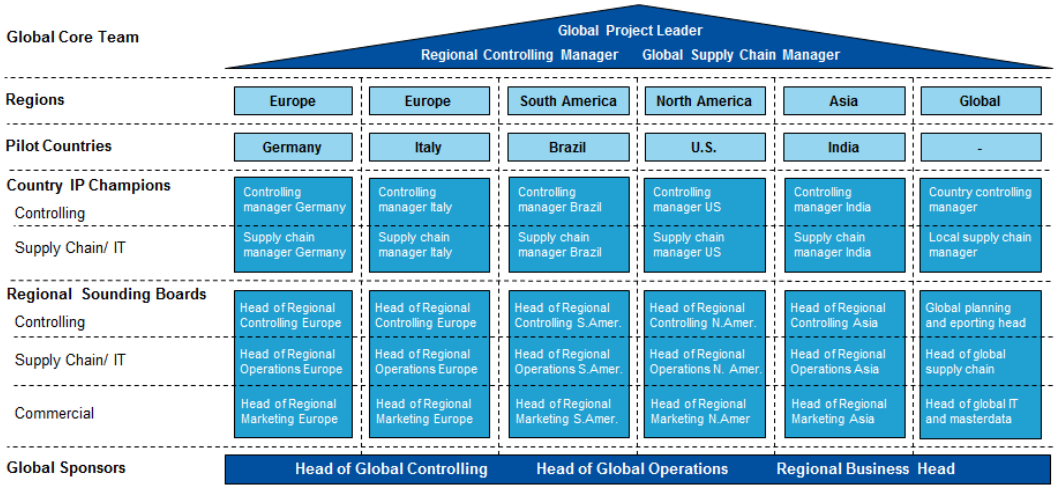
Global Core Team consisting from experienced project manager; controlling and supply chain managers were nominated. Furthermore, within each of the pilot countries, representatives from Controlling and Supply Chain function were defined as local IBP Champions responsible for driving the implementation efforts locally. For steering the implementation in different regions, cross functional sounding boards were nominated in each of the global regions, too. Their role was to shape the concept especially in the initial stages via expert insights and feedbacks, as well as to serve as change champions in their organizations. Especially, the latter point turned out to be one of the critical success factors of the entire IBP implementation.

Figure 52 describes the implementation set-up for the piloting phase. It was important to include the representatives of both most affected business

[129] All three were the members of Global executive management team of the Agrochemical company, i.e. the level Vice and Senior Vice Presidents.

functions – Controlling and Supply Chain on all levels of implementation set-up, from Global core team, through country champions, regional sounding boards as well as global sponsors. Moreover, mainly in order to provide sufficient emphasis on the participation of commercial functions in the IBP process as its key input driver, representatives of regional Marketing were nominated into the regional Sounding boards, serving later as steering committees for regional executive S&OP/IBP meetings.

Figure 52: IBP Implementation set-up for the pilot phase



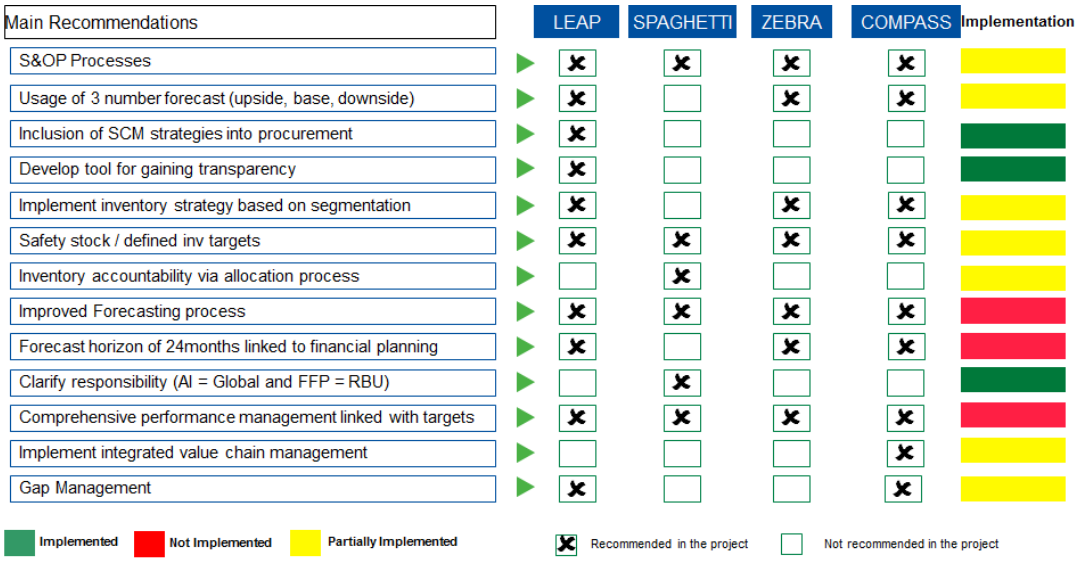
Source: Author, Internal Expertise – Agrochemical company

Sound mixture of seniority levels, strategic and operational thinking as well as project and change management experience was combined in order to form a balanced team structure for the project of such type. This seemingly overstaffed set-up turned out lately to be another critical success factor for the IBP implementation.

As outlined further on Figure 53, there have been numerous projects with similar S&OP improvement ambitions in the past launched in the Agrochemical company, that failed to deliver expected results. As identified by internal analysis, one of the most common reasons for unsuccessful implementation of defined

project targets was imbalanced representation of various business functions in the implementation teams.[130]

Figure 53: Overview of the previous project of similar focus



Source: Author, Internal Expertise – Agrochemical company

3.4.2. Implementation timing

The project was realized in the time horizon from October 2010 to August 2012. It was split into the following six key stages as outlined on the Figure 54 further belllow.

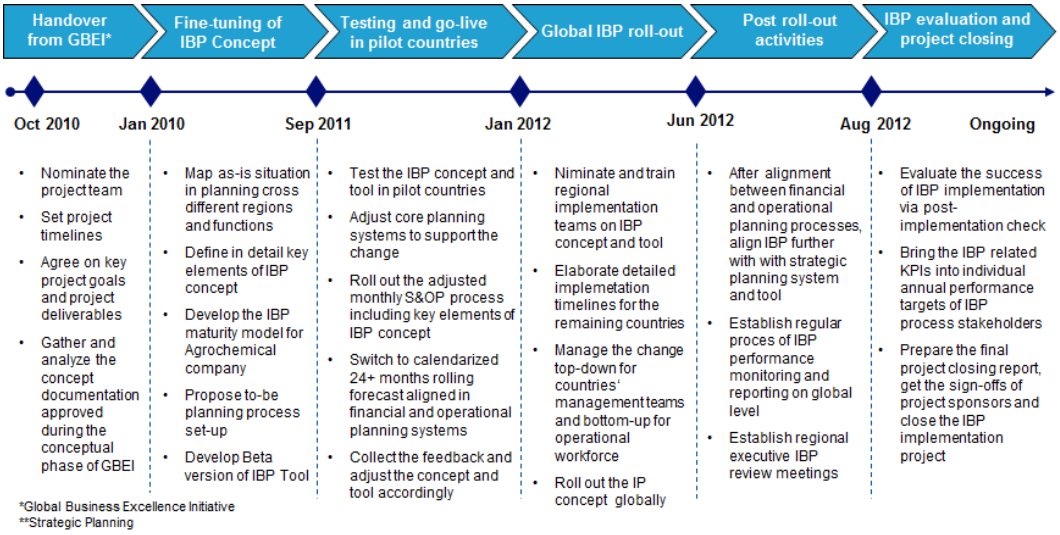
Handover of the IBP implementation work stream from high level conceptual phase

As mentioned earlier, the IBP implementation was defined as one of the implementation work stream of much broader Global Business Excellence Initiative (GBEI). After the Global core team members were nominated and their roles and responsibilities agreed on, the focused was shifted on the finalization of the following actions:

[130] Source: Internal expertise from analyzed Agrochemical company

- Hand-over of all conceptual documentation and previous workload and conclusions from GBEI team[131]
- Preparation of Implementation timelines and set-up for the approval by project sponsors
- Appointment of local IBP Champions and regional IBP sounding boards
- Definition and agreement on the key expected project benefits and deliverables

Figure 54: Main stages of IBP implementation



Source: Author, Internal Expertise – Agrochemical company

Fine-tuning of IBP concept

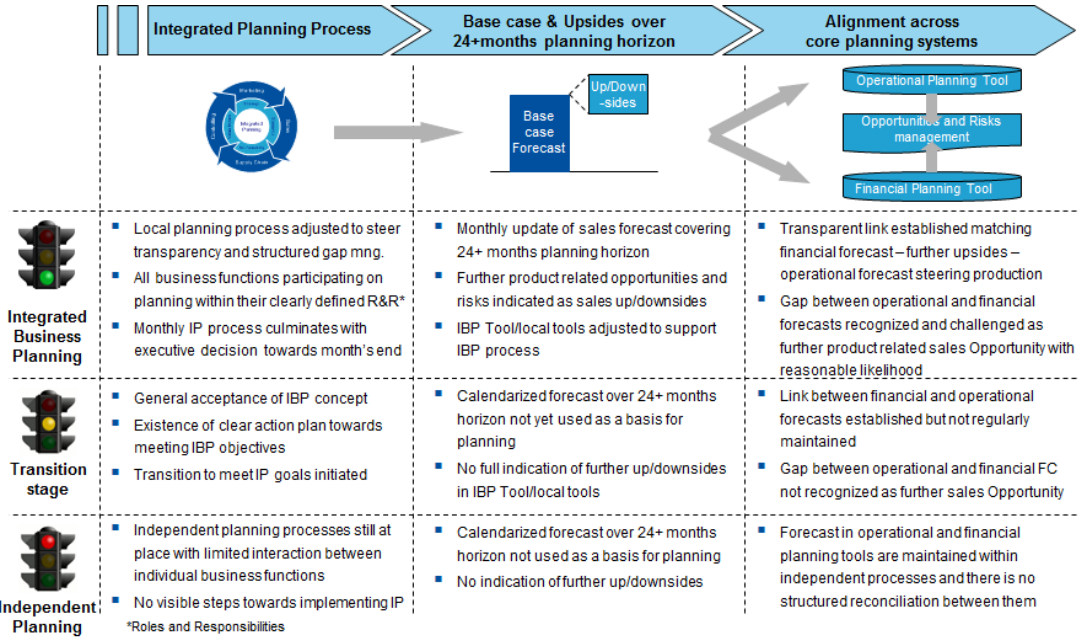
The first step leading to the factual implementation after the project was successfully launched was to further define the next level of details regarding the IBP concept. Several stages of planning process maturity were identified in order to help with positioning of individual pilot countries on the implementation path.

[131] Unfortunately, due to personnel changes, nobody of the initial concept definition phase from GBEI could take part also on the consecutive implementation. The biggest disadvantage was that lots of knowledge was gone and had to be rebuild again. On the other hand this helped to bring some fresh ideas and certain freedom into the further concept fine-tuning.

Within the period of 4-5 months, cross functional workshops in pilot countries across the four global regions were held in order to map the current processes and define common framework for the to-be integrated planning process. Moreover, local specifics reflecting the differences in systems, processes and management views on planning were discussed in this stage.

The criteria summarized on the Figure 55 were further applied to position the actual stage of planning process maturity of each pilot country against the best practice.

Figure 55: Stages of maturity of IBP in Agrochemical company



Source: Author, Internal Expertise – Agrochemical company

In parallel, requirements on to-be concept were collected and incorporated in the final conceptual proposal. From project management perspective, understanding of individual needs and issues in planning across different business functions and seniority levels followed by the proposition of their solution by project team was an important factor for successful management of change. Conceptual work was accompanied with system development requests from different planning stakeholders as a preparation for the design of Integrated

Business Planning tool.[132] This project stage was closed by sign-offs on the key conceptual details by project sounding board.

Testing of concept and go-live in pilot countries

As soon as the conceptual details regarding the process and system set-up were finalized, IBP was rolled out in pilot countries. Within defined roles and responsibilities of different business functions, new approach to planning process accompanied with the release of the first trial version of IBP Tool was launched. Important feedback especially on the functionalities of the IBP Tool was collected to be further programmed before the planned global roll-out. From the project management perspective, successful go-live phase in pilot countries was an important pre-requisite for consequent full-scale implementation in the remaining countries. Realizing that the Agrochemical company matured to the stage, where increased transparency and cross-functional alignment in planning was generally accepted and perceived as positive, was important milestone of the project. Moreover, selection of pilot countries covering great portion of overall complexity also enabled to capture most of the potential issues and hurdles up-front prior to further global roll-out.

Global roll-out

After successful launch of IBP concept and tool in five pilot countries and further fine-tuning and adjustment of concept of IBP Tool was made, IBP was ready to be rolled-out in the rest of Agrochemical company covering more than 70 additional country organizations.

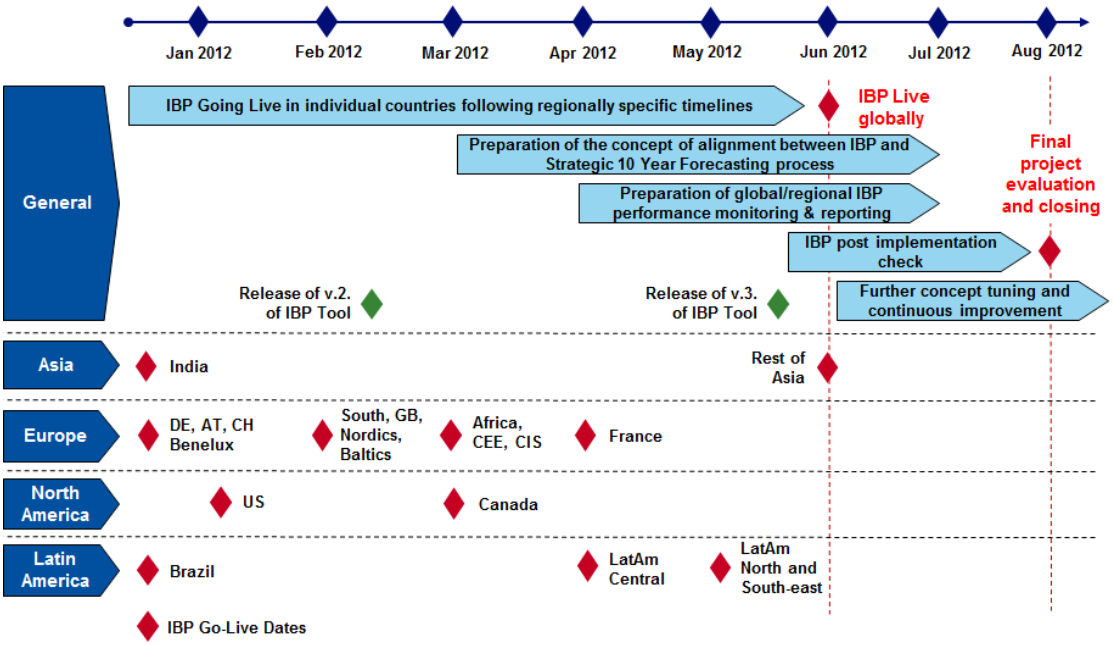
This step was accompanied with the transfer of responsibility for factual implementation from Global core team to regional implementation teams that has been established in all four regions globally. One regional level, one representative from controlling and one from supply chain accompanied with the person from respective pilot country from previous project stage, took over the previous role of Global core team for their region. Global core team assumed the

[132] For more information about the IBP tool see Chapter 3.5.

overall accountability for the implementation and its role was switched from project to more program management coordinating the efforts of individual regional implementation teams. Also, further development of IBP tool as a central IBP platform stayed within responsibility of global functions.

Individual time lines for each of the regions were agreed following various local resource constrains resulting from other corporate or business unit initiatives running in parallel with IBP project. Within the period of first half of 2012, more than 70 countries successfully adjusted their planning processes and adopted the IBP concept and tool. Figure 56 shows the global overview of the final two stages of the IBP implementation project.

Figure 56: Overview of global roll-out of IBP in Agrochemical company



Source: Author, Internal Expertise – Agrochemical company

Post roll-out activities before project closing

As outlined also on the Figure 56, the stage covering three months period before the IBP concept was rolled-out globally and the final project closing, was full-filled with the following key activities:

- *Sustainability concept*

  One of the main issues from previous projects with similar scope in Agrochemical company was the problem of sustainability of implemented solutions. In order to assure that IBP concept will remain as globally followed approached to S&OP, the responsibility for its maintenance had to be transferred from temporary project team to stable organizational structures. In initial project stages, the focus was heavily oriented on local, country based organizations where the forecast data were supposed to be generated. In the last project stage, it has been redirected to regional organizations with establishment of regional executive IBP review meetings. Their purpose was to present the regionally consolidated outcomes of local IBP processes to regional management, identify potential issues and challenge back the countries if needed.

  Due to the scope of regional manufacturing and supply-chain set-up for finished formulated products, these meetings was also serving as a problem resolution sessions in case the bottom up indicated demand forecasts hits supply bottlenecks and decision about available product allocations had to be made.

  Via incorporation of tracking IBP performance into regular monthly local and regional meeting structures, sustainability of IBP was assured.

- *Global IBP performance monitoring and reporting*

  To steer the global transparency and in order to optimize the efforts in analyzing the IBP outcomes on regional levels, the global IBP performance monitoring and reporting structure was established. Its main purpose was to provide regional and global management with the high-level overview of gaps between operations and financial forecasts and thus also indicate potential development of future business in terms of further financial opportunities and risks.

The three main areas for reporting were focused on 1) master data quality in terms of alignment of product structures over which financial and operations planning was realized, 2) Gap overview for the main active ingrediences and product groups[133] 3) tracking of forecast accuracy KPIs following the globally unified methodology.

- *Alignment between Strategic 10year forecasting and IBP*
  The scope of the IBP implementation project was focused heavily on the transparency and alignment between financial and operations planning processes. Both of these processes were characterized by similar level of detail in focusing on rolling calendarized sales forecast on SKU level spreading over 24+ months planning horizon.
  As mentioned earlier, on the top of these two processes, there was the third core planning process of Marketing focusing on long-term strategic aspects of business and related portfolio development. It was called 10 year forecasting and its focus was on product group level, non-calendarized (i.e. full year) sales forecast over upcoming decade and it was updated once a year.
  The alignment between this strategic planning process and IBP was accomplished in two ways. Firstly, the representatives of Marketing on local country level responsible for annual update of 10 year forecast were also involved regularly in local IBP process. They role was to review the updated plan on higher level aggregated level and proposed the adjustments mainly beyond current year horizon in case that key underlying assumptions for the forecast has been changed. Secondly, there was a once a year transfer of planning data established between financial and marketing planning systems assuring that the first two years of 10

[133] Similarly to pharmaceutical industry, a finished formulated products (FFPs) in agrochemical industry are also a combination of certain one or more active ingrediences (AIs) and further additional "non active" chemical substances called formulants. The AI synthesis in analyzed agrochemical company was managed on global level, the further FFP formulations were under responsibilities of individual regions.

year forecast are generated via IBP process, and there is at point in time full alignment at least once a year.[134] This topic was subject to intensive discussions between Financial, Operations Supply Chain and Marketing communities and the final solution was concluded as sufficient. It has been the major step forward comparing to previous "pre IBP" state, when there was no tight structured alignment between strategic and other planning process leading to lots of confusion in the organization.

Post implementation check and project closing

After all the activities conducted after IBP global go-live were finalized, the project was ready for official closing. The formal act of closing was preceded by the final IBP post roll-out evaluation focusing on the level of implementation of key IBP elements.

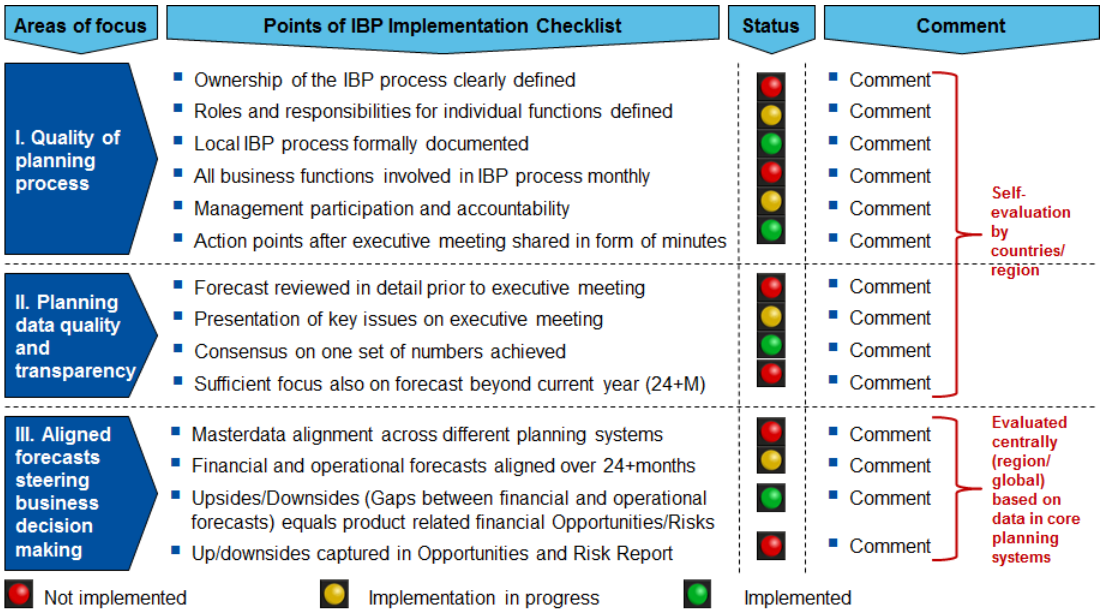
IBP Implementation Checklist was developed by Global core team and was applied for globally standardized evaluation of implemented changes. Regarding the content and areas of focus, it was split into two main parts covering the process set-up and its outcomes, i.e. the quality and alignment of planning data finally used in different planning systems.

Figure 57 displays the overview of IBP Implementation Checklist which was collected from all countries within Agrochemical company that adopted IBP concept. The check of quality of implemented process was performed in a form of self-evaluation by local IBP process owner, with the highest executive in the organization being accountable for the content. For the data quality and alignment check, the evaluation was realized centrally by regional organization under coordination of global.

The results of the checklist served also for definition of follow-up actions in case for any of the points in the checklist was evaluated by "orange" or "red" light.

Figure 57: IBP Implementation Checklist

[134] As via IBP process the financial and operational planning data were reviewed on monthly basis and strategic forecast only once a year, for most of the year there was a misalignment in between the two, but keeping the gaps transparent and explainable.



Source: Author, Internal Expertise – Agrochemical company

3.5. IBP Tool

Another important factor contributed to the successful global implementation of IBP concept in multinational Agrochemical company was the design and release of so called IBP Tool.

As indicated earlier, the situation before the IBP implementation was characterized by independent planning processes and tools. Each business functions was running its planning process over a specific tool designed exactly for the needs of that specific function, however not offering and possibilities for reconciliations of the forecasts from another function. Moreover, the functionalities of these independent core systems were sufficient just for the needs of one or another business function. As an example, operations planning system of Supply Chain was working only with volume forecasts, not being able to generate corresponding financial values. On contrary, financial planning system of Controlling was operating only on the full year forecast basis, not allowing for calendarized viewed needed for effective operational planning. As a result, all previous attempts for reconciliations were confronted with the hurdle of heavy manual workload related to comparison of data over excel spreadsheets.

Assuming a portfolio of over 20 thousands active selling articles, it has been by far a sub-optimal solution.

The idea of designing a technical platform over which countries could realize their IBP process with the focus of effective gap management came already in the early stages of the project. The purpose was not to replace the current core planning systems, but rather to develop the functionalities that they were missing, e.g. sales scenario simulations over different periods and currencies, linkage of financial opportunities and risk management with planning etc.

In the view of challenges described above, IBP Tool facilitating integrated planning process in the Agrochemical company was designed with following key characteristics:

- *Volume and Value view*
  It was possible to review anticipated demand or sales plan on both volume and value view. For multinational companies, when invoiced sales is planned in local currency but the group requires consolidated planning and reporting in some other common currency, translation amongst currency scenarios is necessary.

- *Translation amongst different product aggregation levels*
  It was possible to aggregate from selling articles[135] to product families or up to strategic segments. As different functions are having different level of detail in focus, review plans on different aggregation levels is enabled

- *Scenario planning*
  As most of the businesses were operating in highly volatile business environments with signifficant factor of uncertainty, planning on different scenarios reflecting different assumptions should be used to:

[135] or Stock keeping units

- Capture the potential impact of materialization of different business opportunities and risks (i.e. risk adjusted vs. not risk adjusted sales scenario; Base case, Best case and Worst case scenario, etc.). Via better management of uncertainties, unpleasant surprises can be eliminated leading to consequent reduction of stress for the organization.
- Enable to distinguish between management financial commitment (Budgets or Base case forecast) and figure steering production planning and operations (Base case FC vs. Best case FC)
- Steer the sales targets and motivate the organization via making transparent, what is the effect of incremental sales upside (volumes or price increases) on total forecasted sales value, against which the organizational performance is measured and individual targets set.

- Linkage to the same source of master data
  Although sound trivial, it is not uncommon that different independent planning systems are using different master data sources and working with different products.

3.6. Key improvements delivered by IBP implementation

Despite the short time between the global implementation of IBP and finalization of this thesis, there have already been visible improvements delivered by the project. For the full evaluation of the benefits, at least one full production cycle covering one-two years[136] period would be necessary due to the length of the lead times of Agrochemical company products.

Generally, the benefits can be categorized into two main groups – direct and indirect. For the analysis of direct benefits, value tree decomposition described in Chapter 2.5. may be used to derive concrete financial impacts on the bottom line performance of the firm.

[136] Depending on specific chemical structure (AI, formulants) of product

The indirect benefits are more related to the improvements in communication and cooperation cross different functions cooperating in the IBP process. This consequently lead to more efficient decision making and elimination of “sudden surprises” for management regarding business development arising from lack of communication.

Further non-negligible benefit of IBP implementation is the clearance of master data. Having article structure amongst all planning systems aligned makes the gap monitoring and control much easier and efficient, as the basis for analysis is the comparable.

On the following sub-chapters, the analysis of the most visible impact of IBP implementation – better inventory control via increased transparency and forecast accuracy is analyzed in more detail.

3.6.1. Impact of forecast accuracy on inventory levels

When it comes to S&OP and IBP, as precise forecasting of sales demand as possible is the ultimate aim of these concepts. Accurate predictions ensure the on time deliveries of right amounts of products and thus leading to customer satisfaction. Keeping pleased customers combined with effective utilization of own resources should be a high priority objective of a business to secure future success.[137]

As forecast accuracy directly impacts inventory levels and thus inventory holding costs, it influences finally the bottom-line performance of the company. Through improvements in forecast accuracy, inventory levels and hence costs can be reduced.[138] In order to provide good and appropriate forecasts and to control the forecasting process, the quality of the forecast has to be measured. For this purpose, forecast accuracy is used as a key performance indicator. Especially in supply chain management and financial sales planning, the improvement of forecast accuracy is a task of particular importance. This in turn points at the importance of forecast accuracy measurement in connection with

[137] Palmantier (3), p.1
[138] Hoover (2009), p.1

IBP. Costs associated with inaccurate forecast can be of significant value, and they are mostly related to either to lost sales or higher inventory carrying costs.[139]

There are several methods for calculating forecast accuracy. Most commonly, forecast accuracy is expressed in a percentage and is measured by calculating the prediction error, which is afterwards subtracted from 100% to show the accuracy of the forecast. The forecast error thereby displays the difference between actual numbers and forecasted numbers. If the actual equals the forecast, forecast accuracy is 100% and hence a forecasting error greater or equal to 100% results in 0% forecast accuracy.[140]

The calculation of forecast accuracy using the Mean Absolute Percentage Error (MAPE) was applied for the subsequent analysis of impacts of forecast accuracy on inventories. MAPE is calculated by dividing the absolute sum of the prediction errors over a period of time *t*, which is the difference between the actual and forecasted numbers, through the sum of actuals in period *t*.[141]

$$MAPE = \frac{1}{n}\sum_{t=1}^{n}\frac{Absolute\ Actuals_t - Absolute\ Forecast_t}{Absolute\ Actuals_t}$$

MAPE was chosen since it is expressed in a percentage and is therefore unit-free and hence scale-independent. This is why MAPE can be used to compare forecast accuracy between multiple items[142]. Nevertheless, the disadvantage of the MAPE of "being infinite or undefined if there are zero values in series, as it is frequent for intermittent demand data,"[143] have to be taken into account when working with this metric.

As it was shown in Chapter 3.1.1, business of Agrochemical company is challenged by seasonality, which is in turn leads to intermittent demand. Therefore, this weakness of MAPE has also been considered in the subsequent

[139] Wisner et. al. (2004), p.154
[140] Chockalingam (2009), p.8
[141] Chockalingam (2009), p.14
[142] Hoover (2009), p.18
[143] Hyndman (2006), p.45

analysis. The impact of forecast accuracy on inventories was tested for the main season for which the data were available.

To sum-up, one of the key indicators of increasing quality of planning process is the improvement in the demand forecast accuracy. General assumption is that in case the company is able to plan more precisely, its supply is able to meet the anticipated demand with relatively lower additional product flexibility needs. Each additional flexibility, i.e. the safety stock, either timing or volume, bears certain costs in terms of cost of capital bounded in form of inventories. Also the issue with additional required production capacities and higher costs associated with increased material flows (e.g. warehousing and transportation) can be effectively addressed through more accurate planning.

3.6.1.1. Regression model

As the analysis of direct impact of increased forecast accuracy on the reduction of inventory holding costs can be made only after certain period of time after IBP roll-out, alternative approach to evaluating the effect of IBP implementation was chosen. Assuming the existing relation between forecast accuracy and inventory holding costs, analyzing the impact of IBP implementation to forecast accuracy and deriving the impact on inventories should serve as a good proxy.

Classical linear regression model is applied to determine the strength of relationship between forecast accuracy and inventories. As impact of IBP implementation on forecast accuracy can be observed almost immediately, the consequent link to inventories is thereafter derived.

Regression modeling in general[144]

The leading idea behind regression analysis is the statistical dependence of one variable, the dependent one, on or more other variables, the independent or explanatory ones. The objective of such analysis would be to estimate, or

[144] Adopted from Gujarati (2003), Chapters 2,3

potentially predict the mean or average value of the dependent variable on the basis of known or fixed values of the explanatory variables.

The basic framework of regression analysis is the Classical Linear Regression Model (CLRM) based on certain set of assumptions. Following these assumptions, the least squares estimators take on specific properties summarized in Gauss-Markov theorem which states that in class of linear unbiased estimators, the least-squares estimator have minimum variance.

The simple regression analysis is expressed in the two-variable linear regression model. In this model, a linear correlation between the two variables is implied, whereby the dependent variable is expressed as a linear function of the explanatory one. Within the context of IBP, the linear regression model is applied in order to examine if there is a relationship between forecast accuracy and inventory-to-sales ratio.

The linear relationship between the two variables can be described by a regression line, which connects "the mean, or average, value of the dependent variable corresponding to the given value of the explanatory variable". This implies that $E(Y / X_i)$ is a linear function of X_i:

$$E(Y / X) = \beta_1 + \beta_2 X + u$$

Y = dependent variable
X = explanatory variable
β_1& β_2 = regression coefficients
β_1= intercept coefficient
β_2= slope coefficient
u = unobservable random variable taking positive or negative values

The regression coefficients β_1 and β_2 show the magnitude of the relation. The intercept coefficient β_1 indicates the value of Y on the regression line, if X equals zero.

Statements about the goodness of a regression analysis can be made by considering the coefficient of determination r^2. This coefficient represents the proportion of variation in the dependent variable explained by the explanatory variable and therefore provides an overall measure of the extent to which the variation in one variable determines the variation in the other." The values of the coefficient of determination are limited between $0 \leq r^2 \leq 1$, whereby $r^2 = 0$

implies that there is no relationship between Y and X. In general, the closer it is to 1, the better is the fit.

Further, the coefficient of correlation r has to be taken into account in order to determine the power and direction of the relation between the examined variables. In a single-equation regression model, as it is described here, the coefficient of correlation r equals the square root of the coefficient of determination r^2. The values of the coefficient of correlation lie between $-1 \leq r \leq 1$. If $r = 0$ this means that there is an exact linear relationship between Y and X. Generally, $r \geq 0.8$ describes a strong correlation, whereas $r \leq 0.5$ reveals a rather weak correlation between the two variables.[145]

The test of significance is evaluated by the help of a so called p-value which as the lowest significance level at which a null hypothesis can be rejected. The p-value answers the question: "If the null hypothesis were true, what is the probability of observing the current data or data that is more extreme?". If the p-value is below 0.05, then the null hypothesis is declined, as values below imply that the null hypothesis is unlikely.

Regression model for analysis of relation between FCA and Inventories

The following regression model is applied to analyze the relation between FCA and inventory levels.

$$I_{(i)} = \beta_0 + \beta_1 FCA_{(i)} + \mu$$

Where:

$I_{(i)}$……Dependent variable: Inventory to Sales ratio[146] for i-th product

β_0……Constant in linear model (intercept regression coefficient)

β_1……Slope regression coefficient

$FCA_{(i)}$ Independent variable: Forecast accuracy

μ…….Mean error

[145] Auer, Rottmann (2010), p. 94-95, p.431

[146] This is the standard KPI used in the Agrochemical company applied to measure the relation between Open Inventory Value valued in Averaged Costs (OIV:AC) and Net sales to third parties of the company (total invoiced value netted for applied rebates)

The ex-ante expectations are clear. The higher the forecast accuracy for specific product group, the lower should be the average inventory values and thus the Inventory to Sales ratio. The rationale behind this is quite straightforward – more accurate planning leading to higher forecast accuracy leads to better fit of supply with demand, and thus lower amount of inventory.

3.6.1.2. Results from regression analysis

The analysis was performed on the selected three pilot countries representing the complexity and variety of business models of Agrochemical company.[147] The focus of analysis was placed on analyzing how the accuracy of forecasting within the main sales season impacts the inventory levels in this period.

The seasonal approach instead of full year was selected for the reason, that due to campaign based, non-continuous production of most of products in Agrochemical company, certain products are produced long in advance to keep high utilization of production assets also in the periods with low sales. If we took the full year in consideration, in many cases the inventory levels held would be relatively high despite high forecast accuracy. This would be attributable to the fact that production campaigns were realized long before sales season.

As the final inventory status is the outcome of much more complex interactions than just accuracy of forecasts, the goal was not to elaborate the very precise relation, but to analyze whether there exists similar patterns specific for analyzed Agrochemical company across different markets. In the end the level of inventories is primarily the function of supply/production and realized sales demand.

The following Figures 58-63 outline the results of the analysis for individual tested countries. Examples of Germany, Brazil and Italy were analyzed for the sales seasons of 2010 and 2011 in order to eliminate potential one-off seasonal effects.

[147] From original 5 pilot countries, US and India were eliminated from the analysis due to inconsistency in the data sources comparing to other analyzed markets.

Germany

Figure 58: FCA – Inventories analysis_Germany_2010

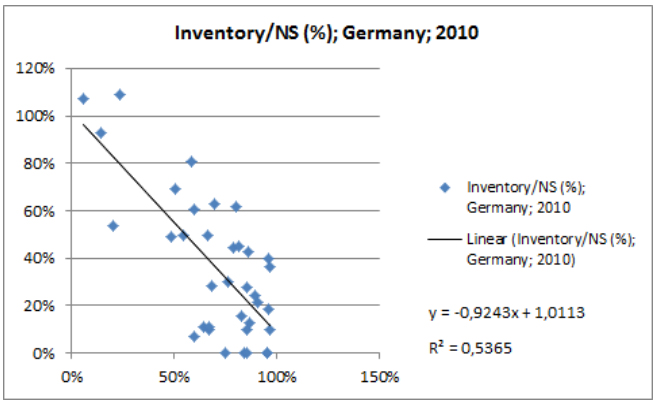
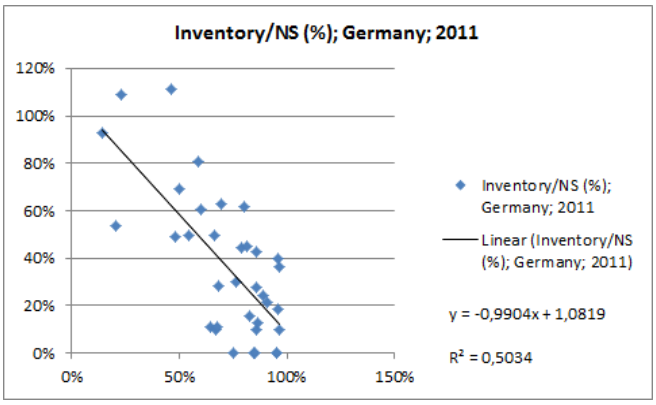


Figure 59: FCA - Inventories analysis_Germany_2011



Brazil

Figure 60: FCA – Inventories analysis_Brazil_2010

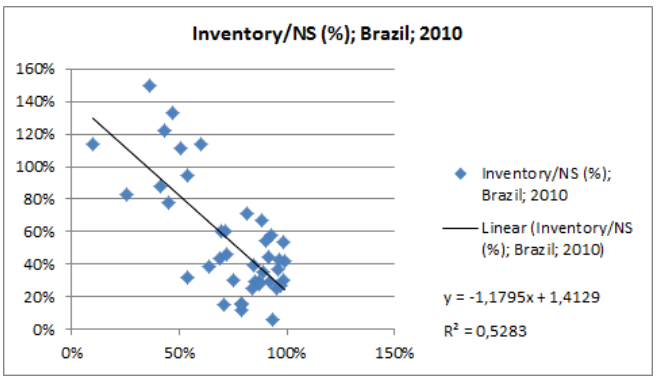
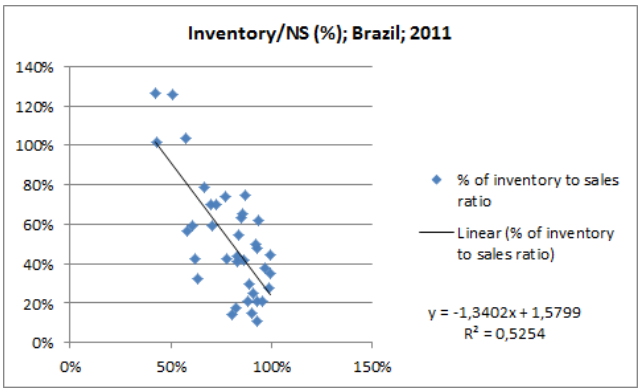


Figure 61: FCA – Inventories analysis_Brazil_2011



Italy

Figure 62: FCA – Inventories analysis_Italy_2010

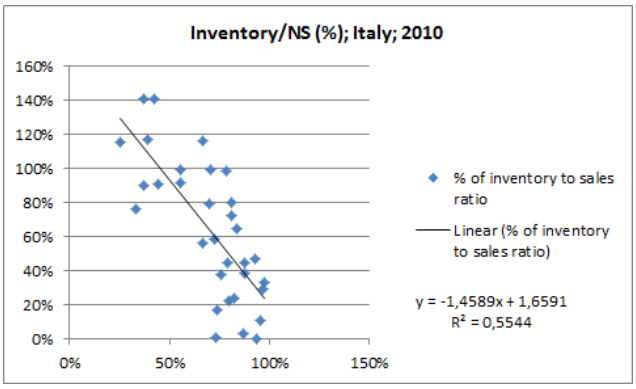
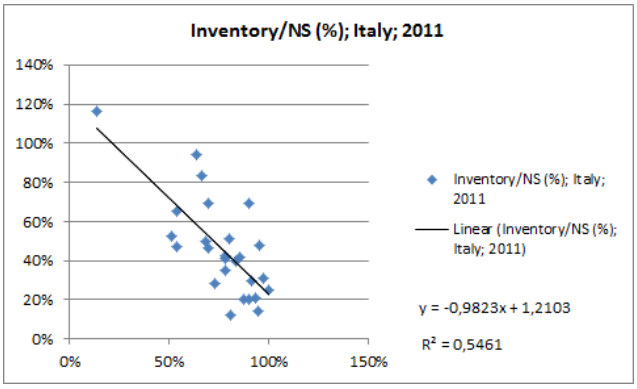


Figure 63: FCA - Inventories analysis_Italy_2011



Sources to Figures 58-63 : Author, Internal Expertise – Agrochemical company

Clear negative relationship between the levels of forecast accuracy and inventory to sales ratio is obvious for all three analyzed countries for both testing periods. This finding empirically supports the theoretical ex-ante expectations of positive impact of increased forecast accuracy on reduction of inventories.

Despite the regressions coefficients were differing slightly in the range from -0.92 to -1.46, the degree of the fit of the model as well as the portion of explained deviations captured by coefficients of correlation and determinations are consistent across different samples.

The results from the regression analysis are summarized in the Table 2.

Table 2: Results from regression analysis

Country	Year	β_2	Correlation coefficient (r)	Coefficient of determination (r^2)	p-value
Germany	2010	-0,92	-0,732	0,537	3,80E-07
	2011	-0,99	-0,709	0,504	1,80E-06
Brazil	2010	-1,18	-0,727	0,528	7,40E-08
	2011	-1,34	-0,725	0,525	3,90E-07
Italy	2010	-1,46	-0,745	0,554	1,02E-06
	2011	-0,98	-0,739	0,546	1,62E-05

Source: Author, Internal Expertise – Agrochemical company

In order to link benefits of IBP imlementation on the bottom line financial performance of the firm with inventory optimization, the missing connection between IBP implementation and improvements of forecast accuracy must be added.

Following the implementation timelines of individual regions outlined in Figure 56 above, it is clear that any meaningful conclusions at this short time after IBP roll-out can be made at most for Europe. For the remeining regions, the time between launch of IBP concept and first robust results is yet too short, and longer period for data collection and consequential analysis would be required.

Table 3 illustrates the results from official measurement of forecast accuracy in the year 2012, i.e. after IBP implementation with the comparable period of last year for major European countries in terms of sales.

Table 3: FCA improvement in Europe

	Monthly FCA - 2012				Monthly FCA - 2011				Comparison		
Coutnry	April	March	February	January	April	March	February	January	Avg 2012	Avg 2011	Delta
Germany	72,2	65,8	61,0	7,0	71,0	74,0	49,0	9,0	51,50	50,75	1%
Spain	67,50	62	70,0	74,0	71,0	63,0	75,0	63,0	68,38	68,00	1%
Italy	73,9	69,9	67,0	72,0	76,0	78,0	65,0	62,0	70,70	70,25	1%
Hungary	85,4	63,1	37,0		77,0	57,0	41,0		61,83	58,33	6%
Denmark	69,9	83	67,0	52,0	75,0	76,0	2,0	12,0	67,98	41,25	65%
Belgium	67,5	74,5	65,0	65,0	66,0	74,0	53,0	39,0	68,00	58,00	17%
Bulgaria	75,3	70,4			76,0	68,0			72,85	72,00	1%

Source: Author, Internal Expertise – Agrochemical company

The obselrvations further supports the basic hypothesis, that the establishment of integrated approach to S&OP via implementation of its advanced concept – IBP brings positive impacts on the quality of planning reflected in increased forecast accuracy. In the case of European countries of Agrochemical company, there has been an average increase of FCA in the current year comparing to the previous one for all of the selected countries. This improvements can be almost completely attributed to IBP implementation.

3.6.2. Improvement in planning data quality

This chapter analyzes the impact of IBP implementation on the improvements in planning data quality, namely on the level of master data structure alignment between financial and operational planning systems. For the reasons described previously, the focus was placed on European countries. The period selected was February 2011 compared to February 2012 as this is the month when the sales season for products of Agrochemical company is generally starting, so the planning data should be very accurate.

For the purpose of this analysis, all articles listed in financial and operations planning systems with non-zero sales forecasted for the current year were taken and investigated regarding their existence in either only one or in both planning systems.

Table 4 displays a comparison between the master data article structures used for financial and operations planning purposes.

Table 4: Analysis of Article Structure Alignment in Europe[148]

Subregion		Country	Tool	as of February 2011					as of February 2012					Improvement
				not aligned	aligned	Σ articles	not aligned	aligned	not aligned	aligned	Σ articles	not aligned	aligned	
APE/D	DE	Germany	APO	66	144	210	31%	69%	47	150	197	24%	76%	+5%
APE/D	DE	Germany	MAP	22	144	166	13%	87%	21	150	171	12%	88%	+1%
APE/D	BE	Belgium	APO	17	107	124	14%	86%	13	132	145	9%	91%	+5%
APE/D	BE	Belgium	MAP	13	107	120	11%	89%	3	132	135	2%	98%	+9%
APE/D	NE	Netherlands	APO	24	64	88	27%	73%	11	79	90	12%	88%	+15%
APE/D	NE	Netherlands	MAP	41	64	105	39%	61%	33	79	112	29%	71%	+10%
APE/S	IT	Italy	APO	21	122	143	15%	85%	7	147	154	5%	95%	+10%
APE/S	IT	Italy	MAP	9	122	131	7%	93%	4	147	151	3%	97%	+4%
APE/S	ES	Spain	APO	18	154	172	10%	90%	24	172	196	12%	88%	-2%
APE/S	ES	Spain	MAP	17	154	171	10%	90%	10	172	182	5%	95%	+5%
APE/S	GR	Greece	APO	53	202	255	21%	79%	31	228	259	12%	88%	+3%
APE/S	GR	Greece	MAP	24	202	226	11%	89%	10	228	238	4%	96%	+7%
APE/S	PT	Portugal	APO	4	87	91	4%	96%	7	76	83	8%	92%	-4%
APE/S	PT	Portugal	MAP	3	87	90	3%	97%	8	76	84	10%	90%	-7%
APE/U	UK	Great Britain	APO	45	185	230	20%	80%	7	196	203	3%	97%	+17%
APE/U	UK	Great Britain	MAP	21	185	206	10%	90%	36	196	232	16%	84%	-6%
APE/U	DK	Denmark	APO	4	42	46	9%	91%	1	42	43	2%	98%	+7%
APE/U	DK	Denmark	MAP	1	42	43	2%	98%	1	42	43	2%	98%	+/-0%
APE/U	IE	Ireland	APO	31	77	108	29%	71%	14	72	86	16%	84%	+13%
APE/U	IE	Ireland	MAP	3	77	80	4%	96%	12	72	84	14%	86%	-10%
APE/O	PL	Poland	APO	13	128	141	9%	91%	14	133	147	10%	90%	-1%
APE/O	PL	Poland	MAP	2	128	130	2%	98%	3	133	136	2%	98%	+/-0%
APE/O	CZ	Czech Republic	APO	13	63	76	17%	83%	8	68	76	11%	89%	+6%
APE/O	CZ	Czech Republic	MAP	9	63	72	13%	88%	7	68	75	9%	91%	+3%
APE/O	SK	Slovakia	APO	10	40	50	20%	80%	1	56	57	2%	98%	+18%
APE/O	SK	Slovakia	MAP	9	40	49	18%	82%	2	56	58	3%	97%	+15%
APE/O	HU	Hungary	APO	2	92	94	2%	98%	4	88	92	4%	96%	+2%
APE/O	HU	Hungary	MAP	4	92	96	4%	96%	5	88	93	5%	95%	-1%
APE/O	TR	Turkey	APO	7	66	73	10%	90%	2	86	88	2%	98%	+8%
APE/O	TR	Turkey	MAP	11	66	77	14%	86%	12	86	98	12%	88%	+2%

Source: Author, Internal Expertise – Agrochemical company

Results captured in the Table 4 indicate that the implementation of IBP brought along distinct improvements in the article structure alignent in the vast majority of the cases and thus contributed signifficnatly to the increase of quality of planning data. Improvements in this aspect forms the key pre-requisite also for effective gap monitoring and management. This can be realized only when executed over the same product basis between comparing systems.

3.6.3. Other improvements

Improved cross-functional communication and cooperation

As described on the previous pages, implementation of truly integrated planning process that brings together on regular monthly basis all relevant business functions is the underlying improvement, out of which all benefits can be consequently derived. It is extremely difficult to isolate the effect of more

[148] APO (Advanced Planning Optimizer) is the name of demand and supply (Operations) planning tool of Agrochemical Company. MAP is the financial planning and reporting tool of controlling.

efficient cross-functional communication and cooperation on the bottom line performance of the Agrochemical company, as it operates in the complex business environment. However, already the selection of IBP implementation project to become a top priority for management of regarding operational excellence indicates the importance of integrated approach to business planning for the firm.

Environmental and safety impact

Higher forecast accuracy leads to a better match of supply with demand. Production planning revisions on short-term basis can be significantly reduced. As a consequence, less production changeovers (incl. cleaning of production equipment) and fewer express deliveries (especially airfreights) positively impact on safety and environment. Additional benefits are achieved through decrease of over-aged inventories resulting in lower disposal of material.

Customer impact

Conceptually, IBP is viewed as a structured approach to translating customer requirements into operations. Customers require the products in time for the agricultural season – late availability in many cases leads to irrecoverable sales. Internal as well as external customers across the entire value chain benefit from more accurate and transparent planning. Higher forecast accuracy leads to better match of supply with demand – impacting positively the service to customers through improved delivery reliability.

Using IBP also as a platform for strategy execution enables the supply chain of Agrochemical company to pro-actively react on changes in the markets as well as to support new product launches successfully.

Increased transparency and quality of planning data

The natural consequence of improved planning process is the increase of the quality and transparency of planning data.

3.6.4. Cost benefit analysis of the IBP implementation project

Although lots of efforts were put into the implementation of IBP concept in the Agrochemical company globally, the cost benefit analysis of the implementation reveals that the proven or anticipated benefits by far exceeds the occurred costs.

Costs

Internal costs of ca. 100 k EUR are attributable to the adjustments of core planning systems of the (e.g. the adjustment of financial planning system in order to allow for calendarized planning on SKU level over three years horizon to enable the alignment with operations planning system. Furthermore, cumulated four FTE's[149] for the whole duration of the project leading to costs of approx. 180 k EUR. External costs amounting to ca. another 100 k EUR spent on the programming of IBP Tool (technical platform facilitating reconciliation of financial and operational forecasts and scenario simulations) rounds the sum of total direct costs.

Project benefits, one-time and annual recurring

Implementation of IBP concept provided directly measurable as well as indirect benefits for the Agrochemical company. The following list combines the actual and further anticipated improvements delivered by the project:

- Considering a scenario of 2 % points of increase in forecast accuracy leads to 2 % point decrease of inventory/ sales ratio, we assume potential capital cost savings of 5 mil. EUR p.a.[150]
- Potential 25 % reduction on airfreight costs due to earlier recognition of sales upsides (and thus potential shortages) → logistics costs savings of 1 mil. EUR p.a.

[149] FTE – Full time equivalent, 1 FTE corresponds to the amount of work of one person per year.
[150] Relationship between forecast accuracy and inventory/sales ratio for Agrochemical company was derived from analysis performed on pilot countries of the project on the data from sales seasons 2010 and 2011. For more information see Chapter 2.6.1.

- Potential 0.5 % point of sales increase due to more efficient allocations of short and tight products and increased transparency in planning → additional sales of 22 mil. EUR p.a.
- Increase of forecast accuracy leading to better match of supply with demand further contributes to:
  - lowering of the amount of reworks and refilling, resulting in savings in operational and logistics costs
  - decrease of volumes of aging stocks/ obsolete inventory
  - improvement of customer service via increased delivery reliability
- Improvement in cross-functional cooperation and communication in planning leading to significant non-tangible benefits to the organization
- Less redundant efforts in the organization due to a combined and concise planning and avoidance of errors caused by lots of manual transitions of planning data
- More effective performance measurement after establishment of globally harmonized Forecast Accuracy Key Performance Indicators

3.7. Conclusions from the IBP implementation

Implementation of the concept of Integrated Business Planning in the analyzed Agrochemical company took almost two years and resulted in the change of local planning processes in more than 70 country organizations worldwide. Due to the long lead times for certain active ingrediences, the comprehensive assessment of the benefits would be possible only after full production cycle spanning over the horizon of two years. However, already now, just the few months after the global roll-out of IBP, the first results are already visible.

There has been measurable improvement in planning data quality and first indications shows also significant increase in forecast accuracy. The most important, however, is the mind-set change that the entire organization overcame. Integrating multiple independent planning processes eliminated the communication silos, fostered cross-functional cooperation and joint approach to problem solving. Contrary to initial project stages, very few employees and managers of Agrochemical company are still questioning and challenging the base idea of full transparency and alignment across financial, operations and strategic plans of the company.

There surely is still some room for additional improvements related mainly to deeper integration of individual systems, eliminating manual translation of data. With adoption of the concept of Integrated Business Planning, the Agrochemical company however made the major step forward reaching world-class operational excellence in planning.

4. Conclusions and Summary

4.1. Conclusions – fulfillment of objectives of dissertation

The framework of this dissertation thesis was elaborated with respect to objectives outlined in Chapter 1.1.4. Following is the overview of their fulfillment:

- *Objective of 1: Collection and summary of recent best practices in the development of S&OP/IBP*

  Case studies from renowned market research and consulting companies as well as the trends visible in specialized journals and literature on forecasting and business planning analysed in the initial stage of the dissertation suggest, that the integration of planning processes is the right response for meeting the challenging requirements of today's volatile business environment.
  This conclusion was supported also by author's findings from his active participation of the international conferences related to the topic of IBP. Their outcomes are reflected in author's proposal of optimal characteristics of IBP analysed in theoretical part and key elements of IBP concept described in empirical part of the thesis.

- *Objective 2: Extension of pre-dominantly business praxis topic of S&OP for academic foundations.*

  Apart from summarization and structuring of recent knowledge about IBP, the main contribution of theoretical part of the thesis comprises of extension of the primarily business praxis topic Sales and Operations Planning for solid theoretical foundations.
  Within this point, concept of Duality from Theory of consumer was applied to analyse potentially antagonistic behaviour of different stakeholders participating within traditional S&OP process. Via the application of microeconomic optimization methods it was showed that executing S&OP

process with misaligned incentives of different functions may lead to inefficiencies in inventory management. This may further negatively influence the customer service and ultimately also the bottom line performance of the firm.
The analysis further confirmed that the set-up of process ownership and thereof derived relative decision-making power amongst individual business functions may lead to antagonistic outcomes in managing inventories. This part bridging the academic research with business praxis opened further possibilities for research in the area of planning process optimization.

- *Objective 3: Analysis of the concept development from traditional S&OP into IBP and characteristics of key distinguishing factors of IBP.*

  Analysing the development of best practices in business planning, it can be concluded that the concept of Integrated Business Planning can bring significant improvements in the efficiencies and effectiveness of business operations. It thus represents the answer on the Research question:
  "*What is the optimal set-up of planning processes in company that would enable it to meet the challenges of volatile business environment in effective and efficient way?"*
  Key advancements of the concept of IBP comparing to traditional S&OP proposed by author, which were analysed in detail in the thesis include a) the assessment of IBP as key platform for operational decision-making in the firm, b) a process of structured gap management and c) linkage between strategy implementation and execution of operations

- *Objective 4: Broadening of concept of S&OP/IBP for selected topics from finance, business strategy and operations.*

  Last but not least, the dissertation extended the theoretical concept of IBP for certain innovative aspects from marketing and finance. On the model of portfolio management it was demonstrated, how the planning process

set-up in the company should be optimized in order to fit with various strategic considerations regarding company's product structure. Understanding the dynamics of product portfolio can directly influence the empowerment of various business functions in the decision making process within IBP. Thereof derived specific adjustment of planning process set-up can bring advancement in inventories management as described also via microeconomic optimization model.
On another topic referring to execution of business strategy it was showed, how the implementation of IBP can substitute various complex initiatives regarding realization of business strategy. Effective linkage of long-term strategic planning and short to mid-term operational planning via the concept of IBP represents relatively easy to implement way of how to translate strategy into daily operations.
Another pioneering part of the thesis was the application of the concept Value Based Management to analyse the implications of IBP implementation on financial performance of the firm. Identifying different parts of value driver tree enabled the isolation of various effects, through which the optimized planning process positively impacts the bottom line financial results of the company.
Specific key performance indicators related to planning were further proposed for individual types of market environments. As a result, companies may tailor the performance management of their planning process according to different conditions under which they operate.

- *Objective 5: Summary of main challenges and findings from practical experience of IBP implementation in multinational company.*

  Applied research realized within empirical part of the dissertation tested the theoretical IBP concepts on the real business case example. Analysis of challenges related to planning in Agrochemical company revealed the inefficiencies with independent set-up of planning processes. Lack of structured reconciliation amongst financial, operations and strategic

forecast brought sub-optimal results related to effectiveness of supply chain, efficiencies in decision-making and in utilization of resources.
As a result, project of IBP implementation was launched in order to align individual planning processes and their outcomes cross different business functions. Set-ups of various planning processes were analysed on the example on several pilot countries across all main geographical areas.
Individual process mapping was realized for countries with differing maturity and complexity of organizations, processes and systems and tailor made IBP process set-ups were defined for each of them.
Key shortcomings were identified and changes in planning processes following the IBP principles were proposed and implemented.

- *Objective 6: Evaluation of measurable financial benefits of IBP implementation.*

  Assumptions of the financial improvements of integrated approach to business planning were tested via the adoption of statistical methods. The relationship between forecast accuracy and inventory levels was valuated through the application of linear regression model.
  Clear negative relation between the two variables was identified for all analysed countries building the important pre-requisite for identification of financial benefits of improvement brought by the roll-out of IBP concept.
  Further analysis proved the increase in sales forecast accuracy for vast majority of the countries where IBP was implemented. Thereof resulted reduction of cost of capital bounded in form of inventories led to measurable positive impact on the bottom line performance of the firm.
  On the top, significant improvements were reached also in the field of planning data quality leading to more efficient gap management and thus also business decision-making.
  The overall cost-benefit analysis indicated that once the organization is transferred through necessary hurdles of change management, the overall benefits significantly outweighs the cost of IBP implementation.

4.2. Summary

The findings from the theoretical part of the dissertation thesis supported the basic assumption of research question that application of traditional, rather independent approach to business planning, is not sufficient anymore to cope effectively with the challenges of today's fast changing business environment.

Optimization models from microeconomic theory were applied to explore the potentially contradicting incentives of different stakeholders of planning process and thereof derived negative impacts on financial performance of the firm. The analysis based on the concept of Duality from the Theory of Consumer revealed that the set-up of process ownership and related decision-making power amongst individual business functions may lead to antagonistic outcomes in managing inventories.

After the companies realized the limitations of conventional independent set-up of planning processes, business planning has undergone gradual conversion into more integrated approach via multiple stages of Sales and Operations Planning (S&OP) development.

Initial attempts for integration of various types of planning processes were focused on volume based supply and demand balancing. The S&OP has thus long been viewed as a process bringing benefits mainly to operations and supply chain functions, with not much relation to commercial functions or finance. Operational excellence has consequently gained more and more importance as a reaction of increased competitive pressures of globalized economies. Executives worldwide realized the necessity of effective and efficient set-up of planning processes characterized by the alignment across all functions in the company.

Over the last three decades, S&OP has thus gradually evolved from industry best practice into industry standard practice and reshaped its content and focus from predominantly production planning process into to a company-wide management process. Especially the enrichment of traditional S&OP concept for strategic, portfolio management and financial aspects accompanied with fast improvement of supporting information technologies shifted S&OP into

its latest development stage. This is being recognized nowadays more and more often under the term Integrated Business Planning (IBP).

Author identified and described in detail three key advancements of the concept of IBP comparing to traditional S&OP. These include the assessment of IBP as key platform for operational decision-making in the firm, as a process of structured gap management and as a linkage between company's strategy and operations.

Moreover, the IBP concept has been enriched by the innovative aspects from marketing, finance and business strategy. Further fine-tuning of IBP process set-up following the specific portfolio management model was complemented with the application of Value Based Management analyzing the impact of IBP on various parts of value driver tree.

Author's practical experience from leading the project of global IBP implementation formed the empirical part of the thesis. Key elements from theoretical IBP concept were tested on the complex business environment of multinational company. Assumptions of the financial and non-financial improvements of integrated approach to business planning were tested and confirmed on the examples of multiple countries.

Via the adoption of statistical methods, significant relation was identified between the IBP implementation and optimization of inventory levels via improvements in forecast accuracy leading to financial benefits for the firm.

Analyzed topics of project and change management may serve also as a detailed guideline for any company that would like to adopt the IBP concept.

Author is convinced that linking theoretical research with real business praxis in this field can contribute to further development of this topic. Bridging the academic and corporate worlds may open further possibilities for research in the area of optimization of business planning processes. Academic institutions can thus represent valuable partners for private and public sector in helping them pursuing the business and operational excellence.

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Appendix: Details of regression analysis

Germany

2010

Results: Analysis of Inventory/NS ratio on FCA; Germany; 2010

Regressions-Statistik	
Multipler Korrelationskoeffizient	**0,732490925**
Bestimmtheitsmaß	0,536542956
Adjustiertes Bestimmtheitsmaß	0,522911866
Standardfehler	0,209334005
Beobachtungen	36

ANOVA

	Freiheitsgrade (df)	*Quadratsummen (SS)*	*Mittlere Quadratsumme (MS)*	*Prüfgröße (F)*	*F krit*
Regression	1	1,724858576	1,724858576	39,36170727	3,80608E-07
Residue	34	1,489904673	0,043820726		
Gesamt	35	3,214763249			

	Koeffizienten	*Standardfehler*	*t-Statistik*	*P-Wert*	*Untere 95%*	*Obere 95%*
Schnittpunkt	1,011349079	0,109639454	9,22431696	8,84486E-11	0,7885349	1,234163259
FCA March to August	**-0,924280764**	0,147321778	-6,27389092	3,80608E-07	-1,223674637	-0,62488689

2011

Results: Analysis of Inventory/NS ratio on FCA; Germany; 2011

Regressions-Statistik	
Multipler Korrelationskoeffizient	**0,709478992**
Bestimmtheitsmaß	0,50336044
Adjustiertes Bestimmtheitsmaß	0,488310756
Standardfehler	0,218831219
Beobachtungen	35

ANOVA

	Freiheitsgrade (df)	*Quadratsummen (SS)*	*Mittlere Quadratsumme (MS)*	*Prüfgröße (F)*	*F krit*
Regression	1	1,601659779	1,601659779	33,44657947	1,82648E-06
Residue	33	1,580274382	0,047887102		
Gesamt	34	3,181934161			

	Koeffizienten	*Standardfehler*	*t-Statistik*	*P-Wert*	*Untere 95%*	*Obere 95%*
Schnittpunkt	1,081940631	0,128794599	8,400512467	1,05023E-09	0,81990605	1,343975212
FCA March to August	**-0,990420278**	0,171255161	-5,783301779	1,82648E-06	-1,338841523	-0,641999033

Brazil

2010

Results: Analysis of Inventory/NS ratio on FCA; Brazil; 2010

Regressions-Statistik	
Multipler Korrelationskoeffizient	**0,726814214**
Bestimmtheitsmaß	0,528258902
Adjustiertes Bestimmtheitsmaß	0,516162977
Standardfehler	0,251632244
Beobachtungen	41

ANOVA

	Freiheitsgrade (df)	*Quadratsummen (SS)*	*Mittlere Quadratsumme (MS)*	*Prüfgröße (F)*	*F krit*
Regression	1	2,765287546	2,765287546	43,67246629	7,42008E-08
Residue	39	2,469432653	0,063318786		
Gesamt	40	5,2347202			

	Koeffizienten	*Standardfehler*	*t-Statistik*	*P-Wert*	*Untere 95%*	*Obere 95%*	*Untere 95,0%*	*Obere 95,0%*
Schnittpunkt	1,41291875	0,137225622	10,29631877	1,11195E-12	1,13535373	1,69048377	1,13535373	1,69048377
FCA July to November	**-1,179469841**	0,178477297	-6,608514681	7,42008E-08	-1,54047425	-0,818465432	-1,54047425	-0,818465432

2011

Results: Analysis of Inventory/NS ratio on FCA; Brazil; 2011

Regressions-Statistik	
Multipler Korrelationskoeffizient	**0,724858622**
Bestimmtheitsmaß	0,525420021
Adjustiertes Bestimmtheitsmaß	0,511860593
Standardfehler	0,204537238
Beobachtungen	37

ANOVA

	Freiheitsgrade (df)	*Quadratsummen (SS)*	*Mittlere Quadratsumme (MS)*	*Prüfgröße (F)*	*F krit*
Regression	1	1,621100812	1,621100812	38,74942387	3,90764E-07
Residue	35	1,464241858	0,041835482		
Gesamt	36	3,085342669			

	Koeffizienten	*Standardfehler*	*t-Statistik*	*P-Wert*	*Untere 95%*	*Obere 95%*
Schnittpunkt	1,579939445	0,174338361	9,062488831	1,04375E-10	1,226013757	1,933865133
FCA March to August	**-1,340205737**	0,215297431	-6,224903523	3,90764E-07	-1,777282758	-0,903128715

Italy

2010

Results: Analysis of Inventory/NS ratio on FCA; Italy; 2010

Regressions-Statistik	
Multipler Korrelationskoeffizient	**0,744606595**
Bestimmtheitsmaß	0,554438981
Adjustiertes Bestimmtheitsmaß	0,539586947
Standardfehler	0,275657643
Beobachtungen	32

ANOVA

	Freiheitsgrade (df)	*Quadratsummen (SS)*	*Mittlere Quadratsumme (MS)*	*Prüfgröße (F)*	*F krit*
Regression	1	2,836664016	2,836664016	37,33084525	1,02591E-06
Residue	30	2,27961408	0,075987136		
Gesamt	31	5,116278096			

	Koeffizienten	*Standardfehler*	*t-Statistik*	*P-Wert*	*Untere 95%*	*Obere 95%*
Schnittpunkt	1,659113626	0,174272546	9,520223738	1,41971E-10	1,303201606	2,015025646
FCA March to August	**-1,458855172**	0,23876918	-6,109897319	1,02591E-06	-1,946486892	-0,971223453

2011

Results: Analysis of Inventory/NS ratio on FCA; Italy; 2011

Regressions-Statistik	
Multipler Korrelationskoeffizient	**0,738959004**
Bestimmtheitsmaß	0,546060409
Adjustiertes Bestimmtheitsmaß	0,527146259
Standardfehler	0,172322285
Beobachtungen	26

ANOVA

	Freiheitsgrade (df)	*Quadratsummen (SS)*	*Mittlere Quadratsumme (MS)*	*Prüfgröße (F)*	*F krit*
Regression	1	0,857307765	0,857307765	28,87047103	1,62062E-05
Residue	24	0,712679275	0,02969497		
Gesamt	25	1,56998704			

	Koeffizienten	*Standardfehler*	*t-Statistik*	*P-Wert*	*Untere 95%*	*Obere 95%*
Schnittpunkt	1,210310815	0,143819819	8,415466126	1,27325E-08	0,913481297	1,507140332
FCA March to August	**-0,982316384**	0,182820315	-5,373124885	1,62062E-05	-1,359638969	-0,604993799

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