Integrated Business Planning: development of framework for technological improvement

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Abstract

Since the 1960s, technology progress has contributed to the improvement and integration of Business Plans and Processes. However, nowadays having one overall plan encompassing supply chain, finance and commercial functions is far from reality for most organizations. The raise of uncertainty in the current markets, and the vital need to keep up with the emerging challenges, such as Digitalization, Artificial Intelligence and Internet of Things, led companies to look for support to keep at the forefront of technological advances. Recent advances in management methods and enabling technologies are now making it possible to achieve the holy grail of Integrated Business Planning, by generating an overall plan that aligns with strategy, people and business functions, with clear objectives that enable performance assessment and control. This master thesis has sought to guide a case company in the Process Industry in its goal to improve the current synchronized planning process, firstly by investigating *how the implemented planning process is performing in comparison to the best practices* and, further on, by exploring *what needs to be improved and supported by an Advanced Planning System (APS) to be selected/improved?* and How to select an appropriate tool (APS)?. The theoretical principles presented in literature are described in order to validate the supply chain planning diagnosis and to find all functional requirements to be addressed by the IT tool which have proven empirically fundamental to maximizing the benefits of IBP implementation. Finally, a multi-criteria model is presented to support decision-making, considering all planning processes, stakeholders, business goals and industry's best practices on the definition of criteria to evaluate the APS vendor to be selected. The results include the ranking of three vendors that are able to support the demand planning, supply planning and Sales Operations planning processes at Client X and drive improvement in the IBP journey. Both functional and technical analysis, as well as the survey of the tools' capabilities, vendors' experience and costs assessment, carried on this dissertation, are the motto for an APS implementation *business case* oriented to the business needs and the complexity of the supply chain in question.

Keywords: Integrated Business Planning; Sales and Operations Planning; Tool Assessment; Advanced Planning System

Resumo

Desde a década de 1960, o desenvolvimento tecnológico tem contribuído para a melhoria e integração dos processos e planos de negócios. No entanto, aos dias de hoje, ter um plano global capaz de integrar a Operações, Vendas e Marketing está longe de ser uma realidade para a maioria das organizações. O aumento da incerteza nos mercados actuais e a necessidade de acompanhar os desafios emergentes, tais como a Digitalização, Inteligência Artificial e Internet das Coisas, levaram as empresas a procurarem novas, inovadoras formas de se manterem a par dos avanços tecnológicos. Os recentes progressos nos métodos e tecnologias de gestão e planeamneto vieram tornar possível o Planeamento Empresarial Integrado (*IBP- Integrated Business Planning*), isto é, obter um plano global para as vendas e operações que "traduza" com a estratégia e visão da empresa, que assegure a colaboração entre as equipas e unidades empresariais, com objectivos claros que permitem avaliar e o controlar do desempenho. Esta tese de mestrado procurou auxiliar uma empresa na Indústria do Processo, cujo objectivo era melhorar o actual processo de planeamento sincronizado de vendas e operações (S&OP - Sales and Operations Planning). Primeiro, avaliou-se *Como é feito o Planeamento Empresarial Integrado na empresa?*, tendo por base as boas práticas na indústria; depois, procurou-se responder a *O que precisa de ser melhorado e suportado pelo um Sistema de Planeamento Avançado (APS - Advanced Planning System) a ser selecionado?* e como seleccionar uma ferramenta apropriada (APS)? Os princípios teóricos apresentados na Revisão Literária são descritos com o propósito de validar o diagnóstico do processo de S&OP/IBP e de encontrar todos os requisitos funcionais a serem suportadoss pela ferramenta informática que se revelaram empiricamente fundamentais para maximizar os benefícios da implementação do IBP. Finalmente, é apresentado um modelo multicritério para apoiar a tomada de decisões, considerando os processos de planeamento dentro do âmbito do projeto, as partes interessadas, a visão empresarial e as melhores práticas da indústria na definição dos critérios para avaliar o fornecedor da ferramenta de planeamento avançado a ser seleccionado. Os resultados incluem a avaliação duma pequena lista de fornecedores capazes de apoiar o planeamento da Procura, das Operações e das Vendas e Operações integradasno Cliente X, por forma a impulsionar a progresso ao no nível do IBP. Tanto a análise funcional como técnica, bem como o levantamento das capacidades das sistemas de planeamento e a avaliação dos seus custos, realizada nesta dissertação, são o mote para o desenvolvimento de um *caso de estudo* para a implementação de um APS.

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A minha gratidão te dá meus versos
– Bocage

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"Pedras no caminho?
Guardo todas,
um dia vou construir um castelo"

Fernando Pessoa

Contents

Acronyms and Symbols

AI	Artificial Intelligence
APS	Advanced Planning System
IBP	Integrated Business Planning MCDM
Multi-criteria decision-making	
MTO	Make-to-Order
RO	Research Objectives
SCM	Supply Chain Management
SCP	Supply Chain Planning
SIOP	Sales, Inventory and Operations Planning
SKU	Stock Keeping Units
SME	Subject Matter Experts
S&OP	Sales and Operations Planning
KPI	Key Performance Indicator

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Chapter 1

Introduction

This dissertation was developed under the scope of IBP Supply Chain Planning diagnosis and selection of an Advanced Planning Tool. It describes a business consulting project, under the supervision of Deloitte's partners, at Client X, whose final outcome has the purpose to be an agnostic ranking of technological planning tools to be implemented, in which Client X could support its decision. It was decided to keep client's name and some information hidden in order to guard client's confidentiality and operate in accordance with the highest ethical standards sought by Deloitte. In this chapter, the project itself is further explained with the presentation of its motivation, objectives and structure, as well as the context in which it was developed. The company description and the structure of the document are also presented.

1.1 Project Motivation

Nowadays, organizations are operating in an unprecedented volatile context. The COVID-19 pandemic, the Ukraine' invasion, the energy and climate crisis, and the spiraling costs of raw materials have put the resilience and agility of organizations to the test, specially on the business planning and risk management field. Many organizations are still lacking off the capability to encompass areas like supply chain, finance or marketing, which can weaken their market share and shareholder value, specially when we consider the raise on customer and inventors expectations, the increased competitors capabilities, the never-ending demands for improved speed and efficiency as well as accelerated product road maps (Richard et al.).

In response to the multiple supply chain disruptions that have recently occurred, CEO and Supply Chain Officers (CSCO) are increasingly looking to invest in the digitalization of their supply chains, one of the macro trends in 2022 (3), to improve operational efficiency, agility and have a better visibility of the processes, costs and revenues (Richard et al.). Poor forecasting creates a reinforcing cycle of excess inventories,with additional costs and potential lost revenues from stock-outs and customers dissatisfaction. In fact, almost all industries (e.g. Life sciences, Chemicals, Consumer goods, services) meet these challenges to somewhat differing degrees, due to external factors (e.g. economy volatility, climate change) or internal factors (e.g. long lead times,

wide product portfolio) . However, several impressive case studies suggest the proper integration of digital tools and self-service analytics on the Supply Chain Management (SCM) and Planning agenda can bring tangible value from process and organizational perspective: increasing revenue 2-5%, improving forecast accuracy 15-20%, improving working capital 10-15% and increasing on-time delivery 10-50% (21; 62).

It is important to highlight that enterprises, in general, have already started to take the first steps on the tactical planning field, through Sales and Operations Planning. But, many businesses struggle with gaining all the expected benefits from Sales and Operations Planning (S&OP), that often fails to be a strategic area. In that sense, Integrated Business Planning emerges as a "way to run the business" that, when most effectively implemented, relies on the integration of people, processes and software tools to drive business success.

In one hand, many companies already have several business planning models and software tools they have purchased and implemented over many years; on the other hand, others are still using Excel spreadsheets. Neither of these paradigm guarantee the integration of processes. Hence, it becomes fundamental for organizations to assess their supply chains performance, identify strategic and operational challenges, opportunities and a roadmap of solutions. The access to global best practice and benchmarks, combined with a deep expertise and experience, make business consulting firms the ideal partners to develop a supply chain management project, that could involve benchmarking, selection and deployment of an innovative and integrated Supply Chain Planning tool. More than just a plan for the entire business, Advanced Planning Systems (APS) can be "game changers". Although, due to the spam of new, innovative solutions on the market, it becomes a priority identifying how the company is performing in terms of supply chain planning in comparison to the best practices in the industry and then, based on the "As-is" and the desire "To-be", develop a framework to identify which technologies better fit supply chains' requirements.

Considering the aforementioned arguments, this project addresses the evaluation and ranking of APS to support current S&OP and future IBP processes. The value delivery by Deloitte in this project is linked with its ability to bring together a team with deep supply chain expertise, a high number of IBP implementations in manufacturing ecosystem and with a deep understanding of clients priorities and challenges, who pushes the thinking across all objectives and ensures coverage across a multitude of key areas. The goal is to address the request for the decision journey on which vendor-tool fits better with Client X's business complexity and supply chain requirements, while considering the objective of improvement Client X's IBP maturity level.

1.2 Company Overview

As it was mentioned, the present thesis was carried out on Deloitte Portugal. Deloitte has emerged as a reference organization in professional auditing services, consulting and tax advisory services, and has been consolidating its leadership in Portugal integrating its offer to better serve the client and meet all its needs.

Particularly, regarding Supply Chain, Deloitte has an extensive cross-industry experience, which

combined with deep domain expertise, digital capabilities and rich industry's database allows it to design customized and highly effective solutions for nearly every industry. One of the goals of this firm is to help the company build lasting competitive advantage on product development, planing, sourcing, manufacturing, logistics and distribution. Deloitte has broadened its range of Supply Chain services and teams, due to the increase on demand from more and "bigger" clients. The core Supply Chain and Network Operations services are: Digital Solutions Networks Strategy, Insights and Advanced Technology Solutions; Manufacturing Strategy and Smart Operations; Product Strategy and Lifecycle Management; Supply Chain Transformation;Supply Management and Digital Procurement; Logistics and Distribution and Synchronized Planning.
Synchronized Planning supports organizations on the development of integrated business and supply planning solutions that effectively manage and synchronize customer demand and supply chain assets to drive and deliver improvements in customer service levels, reduce supply chain costs, and optimize working capital. Among the skills required in projects of this nature, Deloitte highlights its expertise on designing and implementing Integrated Planning & Command Centers, defining and delivering next lasting supply chain planning capabilities enabled by Advanced Planning Solutions, improving Supply Chain Flexibility and Inventory Management with differentiated approaches based on optimization and statistical models, as well as defining and delivering service/repair parts planning. Deloitte has developed several tools/accelerators and has strategic alliances with digital companies (OM Partners , Kinaxis RapidResponse, SAP Integrated Business Planning, Oracle, jda, o9 and Logility) which allow Deloitte to position itself as a reference in the market. Inventory optimization tools, Advanced Supply Chain planning accelerators, Integrated Business Planning Framework, Rapid Deployment and Advanced Demand Prediction Tool are some of the examples that helped Deloitte thrive to be a leading trusted partner on categories such as Business Technology Transformation, Business Analytics, IT Application and Software Consulting, Digital Logistics and Cloud Consulting.

1.3 Client X

Client X is a company in the process industry which produces wood-based products. It was facing significant challenges in improving in IBP journey due the lack of appropriate technology support for its business needs. In order to assess its current context and define the best solution to achieve future goals, Client X looked for Deloitte's consulting services

1.4 Objectives

This dissertation was carried out as part of a Deloitte Consulting SA project, in the client Company X. Aligned with the goals of the consulting project itself, this research intends to answer the following Research Objectives (RO):

- RO1: What are the theoretical steps, design blocks and challenges of implementing Integrated Planning on a company?

- RO2: How can the current IT planning tools on the market, and their features, support companies, in particularly in the Integrated Business Planning process?
- RO3: What should be considered when selecting an Advanced Planning System to support Integrated Business Planning?

Once, the aim is to turn theory into practice and help the Client X to increase its business value, this business consulting project, that integrates the area of Core Business Operations, aims at addressing the following main goals (G):

1. G1: Assess organization maturity in Integrated Business Planning.
2. G2: Identify and prepare a list of functional requirements aligned with industries' best practices and business needs for Demand Planning, Supply Planning and Integrated Business Planning;
3. G3: Explore alternative Advanced Planning solutions (APS) that cover supply chain planning processes and rank the list of alternatives using a multi-criteria evaluation method.

1.5 Methodology

Aligned with research best practices, this dissertation contains a theoretical framework chapter, a case study (experimental exercise component), a discussion of the results obtained and their relevance, as well as the conclusions, limitations of the research and future research directions.A Synchronized Planning Assessment project has been developed for a client operating at Process Industry. It started with a study of the state-of-art in the field of Synchronized Planning, more specifically on Integrated Business Planning in companies, in order to understand the best practices and the most recent technologies available.
In parallel, the definition of the "To-be requirements" was undertaken at the Client X to collect information, evaluate how it was performing in terms of Integrated Business Planning, identify opportunities and pain points to the addressed. The project proposal highlighted the need to select a tool technological improvement importance of implementing an Advanced Planning System due to the fact that it connects and aligns the strategic and operational plans and addresses the requirements and future challenges of the company. Meanwhile, a brief literature review was performed in order to identify proper software tools and to understand how to design a decision tool to select the best vendors/solutions.
Considering the Client X's requirements, and the features offered by the software available among those available in the market, a shortlist of vendors was created and Evaluation Model was developed in order to rank these solutions. Requests for Information (RFI) and demos were requested and evaluated, so that project team could assign scores to each criteria for each vendor on *Vendor Evaluation Model*. Finally, considering the final scores obtained, a ranking of vendors/solutions was delivered to Client with the purpose of the Client X choosing the solution of his preference.

1.6 Thesis Structure

The structure of the thesis is as follows.

Chapter 2, Literature Review, focuses on two core topics: Integrated Business Planning process(es), bound in Supply Chain Planning and the good practices on maturity level diagnosis. Then it is conducted an exploratory study of the characteristics of digital solutions available in Advanced Planning field and how they can support synchronized planning in enterprises.

Chapter 3 presents the Client X used as Case Study. In particular, we explore the business challenges and why Client X looked for Deloitte's support on finding a solution to support its planning activities. Additionally, the methodology adopted for the project at the case company is described.

Chapter 4 explore the current and future situation of Demand, Supply and Sales&Operations Planning at Client X, which involved the identification of the assessment of the "As-is" and the definition of the "To-be" requirements list for the planning processes under scope.

Then, Chapter 5 presents the application of a Vendor Evaluation Model and its outcome – a ranking of APS vendors. Lastly, Chapter 6, Discussion and Conclusions, summarizes the content of this dissertation and its main contributions, from theoretical and empirical perspective, as well as suggests developments for future work.

Chapter 2

Theoretical Foundations

The theoretical section of this paper is divided into two parts. The first is focused on tactical Supply Chain Planning, more specifically on the concept of Integrated Business Planning (IBP), providing a comprehensive outlook of its conceptual processes, meetings and strategic key factors, performance measurement and maturity models. Although it is not yet widely explored in the academic literature like its predecessor Sales & Operations Planning (S&OP), Integrated Business Planning (IBP) refers to the processes(s) of synchronizing all of a company's mid- and long-term plans with a more sophisticated approach which aligns Supply Chain Planning and business strategy. That said, the integration of Strategic, Demand and Supply Planning via IBP is described on this chapter.

The second part explores how the implementation of an Advance Planning System (APS), that is, a software solution can support Integrated Business Planning components and address organizations' requisites for those supply chain planning processes. Based on the literature, it also describes what are the most important elements and features to be considered on the process of evaluating and selecting an APS. It is important to note that, in spite, the practical importance of IBP, most articles to date have been authored by consultants and practitioners, appearing in mainstream media channels, usually on operations and supply chain publications. In addition, although several academic studies has been conducted in S&OP, the majority of them propose to identify what factors are predictive of successful S&OP/IBP initiatives, in other words, topics are typically centered on structural components of the operational process, not giving a full integrative perspective of S&OP/IBP implementation and the empirical outcomes of cross-functional planning (integrating Finance and Commercial functions) (55; 61). The term "Integrated Business Planning" is used on this dissertation to refer either Sales and Operations Planning or Integrated Business Planning, once some principles and tools may apply to companies regardless the business planning maturity stage. Integrated Business Planning is considered a "journey", by multiple practices. This journey starts with the earliest stages of Sales and Operations Planning and evolves to more advanced levels of maturity until a fully "business orchestration". The term "Synchronized planning" is also used to refer to IBP, for example, by Deloitte and some consulting firms, however, due to the ambiguity of its focus, we chose not to use it.

2.1 Introduction

Leaders seek to operate supply chains as efficiently and cost-effectively as feasible, through Supply Chain Management (SCM). This area has emerged as one of the major areas for companies to gain competitive edge (52).
Although the concepts related to Sales and Operations Planning (S&OP) have been developed for three decades in SCM research, technological developments have been crucial to elevate traditional S&P to a next level. The concept of Integrated Business Planning – S&OP successor – emerges the mechanism of end-to-end synchronization of supply chains pursed by leading global organizations, such as P& G, Intel, Boeing, Novartis, in the context of the best practises of Supply Chain Management. This governance and process model has become specially relevant on the uncertainty context that the world is experiencing. It ensures strategic, financial, tactical, and operational alignment, allowing better risk management, more agility and enhanced of the organizations. The following section explores the "state of art" in terms of Integrated Business Planning and the potential value it can create in the context of SCM. Its foundations, structure, benefits and risks are discussed.

2.2 Supply Chain Planning

Supply Chain Management (SCM) is a vast concept which refers to controlling all logistics aspects of Planning, Sourcing, Executing, Delivering and Returning goods and services. The Council of Supply Chain Management Professionals also highlights that SCM requires coordination and collaboration with the stakeholders, e.g: suppliers, intermediaries, third party service providers and customers(9). In this study we will focus on the planning step.
Supply Chain Planning emerges as a need, considering that some decisions have to be taken in advance. It supports decision-making by following these steps: recognizing and analysing a decision problem, defining objectives and forecasting future developments (36**?**).
The naive way of planning, according to (**?**), is based on comparing alternatives considering some criteria, but the complexity of supply chains and processes encounters three major difficulties:

1. **Multi-objective decision problems:** the requirements from a real world application might be that several goals need to be achieved simultaneously, which requires prioritization of the objectives, based on scores or arbitrary weights. In that sense, it might be needed to have an APS to support planning process;

2. **Having an huge/infinite number of alternatives:** dealing with continuous decision variables, e.g. starting times of a job, or discrete decisions, such as sequence of jobs on a machine, might require the use mathematical methods of operations research to find optimal or near-optimal solutions;

3. **Dealing with uncertainty:** nearly always, there will be forecast errors, due to changes on external (e.g. market price fluctuations, changes in the demand, etc) and internal (e.g.

capacity bottlenecks) factors. They can be minimize through planning on a rolling horizon basis or event-driven, which can be supported by APS.

Supply Chain Planning processes can be classified in two dimensions *planning horizon* and *supply chain process* as it is proposed by Fleishmann et al. (12) in its Supply Chain Planning-Matrix. In the next sections we explore the tactical planning, that is, mid- term planning and the end-to-end supply chain processes, by going through concepts such as S&OP, IBP and Enterprise Business Planning (EBP).

2.2.1 Evolution of Supply Chain Planning

Conceptually, upply Chain Planning (SCP) has its foundations on Aggregate Production Planning (1950s) that evolved to Manufacturing Resources Planning (MRP II) in the mid-1980s. During the1990s some companies have gained tangible business benefits in improved customer service and reduced inventories. Consequently, organizations perceived Supply Chain Planning as a key process to increase and sustain profitability. Planning within an organization is an ongoing process that happens at different levels, covering different time horizons. Organizations should guarantee that all the functional plans tie together to support the business strategy at the different planning horizons belowmentioned (36; 25; 24).

1. **Long-term(strategic) planning:** typically it is three or more years out and reveals the future vision of the company. The strategic goals and objectives defined should drive Tactical Planning processes;

2. **Mid-term (tactical) planning** (e.g. Sales and Operations Planning): different authors point different time-horizons, between 3-6 months and 18-24 months, for this regular operations planing process. It is usually made at an aggregate level. Rough quantities, times and locations for the flows and resources are evaluated and may link strategy and operations in areas such as sales, marketing/brand, master production, distribution requirements, and labor planning;

3. **Short-term (operational) planning**: it concerns detailed instructions for immediate execution and control (short-term scheduling) of operations in areas such as customer service, production, inventory management, warehousing and transportation, usually looking out up a reduced time scale (a few weeks) planning horizon on a day-to-day or week-to-week basis.

Considering the literature review – *Sales and operations planning : A research synthesis* (55) findings, most case studies and reports on MRPII trace the origins of S&OP back to practitioners' work. That said, the concept Sales&Operations Planning has evolved from the shared experiences of different organizations, and, back in the 1980s, it was defined as an integrated set of business processes and technologies with the main purpose of effectively balancing/aligning supply and demand and linking the strategic plans (long-term goals) to the operational plans of the firm (50; 15; 26). It also has been called SIOP (Sales, Inventory and Operations Planning) in some

publications.
Many view S&OP as a part of company's master planning in which a cross-functional team reaches consensus on sales forecasts, capacity and/or production plans. This provides insights into the optimal market deployment of resources and most profitable supply chain mix. Others suggest that S&OP should be used as a real-time technique to respond to changing market and operating situations. In either case, the main perception is that S&OP is predominantly a tactical planning tool that requires collaborative inputs, from the functional leaders in sales, marketing, demand and supply planning, finance and gathers all information and supply chain constraints to develop the most efficient plan, at both the detail and aggregate levels, for 6-12 months horizon [1].

According to Lapide (28), traditional S&OP is an "internally focused and technologically challenged" process that should have the major objective of helping companies achieve their financial performance goals. However, in recent decades, the focus of S&OP has moved towards a better integration and alignment of the internal functions (financial and commercial) of the enterprises, alongside with better understanding of the global and external environment. Hence, the concept of Integrated Business Planning and, more recently, Enterprise Business Planning emerged. Although IBP originally intended to integrate finance and commercial organizations on the planing process, some authors argue that, in practice, these areas have been participating as "guests" in S&OP and IBP meetings. Enterprise Business Planning (EBP) goes beyond IBP in its level of integration, adding the dimensions of marketing, pricing, and capital asset planning, completing the convergence of planning efforts across all functions.

Though cross-functional engagement in planning processes seems to be the future of SCP, EBP remains an aspiration for many companies. Gartner's survey gauged (6) only 17% of supply chain executives say finance is engaged as a facilitator, while 23% say finance's role is limited to that of an observer within IBP . Moreover,a recent Ventana Research survey (44) found that 43% of organizations remain at a basic, tactical level in their planning process, with only 11% operating at the highest innovative level (45). Lastly, back in 2012, a study showed that the integration of S&OP and financial planning was handled by almost 88 percent of S&OP top performers, but only 25 percent of non top-performers: "The 250 percent difference in rate of adoption of Integrated Business Planning is truly striking" (40, p. 32). In that sense, in order to address the current scenario of enterprises, the following chapters explore in more detail the Integrated Business Planning.

2.3 Integrated Business Planning (IBP)

As mentioned in the previous section, the original concept of Integrated Business Planning represents the evolution of S&OP developed in the early 1980s. According to Reed (42):

> "Having transitioned from its predecessor, S&OP, IBP includes far more robust financial integration. This not only requires careful thought, but an entire re-evaluation of how the finance group interacts with the rest of the organization."

[1] Some studies report horizons from 18 months up to 24 or 36 months.

IBP can be defined as the cross-functional, end-to-end mechanism by which functional areas align to actualize overall strategy via operations. Related to the link between operational and financial plans, that allows a better overview within the whole company, IBP has the objective of improving the accountability of the planning processes, whose performance may be consistently measure, driving continuous operational improving; predicting, identifying and resolving business issues and decisions in a collaborative environment that breaks down silos. Therefore, experts claim IBP is not an information "forum", but an holistic decision-making framework, a "continuous planing and performance-management process" (8; Richard et al.; 60).

Considering Tavares Thomé et al. (55), the goals presented in Table **??**) serve as a vision for S&OP implementation, that can be extended to IBP [2]. These are the conceptual objectives enterprises should expect when investing into large scale Integrated Business Planning projects.

Table 2.1: Goals for S&OP/IBP implementation

Focus	**Goals**
Alignment and Integration	Organizational alignment, supply and demand balance, cross-functional integration or supply chain integration.
Operational improvement	Improvement of sales and operations forecast, stock reduction, optimize the allocation of capacity, supply chain optimization and increase in business control.
Results focused on a single aspect	Improve supply chain performance, minimize demand distortions, enhance revenues or reduce costs.
Results based on trade-offs	Optimize profits (revenue vs cost), optimize costumer service vs inventory or optimize supply chain costs.
End Results	Improve financial indexes such as Return on Investment or Earnings, Before Interests, Taxes, Depreciation and Amortization.

Following the Lapide (26)'s approach to S&OP, which can be extended to IBP, this study focus on the process itself (design and implementation) and diagnostic tools (maturity models) to assess where a company is in its evolution of the process and, finally, its enabling technologies.

2.3.1 The Integrated Business Planning Process

IBP process steps slightly varies in literature, due to some confusion around the terminology (i.e. distinguishing between S&OP and IBP). However, it can be interpreted that Portfolio/Strategic Planning, Demand Forecasting, Demand Planning, Supply Planning and cross-functional meetings are the main steps of IBP process over a rolling 24- to 36-months. The coordination of these plan guarantees the balance between demand and all the supply capabilities, namely production, distribution, procurement, and finance, to ensure alignment with the strategic goals (36). The process is usually led by senior management and depend on supporting activities/tools, such as data gathering, performance reviews, meetings and integrative technology (15; 61; 25). The Figure 2.1 suggests how the IBP process must materialize in cross-functional periodical meetings (15).

It is not clear, in the literature, if Demand and Supply planning are considered sub-processes of IBP process, once some publications suggest they are inputs/outputs of the integrated process. The

[2] IBP – as an advanced form of S&OP – is predominantly a practitioner's phenomenon. Consequently, studies on this concept are mainly published in practitioners' journals, consultancy reports or online blogs. Thus, academic definitions do not exist currently (56).

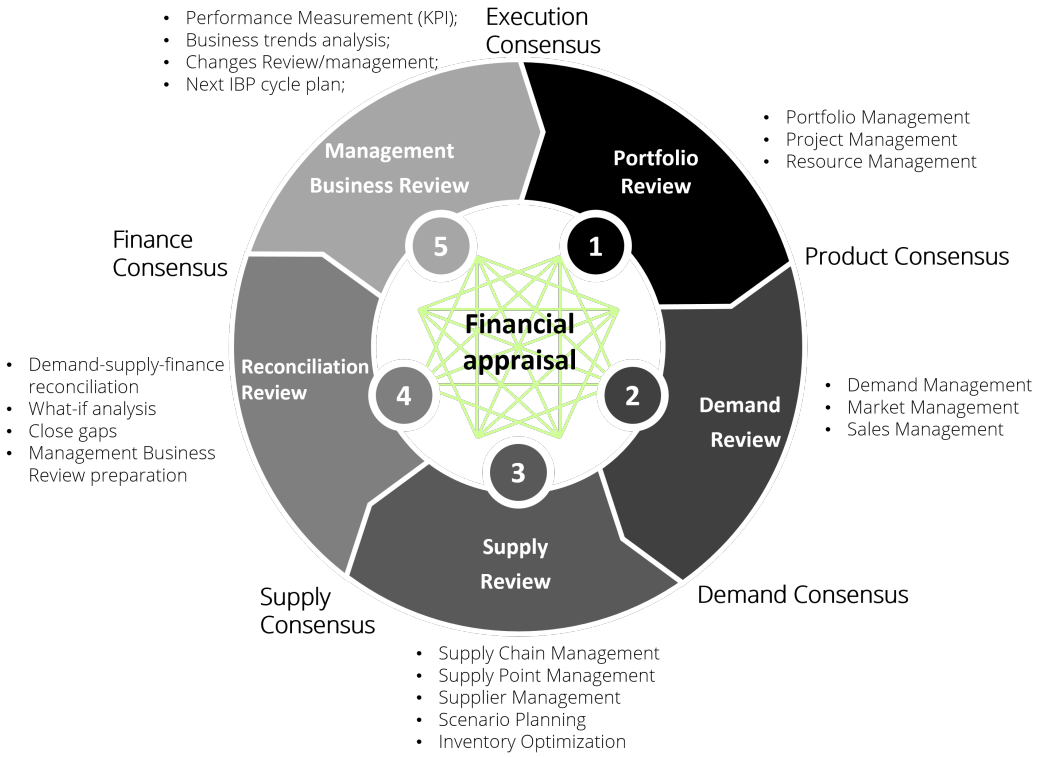

Figure 2.1: IBP cyle, adapted from Oliver Wight (42)

same happens with Strategic Planning, due to the fact some authors argue that Portfolio Planning is a corporate-level strategy and IBP bridges the gap between tactical and strategical plans.

2.3.1.1 Strategic Planning

IBP is a strategy-oriented planning process, so it is fundamental to include strategic initiatives into operational management. Strategic planning is usually divided into monthly and annual business planning. Annual planning, discussed by business development team on the annual meeting, addresses business risks, challenges, opportunities, and their impact on revenue and market positioning for a long-term horizon (10 years). On the other hand, month planning usually covers the review of production, supplier, distribution/network and product strategies, manpower requirements, regulatory issues, as well as customer segmentation, portfolio management, financial and volumetric reconciliation on a local and global level. This process, led by supply chain managers at monthly meetings, aim to be aligned with the goals of the ongoing and next years (27).

2.3.1.2 Demand Planning

Demand Planning usually performed by Sales and Marketing teams, is a supply chain management process of developing an unconstrained demand forecast for products/services to ensure

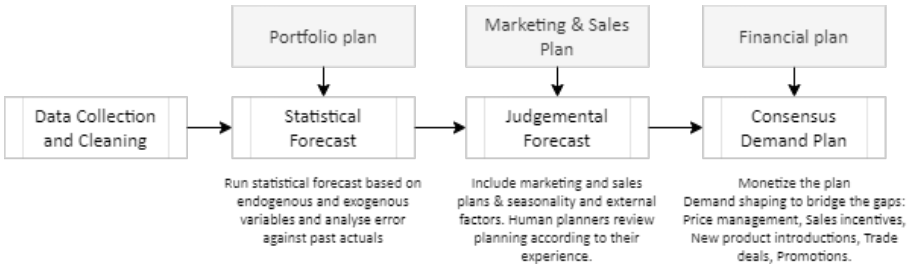

Figure 2.2: Demand Planning Process

they can be delivered and satisfy customers. Predicting process entails the collection of historical, trend analysis and assessments of forecast accuracy, that means, it consider all known factors that influence demand, i.e. anticipated marketing plans, such as the introduction of new products along with advertising and promoting plans. Although there are some inconsistencies in the literature, there is only one true forecast. Therefore, "shipment forecast, financial forecast, sales forecast" refer to *plans* created from the demand forecast. Demand plan is built from demand forecast as well, and it depends on specific activities, skills (people) and technology to achieve a specific purpose, as it happens with any other plan (7).

In spite some academics and consultants mention the concept of "one-number demand plan", the goal is not to create a single plan, but a set of integrated plans, of which the demand plan will be part (7; 42).

The Figure 2.2 shows the Demand Planning steps and, the following list, the best practices related to those steps (7; 41; 33). As it was mentioned, the collaboration should be between sales and marketing, counting on finance to assess the profitability of programs and to push back on Sales and Marketing if this is not the case.

Considering that the final supply and demand plans are developed from this working-draft plan, multiple authors agree on the importance of clarifying the requirements of all processes that will use the forecast (e.g. time period, product, geographical region), selecting accurate forecasting methods and tracking and analysing the forecast errors (61; 22). Regarding Demand Controlling, for controlling the quality of both forecast and planning process itself, some metrics are indicated: forecast accuracy metric, Forecast error by time, forecast accuracy by product and geography, forecast value added, biased forecasts.

Moreover, experience shows Demand Planning improves with the use of digital technology, advanced analytical service provision, adoption of one-number unconstrained demand forecast for the organization and with the commitment of managers with operational excellence(33). Chase (7, pg. 19) emphasizes:

> *"The goal for demand planners shouldn't be to use the latest or most complex tool for their own sake, but to identify the analytical method that best fits for a given product line by providing the necessary intelligence on a timely basis"*

In the S&OP/IBP process, Demand Planning process is the preparation work that is done before the Demand Review meeting. This planning work should be a report that covers: (1) Latest

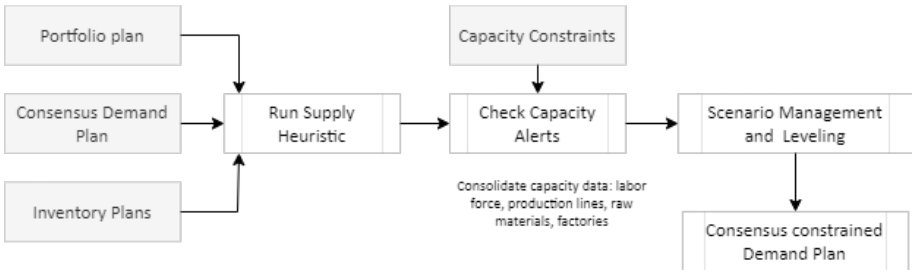

Figure 2.3: Supply Planning Process (33; 31; 51)

estimate vs. revenue budget, including the new products revenue plan, the identified shortfalls and risks to financial revenue objective attainment; (2) Assumptions (quantified, measurable as much as possible); and (3) Risk and opportunity scenarios.

2.3.1.3 Supply Planning

Typically, the Supply Planning process is sponsored by Operations/Supply team that collects and analyses information about inventory strategy (build-up or draw-down), supply chain and operations capacity (distribution, personnel and material). Supply planning starts from the "unconstrained plan" (production needs) and has the purpose of efficiently translating the demand plan into an appropriate supply plan aligned with business goals in terms of profit, revenues and customer service. The expected outcome is a rough-cut capacity plan for the inventory, production and procurement (25; 15; 61**?**). In order to develop this rough-cut plan, supply team should agree on the production strategies (level loading and demand chase), production volume, inventory targets and policies, safety stocks levels, number of setups, overtime needs, as well as evaluate if there is any capacity shortage which require hiring or subcontracting capacity. These decision variables may address the seasonality and variation of demand, and consider strategic inputs, such as plant locations and production equipment and external parameters like holding costs, production costs and setup costs.
The Figure 2.3 illustrates the aggregate Supply Planning process

This planning process usually requires the bottom-up information flow, which may be done through a Supply Chain Planning tools or shorter-term planning methods (bill of materials), which focus on short-term constraints and gaps. Supply planning excellence drives quality, forward-looking contingency planning and timely capacity investment decision making. Although this process is usually owned by the Head of Supply, the participation of Operations, Manufacturing, Logistics and Finance is crucial to gather inputs and address the requirements/goals (33).

2.3.1.4 The IBP cycle

The standard cycle for IBP occurs in five primary steps and it is adopted from S&OP cycle described on the majority of papers (15; 25; 42).

1. **Portfolio review:** aims to update the product portfolio to fit company's expectations for revenue, margin objectives and that new products planned for launch are progressing according to their schedules. Portfolio planning includes plans for new products, additions to the product lines, product improvements, repositioning of current products and End-of-Life rationalization of older products. It is typically sponsored by marketing leaders and product managers that link R&D and supply chain teams. Good practices, pointed by Lloyd (30), include support the decision-making on KPI, e.g. level of obsolescence of products, launches on time, time-to-market and the number of out-of-life products. In spite the most common approach is related to product mix, some authors claim progressive organisations, often those driving very aggressive innovation agendas, broader their scope to manage «new activities». But this changing context can have dramatically change further steps of the process (43).

2. **Demand Review:** looks for reach a consensus unconstrained demand plan on known planning volumes and respective revenue, without taking into account limitations on supply-side. Moreover,the output also includes deciding to shape demand to meet business revenue goals, by addressing plan vs. budget gaps. The discussion around unconstrained forecasting takes into account the historical data, but it may focus on the future and financial goals, by addressing the challenges and risks of product portfolio plan and revising assumptions (*Why we think the plan must be this way?*). In more mature organizations, this preliminary demand plan is converted into monetary terms and the assessment of the gaps between demand plan and budgets extends to financial, where Cost-To-Service inputs can play a crucial role in managing demand opportunities and risks (61**?**). The agenda of the meeting should include: addressing Product portfolio plan; Demand plan review, assumption update and agreement; Demand and revenue risks and opportunities, Demand plan to revenue budget gap review and mitigation, Final agreement on unconstrained consensus demand plan and Continuous process improvement (22).

3. **Supply review:** relies on the Supply Planning as an input, whose plan is discussed in order to obtain a constrained plan. In this step, different alternative scenarios and inherent consequences, risks and opportunities, unprecedented changes and special events should be considered. Concurrently, an updated financial plan is generated to compare actual performance against the business plan (61; 15).

4. **Operational/Reconciliation review (Pre-meeting):** aims to develop a final consensus operating plan, which includes the demand and supply plans, the discussed scenarios and inherent consequences, risks and opportunities. IBP team, that might composed by representatives from sales, marketing, operations and finance, meet to resolve demand/supply imbalances and guarantee financial reconciliation between financial and operational plans. The final plan sets the guidelines for the upcoming cycle.

5. **Executive/Management review** Finally, at the end of IBP process, executives make decisions about resources allocation, supply chain networks, supported by decision-making and scenario modelling tools. This meeting aims to close the gaps between demand, supply and finance plans,to communicate the plan and distribute responsibilities (e.g. operations team is "responsible" for meeting the required production targets, while sales team are aware of the quantities agreed to sell and intervenes when adjustments are needed). Defining process performance measurements is also essential, in order to control the effectiveness of the plans: although these measures can differ among industry, process and product line, some KPI are pointed in the section 2.3.3(e.g. service level, sales growth, lead time, variance to baseline forecast, etc.)

To sum-up (55), IBP process receives, as inputs, the unconstrained forecast, functional plans and external data. The main excepted outcome expected is a set of integrated plans Demand-side plans should define how to execute the demand for each product group/region/customer. Supply-side plans include sourcing plans, manufacturing plans and inventory plans. Financial plans included budgeting, investment plans and cash flow plans. Demand-side plans include sales forecast, marketing plans and product life cycle plans (61). Nevertheless, different scenarios are risk management should also be included. Some authors claim there is a final step that aims at measuring and control the effectiveness of the integrated plans and the IBP process itself though Key Performance Indicators (KPI) (15; 25).

2.3.2 IBP Design and Implementation

Based on the literature review by Goh and Eldridge (14) conducted in the context of S&OP implementation, contingency theory claims *"organizational units operating in differing environments develop different internal unit characteristics, and that the greater the internal differences, the greater the need for coordination between units"*. That said, IBP design and implementation may be customized to the firm's specific needs depending on organizational characteristics: industry sector (55)(product/service characteristics), supply chain complexity (55), dynamic complexity (demand and supply uncertainty), manufacturing strategies, economic maturity, firm size, region, operations planning and control systems (55; 26; 15). Before stepping into synchronized planning implementation, some authors, in particularly Tavares Thomé et al. (55) and Moon et al. (33) discuss the importance of the following building blocks of IBP design:

1. **Design parameters:** refer to the set-up details, e.g. planning horizon length, meetings frequency, aggregation levels (granularity) and planning objects;

2. **Meetings and collaboration:** refers to the human-effectiveness, and the set-up of the monthly calendar, agenda for meetings and planning steps (presented in Section 2.3.1.4);

3. **Organization:** refers to the governance and organizational structure aspects of IBP. Define of who has the ownership of the different processes, evaluate the need to have an independent department or a support function in a matrix organisation and assess the organizational and individual skill-sets required for IBP;

4. **Information Technology:** This refers to the tools, systems and data used (e.g. Excel, Enterprise Resource Planning (ERP), Advanced Planning and Scheduling systems);

5. **Metrics:** This refers to the performance metrics designed for assessing the effectiveness, efficiency and quality of S&OP/IBP process.

2.3.2.1 Design Parameters

In order to assess the specific goals and requisites of enterprises, scholars claim it is fundamental to define/evaluate: (1) planning horizon (33; 15); (2) planning frequency (25; 15), (3) planning level/granularity (25; 15) and (4) planning time fences.
Regarding planning horizon, Moon et al. (33) claim the planning time horizon must be long enough to plan resources and support annual business planning, and it should be aligned between functions, in order to facilitate integration. Usually Telescoping Planning Horizon is defined from 3-18 months, based on all supply-demand lead times (28). On the other hand, some authors argue that IBP is a tactical-strategic process, so it should take into account the 1-3 year horizon.
There are two approaches regarding planning frequency of S&OP/IBP in the literature. The majority of academics and analysts (25) suggest monthly meetings, but top performers usually adopt event-driven meetings in order to be more agile and flexible on the response to market volatility or to existing problems in production (15; 55).
The planning level represents the granularity with which the planning is performed. Regarding product, time, factory, customer, among others, planning may be carried out at an aggregate level, since it enhance effectiveness. However, it depends on the complexity of the supply chain and the requirements of each business. So that, planning can be performed e.g. at SKU,family of SKUs, product group or line of products level and at customer, customer group, country or region level (55). These parameters are not only important for companies that are taking the first steps in the IBP journey, but also for e.g. implementing a Supply Chain Planning Tool.

2.3.2.2 Factors for successful implementation

When it comes to finding the key strategic elements (also called "Factors for successful S&OP process" by Lapide (26)), companies typically brought together the following factors presented in the Table 2.2 to support their Integrated Business Planning environment. However, there is no "one size fits all solution".

Table 2.2: Key factors for successful implementation

Key factor	**Authors**
Common/aligned planning calendar with milestones	e.g:Prokopets (40)
Shared, standardized metrics and performance evaluation across the company	e.g:Lapide (25); Prokopets (40)
Planning assumptions aligned	e.g:Prokopets (40)
Information systems: an integrated cross-functional data model enabling rapid integration of cross-functional plans	e.g:Lapide (25); Grimson and Pyke (15); Prokopets (40)
Demand and supply planning	e.g:Lapide (25)
Enabled participants to decision making	Lapide (25)
Organizational structure oriented to changes: a culture that enables effective cross-functional collaboration and implementation of new processes	e.g:Grimson and Pyke (15); Prokopets (40)
Meeting attendance	e.g:Lapide (25, 26); Prokopets (40)
Forecast accuracy	e.g:Lapide (26)
Cross functional integration	e.g:Lapide (26); Kepczynski et al. (21)
Consideration of external environment	e.g:Lapide (26)
Top management support/Senior Leadership: effective leadership by senior managers may include setting and communicating goals and expectations, active participation in the process,data-driven decision-making, owning and adhering to the plans and measuring performance of teams, managers and processes.	e.g:Grimson and Pyke (15)
Training	e.g:Grimson and Pyke (15)
Cross-functional modeling of business scenarios	e.g:Prokopets (40)

2.3.3 Performance management

Measures drive accountability and ownership for mutual goals by making the processes more disciplined and factual.

Although the effect of the IBP process on organizations performance seems to be positive, its extension is still not empirically proven in the academic literature (54). By combining the different outcomes in different situations, the ultimate desired outcome for enterprises seems to be the ability to consider all necessary factors in tactical planning. However, some, more specific quantitative and qualitative outcomes are pointed in the literature which are related to the fulfillment of quantitative and qualitative goals (Table **??**).

In that sense, it is critical to define metrics to evaluate the outcomes of IBP process. That is called *Performance management* and it is pointed in literature as one of the most critical success factors for strategy implementation and execution, once it enables stakeholders to assess the effectiveness and efficiency of the S&OP/IBP implementation on the company.

Yet, the concept of S&OP/IBP process performance is not clearly defined in either academic literature or practitioners reports[3], resulting on a large number of measures at different organizational

[3]Consulting firms and Software providers are examples of practitioners.

levels. Some are related to the implementation process itself, but the majority focus on the performance of the organizational functions (i.e. the effect of the IBP process on companies' performance) or even on the achievement of business/planning goals (55). In line with this, Thomé et al. (56) points one of the major drawbacks is the absence of comprehensive process-oriented framework for measuring S&OP/IBO process performance.
Multiple authors developed frameworks for measuring the performance of S&OP/IBP process inspired by Balanced Scorecard (20) that aligns performance measures with organization strategy, or even SCOR model (2), which manages the business activities associated with Plan, Source, Make, Deliver, Return and Enable dimensions. In *Sales and operations planning and the firm performance*, Thomé et al. (56) proposes a Performance management framework aligned with Balance Scorecard and SCOR principles, which distinguishes measures according to process categories (plan, source, make, deliver and return) and different planning levels (strategic, tactical and operational). On the other hand, Grimson and Pyke (15) suggests that performance measures may differ based on the IBP maturity level. Either of these approaches focuses on the aggregated level, instead of the specific activities of a cross-functional planning process.

If we take into account IBP is a process which receives inputs, performs certain activities and generates outputs, hence, the primary focus of performance measurement, and consequently, the definition of process metrics is effectiveness, efficiency and adherence, accordingly to Kepczynski et al. (21). Effectiveness measurement is a measure of process output that explains how good is IBP performing on the company. Efficiency measurement is based on process activities and process inputs, so that it explains how time-consuming or complex processes are. Finally, Adherence/quality measurement is about measuring process activities in order to check if process steps are executed according to good practices.For example: presence on meetings, inputs (demand and supply planning) provided on time.

To plan and manage outcomes of IBP, Hulthén et al. (18) suggests the process-oriented framework illustrated in Table **??**. It specifically addresses the performance of the S&OP/IBP process by considering all the major process steps and their related outputs. The measures are categorized based on the key areas of a process performance such as effectiveness and efficiency.

2.3.4 Business Planning Maturity Model

A maturity model can be defined as a staircase, diagnostic tool that describes how companies manage a certain area of their business, being used regularly for benchmarking and continuous improvement. It helps the assessment of the current stage, the identification of the opportunities for improving it and possible evolution paths, by comparing the "As-is" with the next stage and best-practices (26; 5).The S&OP literature has seen the rise in popularity of maturity models (26; 15; 61, e.g.) as the Table 2.4 shows. When comparing the dimensions used by to assess the maturity of the S&OP/IBP process they are for the most part equivalent. Grimson and Pyke (15)´s "Information Technology" and "Plan Integration" are similar to Lapide (25)´s "Technology" and "Process" respectively, and "Meetings & Collaboration" and "Organization" in Grimson and Pyke (15) model broader encompass "Meetings" suggested by Lapide. However the evolution

Table 2.3: An overview of measures related to S&OP process performance adapted from Hulthén et al. (18)

Areas of S&OP/IBP performance measures	**Effectiveness: How does the S&OP plan influence corporate effectiveness**	**Efficiency: How well is the S&OP/IBP process managed**
Demand related measures	Forecast accuracy/variability New product development cycle time New product launches Customer perceived value of products Expected responses to promotions Adherence to sales and marketing plans Quality of data for demand planning	
Supply related measures	Delivery reliability Lead time Speed Flexibility Variation in delivery Distribution Costs Inventory levels Turnover Obsolete inventory Labor productivity index Materials quality Quality variation Supplier lead time Order fill rate Capacity utilization Variations in deliveries Adherence to sales and marketing plans	
Other measures	Total sales vs demand Contribution margins Customer perceived value of products Customer service vs inventory Meeting demand with reduced inventory Baseline forecast vs budget Cash to cash cyle Return on assets Gross profit return on inventory Company/product profitability Expected revenue of plans vs financial targets Integration of measures cross-functionally, with business strategy and reward system	Cross-functional integration plans Supply and demand planning in balance Planning linked to execution Monitoring actual performance against S&OP/IBP metrics Meeting efficiency Information preparation and sharing Holistic view of supply and demand to

on S&OP/IBP maturity models led to the integration of "Measurements" parameter (15), because it is essential to successfully manage planning process, as we already discussed in the previous subsection 2.3.3. The Grimson and Pyke (15) 5-stage model has been considered a point of reference on S&OP maturity models, once it is based on research literature and interviews of wide array of companies and it emphasizes vertical and horizontal integration to achieve higher profitability. Although the boundaries are not clear, we can affirm stages 1 to 3 correspond to companies performing S&OP, while stage 4 and 5 correspond to companies in IBP maturity stages. The goal of Grimson and Pyke (15) model is profit optimization through the integration of the sales, operations and finance function's plans. However, some confusion around IBP concept raises from the fact that market analysts and academics developed separate maturity models for S&OP, Financial Planning and Budgeting Software (7).

Recently, Danese et al. (10) developed a model very similar to the one from Grimson and Pyke (15) which can be consulted in *Managing evolutionary paths in Sales and Operations Planning: key dimensions and sequences of implementation* paper. This framework classifies the companies

Table 2.4: Maturity models

Studies	Dimensions	Evolutionary stages
Lapide (26)	Meeting frequency and type; Alignment of demand and supply plans; Technologies implemented	(1)Marginal Process; (2)Rudimentary process; (3)Classic process; (4)Ideal process;
Grimson and Pyke (15)	Meetings and collaboration; Organization; Measurements; Information technology; Plan Integration	(1)No S&OP process; (2)Reactive; (3)Standard; (4)Advanced; (5)Proactive;
Wagner et al. (61)	Process Effectiveness; Process Efficiency; People Organization; Information Technology	(1)Undeveloped; (2)Rudimentary; (3)Reactive; (4)Consistent; (5)Integrated; (6)Proactive
Danese et al. (10)	People and Organization; Process and methodologies; Information technology; Performance Measurement	(1)No S&OP process; (2)Reactive; (3)Standard; (4)Advanced; (5)Proactive

in five different ranks, from “No S&OP Processes” to “Proactive” across four different dimensions - “People and Organization”, “Performance Measurements” which are business process related, “Information Technology” and “Process and methodologies” which are information process dimensions. Although the boundaries are not clear, it is possible to consider stage 3 to 5 correspond to IBP maturity levels, while stages 1 and 2 correspond to S&OP.

The “People and Organization” parameter assesses the level of effectiveness of the human component and business structure in the whole S&OP/IBP process. While the lower stages are characterized by having silo culture, low attendance, missing support and involvement from finance, product, development and IT department; being at the stage 3-4 requires having strong governance, executive buy-in, counting on the participation of CEO and Finance in IBP. For achieving the highest level of this parameter, companies may promote involvement and alignment between all functions (including Product, Development, Sourcing and IT).

Concerning "Process and Methodologies" parameter, at the beginning the goal is to create an operational plan that match against supply, with no or little external collaboration. Stage 4 presupposes the ability to calculate profitability of the operational plan, drive strategy through meetings and support communication and the participation of suppliers and customers in S&OP/IBP through collaborative platforms. The highest stage in terms of IBP processes rely on event-driven meetings, monitoring performance and accessing external data in real-time, while trying to perform demand sensing, trade-offs and conscious decision-making.

Beginners in S&OP/IBP have weak IT support, with a heavy reliance on individual datasets/spreadsheets, while companies on IBP stages have technology to guarantee the connectivity between systems (e.g.ERP and IBP) and to support communication with trading partners. Performing scenario analysis, demand/supply shaping, financial optimization are some of the capabilities top IBP performers are able to with the support of advanced (planning) tools. Finally, in terms of performance management, early stages are characterized for focusing on individual, functional measurements(no linkages), while being at the stage 4 means S&OP/IBP driven performance measurements throughout the organization, that means measuring new product introduction effectiveness and S&OP/IBP effectiveness. For companies at the stage 5, strategic measurements are reviewed during S&OP/IBP process, and metrics seek to capture company profitability and the impact on the ecosystem (e.g. social impact, global environmental impact).

The maturity level is evaluated for each of the parameters, and the final diagnosis is the combination of those "classifications". Achieving the last stage of maturity in all parameters is almost utopian for most companies, in that sense it is essential to design an improving roadmap and prioritize "activities/goals" after assessing the maturity stage of a company (15; 10). Scholars provide several arguments suggesting that interventions on "People and Organization" should precede the others, and that interventions on "Process and Methodologies" should precede improvements in IT and performance measurements areas. It is important to note in the past decades, other models have been developed by Technology companies or consulting firms, some of them focusing "only" on IBP process (ranging from tactical to strategic process (7)), for example, Deloitte made use of its own maturity model which was aligned with the Gartner's Maturity Model (57). Although maturity models mentioned are qualitative, there are also quantitative models, such as the quantitative model proposed by Aberdeen Group (60), whose metrics are *Customer Service Level*, *Average Cash Turnover cycle* and *Average accuracy of sales forecast* at the aggregate product level.

To sum-up, many S&OP/IBP maturity models with different dimensions of evaluation have been suggested in the literature. Although they define clear milestones to be achieved by companies in each of those dimensions, a successful S&OP/IBP implementation or development, that is, the achievement of those goals can be complex and challenger, as the next subsection explores.

2.3.4.1 The Challenges of IBP development

Regarding IBP, there is limited research available concerning its implementation and issues. However, various barriers that obstruct S&OP implementation were found in the literature, that can be extended to IBP. The major difficulties raise from the fact that it does not only require the change of businesses processes, but companies culture as well, since it involves communication, breaking functional silos, aligning goals and different functions have different values, goals and behavior guidelines.

- **Processes**'s alignment and integration required in IBP can be difficult, considering there is a set of competitive priorities while pursuing strategic goals. Achieving this goals may require some extra daily activities with reporting processes, measuring and tracking specific key performance indicators and, above all, the formalization of demand-supply balancing process (34). Moreover, we can identify changes on the decision-making process.

- **Leadership** is a seemingly vague and esoteric concept, but it is an essential element of effective IBP implementation (42). The concept refers to a quality of individuals' behaviour whereby CEO and key functional managers guide people or their activities in organized effort.

- **Culture** can be a challenge, because employees are likely to offer resistance to change, once changes are commonly connoted with considerable uncertainty, anxiety and pain in the process of change (29). Moreover, the predominance of silo effect in organizations, in which

individual business functions tend to isolate themselves and specialize in their own parts of planning processes, can generate conflicts and make integration more difficult. According to van Hove (58), cultural challenge might be felt in two dimensions: changes in the operational activities of personnel and the behavior of individuals within the entire organization. This barriers are more difficult to overcome on organizations with rigid structures (15; 33).

- **IT tools adoption or adaptation** requires a business change. According to Viswanathan (60), the majority of companies already have IT systems to provide parts of the solution, but when trying to get data from multiple data sources into an integrated workflow, significant integration challenges can raise. Moreover, the lack of functional expertise can causes stakeholders to misinterpret key planning concepts, hence the IBP process.

- **Management and Employee Involvement** have to be a priority to guarantee an efficient IBP development strategy, since it demands collaboration and empowerment of staff. The lack of training with all process participants, incentives and penalties, as well as irregular meeting attendance and not understanding meeting procedures can be some of the barriers (33).

- **Supply Chain Complexity** arising from wide portfolios of products, different pricing, cost structures ans service expectations, shared resources across multiple business units and wide variations in demand volume and mix can constrain the development on IBP joruney. Ideally, on a fully integrated planning process, inventories, resources and cost structures self-adjust to changing customer requirements, market conditions and profit targets, but establishing such processes is heavily affected by business and supply chain complexity.

Although previous S&OP studies have emphasized the importance of individual and organizational factors (15; 26), when we consider the challenges mentioned above and the actual business planning paradigm, having planning processes supported by the proper planning tools seems to be the priority (60**?** ; 54; 1). Organizations are increasingly turning to technology to support the S&OP/IBP process, since Advanced Planning Systems enable the sharing of real-time data across functions and lead to more accurate and detailed planning, as we are discussing in the next section

2.4 Overview of the Advanced Planing Tools

In the previous section, the IBP process and supply chain mid-term decisions of an organization were described in detail. In this section, we aim to approach existing literature from the technological system's – Advanced Planning Systems (APS) – perspective.

2.4.1 Introduction

In the academic literature, it is possible to recognized two main topics of discussion. First, IT systems as key enablers of S&OP and IBP; and second, the specific data requirements. Giving particular attention to IT platforms, the findings of Williams et al. (63) support the theory that

information sharing technologies and processes yield greater returns when it comes to the integration of internal processes. In addition, nearly 70% of Sales& Operations Planning consider technology to be an extremely critical or very critical part of their organization's planning process. For decades, technology was one of the main barriers to improve cross-functional planning. Function-specific systems were developed to fit the unique requirements of a single function, which result in independent and unaligned financial, supply chain and marketing plans and result on organizations holding several systems that worked in silos. New integrated systems were developed in recent years. Though, accordingly to **(author?)** (Richard et al.), today the main barriers revolve around organizational inertia, misalignment of incentives to adopt new processes and systems, unclear benefits and high investments on technology and talent development. Supply chain modernization, that is, business driving to stronger digitalization, generates ongoing tension between process, people, analytics, data requirements and technology needs, once the ability to collect, cleanse and share data across the organization usually requires a significant investment, without an immediate return on investment (ROI), that some companies consider risks they are still reluctant to take.

> *COVID has made it imperative for supply chain leaders to have some form of a modern planning solution that cuts across various individual functions—be it sourcing planning, execution planning, manufacturing planning or sales and distribution planning.* Balaji Abbabatulla, Gartner senior director analyst of product management research for SCM software.
> *McCrea (32).*

Looking ahead, accordingly to McCrea (32), supply chain modernization includes migrating to the Cloud (timespan: 2021-2022) and it is the most widely used technology in business planning process; optimizing processes through the adoption of growth technologies such as Artificial Intelligence (AI) and Advanced Analytics (2022 and beyond); and finally, as companies will implement emerging technologies, process augmentation is expected in 2023 and beyond.

2.4.2 Technology solutions for Synchronized Planning

According to Grimson and Pyke (15), in the early stages of IBP (S&OP) in organizations, the data is separately owned by different functional areas and updated without any consolidation. In the standard level of S&OP/IBP, data is shared and consolidated but not in an efficient and automated way. Advanced and Proactive S&OP/IBP stages include integrated real-time data and external data from suppliers and customers. Companies started to introduce Enterprise Resource Planning (ERP[4]) systems (e.g., Baan or SAP/R3) and the wide spreading of those ERP systems promoted the genesis of Advanced Planning Systems (APS) (59), which are presented in the next chapter.

[4]ERP systems refer to transactional tools which integrate data of all major business units, but that provide limited support on planning field (Production Planning and Control)

Regarding planning tools, in general, organizations can benefit from the use of the following features (64; 35): Cloud Computing, Collaboration tools and software, Big Data and analytics, Artificial Intelligence (AI), Internet of Things (IoT) and Supervisory control and data acquisition (SCADA technologies), which will one be explored in the scope of this dissertation, but that is subject for future research.

2.4.3 Scope of Planning: Company's Requirements

As organizations look for new ways to plan and forecast, technology is often one of the strategies they use to achieve a a better performance in these areas. According to Lapide (25) and Wagner et al. (61), it is necessary to have in place three different, or a three-sided, software, since the process deals with three major types of information,

- **Sales or Demand**: the system needs to be able to support the production of the sales forecast (Demand Planning). A feature that allows the production of "what-if scenarios" is regarded as essential too (Scenario management). Financial modelling and price optimization are also essential to support IBP (60).
- **Operations or Supply**: the system needs to be able to support the production of the capacity plan, and to mirror perfectly the operational and capacity limitations of the company (i.e. Supply Planning and Inventory Planning).
- **S&OP/IBP environment**: the IT tool needs to be able to share, display, store and change the information from both the sales and operations parts of the system., in that sense Executive Reporting Dashboards are essential.

According to Vidoni and Vecchietti (59), the most important planning sections of the SCP-Matrix, proposed in **?**) are covered by a respective software module. Depending on the company, and considering that planning modules' names differ according to the software provider, to properly implement IBP, companies should look for Demand Planning (e.g. demand forecasting and consensus demand planning) and Supply Planning modules (e.g. demand forecasting and consensus demand planning), as well a support module/functionality for aligning planning decisions across the enterprise and across multiple planning time horizons.

In order to benchmark the products on the market, it is essential to understand what companies are demanding for, by defining key-drivers for the decision making. The following factors have been identified as a result of companies' feedback and market research (**?**):

1. One unique platform supporting, ideally, end-to-end planning processes for all stakeholders that ensure a single user experience.
2. One Data Model gathering all planning processes, but that allows customizing hierarchies and dimensions adjusted to each business function (flexible business model).
3. Analysis and Machine Learning to leverage knowledge and improve the accuracy of plans cycle over cycle, through patterns and values of the historical data;

4. What if Scenarios supported by dashboards. These feature can be a support for S&OP/IBP meetings, allowing collaborative decision making.

5. Workflow management virtually, which enables better cross-functional collaboration and supports all cascading or escalating decisions, as well as it ensures visibility of the status of processes and their automation.

APS providers offer several software components and/or software modules covering the planning tasks and requirements (mentioned above) of each enterprise, yet respect the peculiarities of the particular type of its supply chain. The next section explores in more detail those systems.

2.5 Advanced Planning Systems

APS describes any supply chain planning tool that provides companies the technology support to create, manage, link, align, collaborate and share its planning data across an extended supply chain, supporting the demand forecast, detailed supply-side response, strategic and tactical-level planning. Commonly, it uses heuristics and other techniques to solve multi-objective problems and provide real-time planning and decision support, based on multiple scenarios evaluation. From the scenarios created on the software system, one scenario is selected as the “official plan” – one source of truth.
This supply chain planning technology is needed to facilitate responsive, agile, end-to-end planning that supports a company’s strategic goals and works as single version of truth in decision-making matters at any level(47; 26).
As we explored in the previous section, the three main components of APS systems are (1) Demand planning, (2) Supply planning and (3)Support for aligning planning decisions across the enterprise and across multiple planning time horizons (e.g. S&OP). However, multiple solutions also include Advanced analytics and artificial intelligence (AI), Digital supply chain twin, Integrated business planning (IBP) and Continuous planning and Supply chain segmentation (1; 47). Some examples of APS are OMP Supply Chain Planning Solution (by OMP), Oracle Supply Chain Planning Cloud (by Oracle), SAP Integrated Business Planning for sales and operations (SAP IBP) or SAP Advanced Planning and Optimisation (SAP APO) (by SAP), Anaplan for Sales and Operations Planning (by Anaplan), o9 Solutions Integrated Business Planning (by o9 Solutions).

It is important to be aware that the acronym APS has two different standings on the literature: "Advanced Planning System" and "Advanced Planning and Scheduling". Advanced Planning and Scheduling usually refers to a SC planning problem that can be solved with advanced mathematical algorithms or logic to perform optimization on finite scheduling simulation. While, according to the same author (16), Advanced Planning System is an information system that solves planning problems, establishing itself as a complement to the existing ERP. In spite of that, the concept of "Advanced Planning and Scheduling systems" and "Advanced Planning Systems" are overlapped.

2.5.1 Planning modules to support IBP process

Ivert and Jonsson (19) studied the APS system appropriateness in S&OP processes and conclude complexity, uncertainty, and vulnerability on planning environment increased the need for APS features, yet the dimensions demand different characteristics. Complexity is bond with complex trade-offs between priorities, dependencies and (inevitable) constraints (due dates, capacities, transportation costs, setups) (19) that multiple companies face, specially on Synchronized Planning process. Researches on case companies also found that when the level of planning complexity is too high, APS implementation is mandatory, although its success may depend on technological issues (accurate APS modelling, effective system integration, and a high level of data quality are technological issues).

APS usage in planning processes depends on two separate issues: APS functionalities and S&OP/IBP processes (19). Regarding the functionalities within the APS modules that support S&OP/IBP processes, Ivert and Jonsson (19) refer "sophisticated" methods", such as multiple statistical (quantitative) forecasting methods, are used to developed Demand Forecasting and Demand Planning in different settings for different planning horizons with the possibility of incorporating judgmental factors. They also enable the integration of inputs from various functions/companies into the forecasting process (integral planning), and to aggregate/disaggregate forecasts using a pyramid forecasting approach, hence creating a collaborative process. Typically, users can do manual adjustments to add inputs, modify the shape of the life-cycle curve, and schedule product launching, supporting decisions on scenario-analysis (what-if analysis) (**?**). To support the creation of a preliminary production plan (supply plan), consensus plan and the setting of"final" integrated plan, APS tools feature integral planning, constraint-based planning, optimization, and what-if simulation. That means the entire supply chain plan can be modeling simultaneously, considering multiple constraints and approaches toward evaluation of constraints, which may result in different scenarios to be compared on a graphical interface (what-if analysis) (19**?**).

From a technical perspective, some software connect multiple separate systems, integrating data in real time which usually provide the best-practices dashboards for value-based tactical planning processes which, together with the "Supply Chain Control Tower", enable end-to-end visibility along all levels of the supply chain and work as the interface to executive IBP meetings. Those interfaces are customized views for each of the planning process and employee/function role, that is, APS are usually configurable to adapt to different levels of maturity/speeds within the organization.

Once we have analyzed how an APS can support the IBP process, it is important to explore what should be taken into account when selecting and implementing such tool.

2.5.2 Selecting and Implementing Advanced Planning Systems

Both **?**) and Stair and Reynolds (53) point out the importance of careful investigation of the vendors, because it is not only about choosing the "best software product" but also the right

long-term business partner. The main deficiencies enterprises should avoid in Vendors' evaluation process are the poor assessment of the opportunities for improving the current system, deficient investigation of alternatives, and poor analysis of the relationship between adherence and quality of the solution. In order to avoid those issues, appropriated criteria may be defined.

2.5.2.1 Selection Criteria

When it comes to define what may drive APS selection, good practices emphasize the decision making process should take into account more than only on criterion (e.g. cost-benefit or financial based criterion) (15). The selection of a vendor/software is a complex decision, in which multiple business requirements and external factors should be taken into account to multiple. Some studies highlights the Multi-Criteria Decision Making (MCDM) approach (17) as a solution, if it considers both tangible criteria and intangible criteria. The tangible criteria refers to quantitative criteria such as cost. In contrast, qualitative criteria can be referred to intangible criteria such as delivery and performance history. Each criterion will influence the decision making process with an equal or different weighing factor.
Often, the selection models are designed by enterprises/consulting firms based on expert's experience and organization's needs. That said, a huge number of selection criteria have been suggested by different authors, but the goal is to obtain an objective and structured comparison between different software vendors. **?**) divides the criteria into three dimensions that, somehow, coincide with the dimensions proposed by Gartner in "Magic Quadrant for Supply Chain Planning System of Differentiation" (48). Those dimensions are *Functional* criteria, *Vendor specific criteria* and *User Situation*. *Functional criteria* is related to the functionalities, software modules and their extension. Vendor specific criteria aims to evaluate e.g. vendor experience and reputation, financial stability, number of installations, market share and popularity of the vendor/solution. Finally, User Situation concerns the relationship between the user and the software, such as implementation time, user support and user friendliness of the system (**?**).

2.5.2.2 Vendor Selection Method

Different selection methods can be used when selecting an APS vendor. According to **?**), first it is important to identify the current and future supply chain planning maturity and technology landscape. Based on the to-be maturities and technology landscape identified, set dimensions/criteria to be used on the evaluation process, as mentioned on the previous section, and create an initial Request for Information (RFI) document to help gather input on the potential different vendors/solutions in the market that might meet the business requirements. Then, identify a list of vendors (up to 10) to approach with the RFI for more information and when the list of vendors is finalized, release the RFI to vendors. Some weeks could pass between the release of RFI and the receiving of responses. Once received, those responses are considered to create a shortlist of vendors for which light demo sessions are requested.
RFI and demo sessions are evaluated based on the criteria previously defined and, in some cases,

a Request for Proposal (RFP) is prepared and sent to vendors, in order to deep dive into some of the requirements. Finally, considering the different scores in areas such as fulfillment of functional requirements, post-implementation support, implementation methodologies, choose two to three vendors to take through the three remainder steps of the selection process, that are (1) the organization of Vendor's day with each of the finalists to clarify questions, project implementation and analyse budget/costs; (2) call/visit at least two or three references to collect their on that technology; (3) final vendor selection accordingly to the evaluation of each vendor on its fit against the weighted RFP scores, demo scores and reference scores. The selection process described above is a lengthy process and in practice, due to time and resource constraints, companies opt for shorter approaches. For example, Deloitte's approach, which is detailed in Section 4, is similar but shorter. It starts with the definition of the criteria to be included in the vendor evaluation model. Then, the RFI is prepared based on the Client's functional and technical requirements and a shortlist of vendors is selected based on *Gartner's Magic Quadrant*[5] and Deloitte's experiences in other projects. RFI are launched to that shortlist and responses are evaluated on how they fulfill functional and technical requirements. Based on that intermediate evaluation, two or three vendors are selected; Demos and Cost analysis are performed for the three finalists and evaluated, enabling to rank vendors and support the selection. Analysis are score-driven, so each object (vendor/solution) is assess in terms of how it can address clients' requirements (e.g. coverage degree, coverage method) and the priority of each of those requirements. The final criteria score corresponds to the weighted average scores of associated sub-criteria. This method allow to score APS vendors and support the decision-making process.

After the selection, stakeholders might negotiate the final proposal and setup a detailed implementation plan including a refined estimate of the effort and the timelines for the implementation and integration of the APS, as pointed out by **?**).

2.5.2.3 Implementation Project

Process and technology trends generate huge disruption which, according to Kepczynski et al. (21), mainly depends on the (1) ability to change behaviors and capabilities and (2) ability to continuous manage technology adoption. Depending on the scope, supply chain complexity, supply chain planning maturity, data availability and quality, companies may decide between implementing their solution by working only with the software vendors or, the most common, rely on the support of other implementation partners (e.g. system integrators and consultants).

The following list distinguishes the phases of a typical APS project, (**?** 23):

1. Evaluation phase: identify company's requirements for future planning tasks and processes, without considering any specific APS. To get an initial overview of the supply chain, the SCOR methodology can be applied (**?**) and then, based on the results from this evaluation, business strategy potential improvement areas should be identified.

[5] Gartner's Magic Quadrant is a vendor rating report developed by Salley et al. (47) that rely on proprietary qualitative data analysis methods to demonstrate market trends, assess the vendors' vision and their ability to execute. It offers visual snapshots, in-depth analyses and actionable advice to compare vendors/solution.

2. Selection Phase: as described in Section 2.5.2.2
3. Project Phase: comprise and organize activities (roadmap of activities and responsibilities), such as model building, setup of internal data structures and databases, validation/testing, training, and go-live.
4. Introduction Phase: pre-implementation testing, cleaning up data and parameters, providing additional training to users, particularly on business processes, and working with vendors and consultants for resolving bugs in the software.

APS software implementations may be manage as a business change project, accordingly to Fleishmann et al. (12), so that good practices emphasize it requires (23; 13): (1) Align vision between corporate and IT strategy; (2) Define scope and impact; (3) Align vision between corporate and IT strategy; (4) Leverage training and education; (5) Create a strong business case by defining improvements in business capabilities and assigning accountability to both business and IT leaders; (6) Leverage third-party support to develop the business case and support organizational change; (7) Build a strong project team and define roles, responsibilities and priorities; (8) Create a roadmap for the implementation and involvement of the stakeholders; (9) Evaluate how roles and responsibilities will change and how people are affected globally, regionally and locally; (10) Opt for an agile implementation, i.e. test systems in advance; (11) Build in techniques to determine if stakeholders have sufficient understanding of the changes that will affect them and the reasons for those changes.
Whether or not the implementation requires the implementation of a technology, different types of approaches are pointed out in the literature (**?** 33):

- **Big-bang approach:** roll out the technology to all entities at the same time. It is often too complex, risky and it doesn't work for large-scale supply chain planning transformations.
- **Theme approach:** select elements (narrow focus) to be deployed in parallel around all locations or business units. It suits better organizations that have planning processes in very different stages of maturity or specific pain points;
- **Flagship approach:** roll out technology to a single business unit end-to-end, as a pilot test (more common on large organizations);
- **Node by node approach:** implement supply and inventory planning capabilities sequentially on different layers (finished goods, semi-finished goods and finally on raw materials).

2.5.3 Challenges and consequences of APS

Due to the lack of either practical or academical analysis on APS implementation, some questions raise around when to use APS systems to support S&OP/IBP and how the complexity and planning context of some supply chains affect the effect of APS on companies an APS system to support an S&OP/IBP. Nevertheless, some positive consequences/gains are expected (59**?** ; 33), such as:

- Companies can optimize their supply chains, mitigating unnecessary costs, improving on time delivery, customer service level, average sales price, reducing inventory levels, improving product margins, and increasing industrial yields;
- Company can address the conflicting objectives, unnecessary costs and the decisions affecting inventory drivers, as well as optimize product mix with regard to resources;
- Quick and precise decision making and quick reaction to unexpected events and volatility;
- Continuous improvement and feedback loop incorporated;

However, companies implementing a new IT tool, in particularly an APS, can deal with some issues and risks:

- Poor data quality and availability, as well as industry peculiarities can led to additional cost, more reluctance to change and longer implementation periods;
- Kepczynski et al. (21) point people and technology are the components associated with high risk and high resistance, once the ability to adopt, create and continuous improve require a proper skill set, talent management and organizational structures (from internal or external sources) that many organizations lack;
- New software requires a comprehensive maintenance, support and update plan for the long term; this involves the annual fees to be paid to third-party software companies (4).

2.6 Conclusion

The current tactical planning processes performed at Client X haven't already reached IBP maturity levels, although the sales and operations alignment follows the theoretical basic steps of IBP cycle described in this Chapter (e.g. meetings, planning sub-processes). The proposal of assessing the maturity of planning processes, defining the "To-be" requirements aligned with organization's needs and then developing a framework for vendor's selection is in line with the best practices for and "Implementation Project" (Section 2.5.2.3) explored. Therefore, considering the "IT Technology" dimension was chosen for leading IBP improvement, it is expected that the future APS deploy will provide the support needed for planning processes and improved business performance, as research points out. For future work, we can highlight exploring how IBP addresses the specific problems/complexity of a process industry company and which technical requirements are crucial to address its planning challenges.

Chapter 3

Case Study - Company Description and Challenges

The chapter begins with a brief contextualization of the paradigm at the process industry, followed by the presentation of the Case Company and the characterization of its problem. It explains the main reasons why Client X felt the need to embark on a process of improving S&OP towards IBP process through the selection of and Advanced Planning Solution to be implemented. Following the Deloitte's good practices on project management, the project carried on at Client X required the definition of responsibilities, timings, activities and milestones, in order to guarantee a highly successful management.

3.1 Introduction

> "Process manufacturers operate in a world of tight margins and ever-changing requirements but often lack the technology and integration necessary to generate meaningful insights that would help them to optimize operational performance."
> *Todd Gardner, VP,Siemens Process Industries and Drives (39).*

Process industries (e.g. petrochemical, metallurgy, building material,energy) constitute a significant proportion of EU manufacturing base, and play a key role on sustained economic growth. They connect important raw material companies, that extract, transport and process those materials to manufacture semi-finished or high-quality end products through processes, that could be physical, mechanical or chemical processes. When compared to other sectors, such as Automotive sector, process industries have high energy and resource consumption, low value-added products and high environmental pollution (65; 49). While process industries generate huge volumes of data, their process-management and information-technology capabilities are often not very advanced, as highlighted in a McKinsey article (**?**).

Some studies (49) have already pointed short product life-cycles, mass customization, more dynamic and competitive markets, as well as the need to evaluate and improve sustainability. Most recently, on the post-pandemic period, simultaneously with the expected rise in inflation

and interest rates, increase of materials cost and key material shortages (hydrocarbons, minerals, metals, chemicals and energy), there is a growing pressure on supply chains to increase buffers (31).
In this context, Advanced Business Planning (APS) systems can be part of the solution to address the challenges of the process industry. More than just a plan for the entire business, they are a "game changer". Due to the spam of new, innovative solutions on the market, it becomes a priority identifying which technologies better fit supply chains' requirements and how is the selection of an APS in a process industry.

This chapter presents Client X – a company operating in the process industry – and the challenges it has been facing in regards to the integration of plans in a complex supply chain and the support of technology to its planning operations.

3.2 Case Company presentation

Client X is one of the world's most relevant players in the wood-based products manufacturing industry, with a turnover above 800 million euros (2021). It is dedicated to the development and production of sustainable wood-based products for furniture, decoration and construction, counting on more than 20 industrial and commercial units across nine countries and two continents, and selling its products in more than 80 countries. Internally, operations are divided in three regions, that, for confidentially reasons we will keep refer to as R1,R2 and R3. The portfolio offered to clients is diverse, offering core and decorative products, which can also be customized resulting on thousands of combinations.
The Case Company is highly vertical integrated company and has the control over several areas: product development, sales, production, customization, delivering, and providing technical assistance. Therefore, the variety of operations, products and location where it operates brings additional complexity to the business and supply chain operations, raised the need to improve operations efficiency and customer service. As a way to increase the support to planning activities enabled by technology, Client X looked for Deloitte's support to address challenges and SC complexity.

3.3 Case Company's challenges

In the context of the project, it was decided to distinguish between business and technological. challenges.

3.3.1 Business perspective

Several factors have contributed to the complexity of the business's supply chain, that, in part, drove the need to improve planning processes. Client X is a high mix - low volume business, as customers order small low quantities each time which, combined with the business decision of

having "confirmation to the day" option, reduces the flexibility on the planning side and increases the effort to optimize production and distribution operations. Around 80% of the production strategy was make-to-order (MTO) and buffers are little, not only because of their customers' demand patterns, but also of its limited warehouse capacity and the wide, customized portfolio products. These factors limit the possibility of planning/producing in advance. Regarding the portfolio of products, it offers more than 14000 Stock Keeping Units (SKUs) which are produced, sold and distributed in multiple locations, in different markets that differ on the complexity and execution of the planning process. At the planning level, the lack of alignment/integration between these geographies, functions and planning systems, has lead to multiple inefficiencies. Even though most production is make-to-order, production orders are not directly linked to sales orders in the system (anonymous production), making traceability difficult. Concerning the production, there are some other factors that affect the Sales and Operations Planning: high production volatility, in terms of volume, but also in terms of costs, due to the cost of raw materials; quality issues which generate last minute changes, and that can not be covered by any existing buffer, since Client X integrates a capital intensive industry, in which the need for high-capacity utilization means virtually no possibility to have capacity buffers. Finally, the fact that some customers usually specify the production unit where they want their orders to be produced and Client X is giving the priority to the fulfilment of customer's requirements, the ability of planning has been limited by these order allocation practices.

3.3.2 Technological perspective

Client X has been undergoing technological implementation processes, carried out during more than 20 years of internal SAP systems developments. However, the Board of the Client X has conclude that the complex and highly customized SAP solution implemented has not achieved the results expected. In specific areas, difficulties with maintenance, increased integration effort, higher Total Cost of Ownership (TCO) and difficulties on building expertise has occurred. At the same time the SAP system did not provide enough support to the complex supply chain of Client X. The supply chain was being supported by a set of interconnected system modules, as illustrated in Figure 5.4. Regarding their integration, some pain points were identified between SAP APO (Advanced Planning and Optimization module), that was covering Operational Planning, and the cloud solution, SAP IBP (Integrated Business Planning), that was supporting Sales and Operations Planning. However, some processes were still supported by ad-hoc Excel files and executed differently in each geography, which required manual efforts to guarantee the alignment between functions and geographies. For example cut pattern optimization was supported by an external tool only in R2, whose operations also relied on ad-hoc procedures. Furthermore, there were also inconsistencies on master data across regions.

In addition to the disconnected, homegrown supply planning tools, along with manual reconciliation processes, there was the fact that SAP APO support and maintenance was planned to be discontinued in 2025. Accordingly to Duncan and Werner (11), there were two options: users turning to its successor, SAP IBP, or looking for other alternatives.

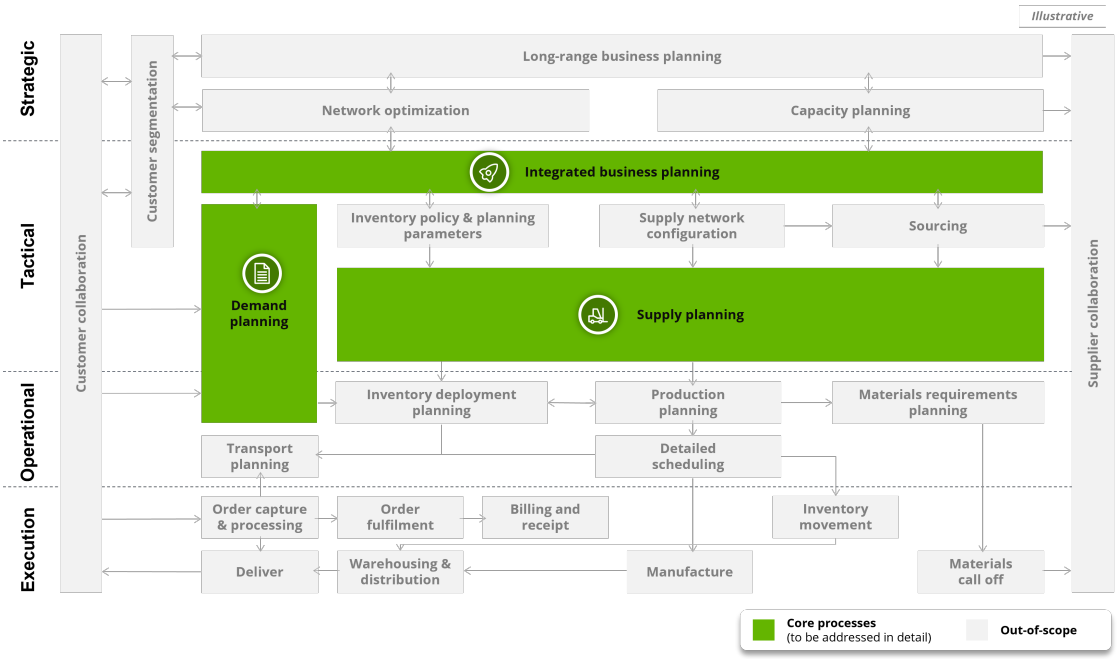

Figure 3.1: SCM processes in scope

3.4 Scope and goals

Bearing in mind the above mentioned, Client X requested Deloitte's support for a more conscious selection of a Planning Tool that would be able to cover tactical SCP processes and meet business requirements. With the implementation of that Advanced Planning tool, Client X excepted great improvements in IBP field, driving towards a fully integrated, cross-functional SC planning, oriented by the best practices in the industry (to be discussed during the project). The project proposal was already targeted at improving processes through technological support. Therefore, as Deloitte's team had a vast experience in IBP implementation tools, as well as experience in the are of activity of Client X, the challenge was accepted. Always assuming an agnostic position, Deloitte's team committed to reach the following project goals: (1) To identify and preparing the functional requirements list, according to operations and business needs; (2) To analyze and assess APS solutions that covers tactical supply chain planning processes under scope; and (3) To define an implementation strategy and roadmap.

It is important to highlight the choice of the final solution to be implemented would be a responsibility of on Client X. The evaluation considered only tactical planning processes under scope (i.e. Demand Planning, Supply Planning and Sales& Operations Planning), as illustrated on Figure 3.1, using region **R1** as a reference/pilot. Technical requirements were also excluded from the scope of this dissertation, although they can be object of future research work.

3.5 Roles, Responsibilities and Meetings

In order to ensure that *everyone knows what to do, what is being done, and who is responsible for each task*, roles and responsibilities were defined at the beginning of the project. The roles and responsibilities of each team involved in the project are described below, except for the individual responsibilities of the members of each work team. Deloitte's team was divided in *Steering Committee, Project Leadership and Project Delivery Team.* Steering Committee was responsible for providing strategic orientation, validating and approving proposed solutions and they had responsibility for overall project. To the Project Leadership was assigned the responsibility for project deliveries and outcomes, participating in executive checkpoints and connecting to SMEs. Finally, Project Delivery Team's tasks were focused on project deliveries and coordination with Client X team and SMEs, which involved gathering inputs, collecting data and synthesizing findings, identifying and escalating risks or issues, as required and preparing deliverables and recommendations. From Client X, *Supply Chain* team was the owner of the project. Within the Client X's stakeholders, a small team was created – the **Core Project Team** – which included the *Group Supply Chain Director* and the *IT Business Partner* who had the "last word" on the project deliverables and project decisions. To this team was also assigned the responsibility for the process performance and its alignment with business goals that, in collaboration with other process owners, support the strategic alignment of the process. Moreover, they were responsible for ensuring that activities are performed according to what was documented and guaranteeing continuous process improvement. Workshops and some discussions count also with the participation of process owners and their teams, such as the Sales Director, **R1** Supply Chain Director, Demand Planners (team), Supply planners (team).

As important as assigning responsibilities, was the scheduling of multiple touchpoints meeting to constantly monitor the project and ensure the achievement of objectives. Some are presented just below, but more detailed information on the main touchpoints and the respective stakeholders involved are presented in Appendix A Figure A.1.

1. **Project Status meetings**, occurring on a weekly basis, focused on the follow-up on the activities of that week, discussion of pending topics, blocking issues and alignment of the next steps. It counted on Project management team and, sometimes, Steering Committee's elements.

2. **Steering Committee Meetings** frequency adapted to project's main milestones' timings, (e.g. validation of "As-is" assessment) and their goal was controlling the quality of the project, revising results and main process changes, as well as checking Client's Satisfaction. They counted on Project management team, Steering Committee and, occasionally, other elements

3.6 Project Plan

The Figure 3.2 systematizes the phases of the project, the different activities and key milestones, to be carried out during 14 weeks with Client X. These Gantt chart was used to follow-up the development of project deliverables.

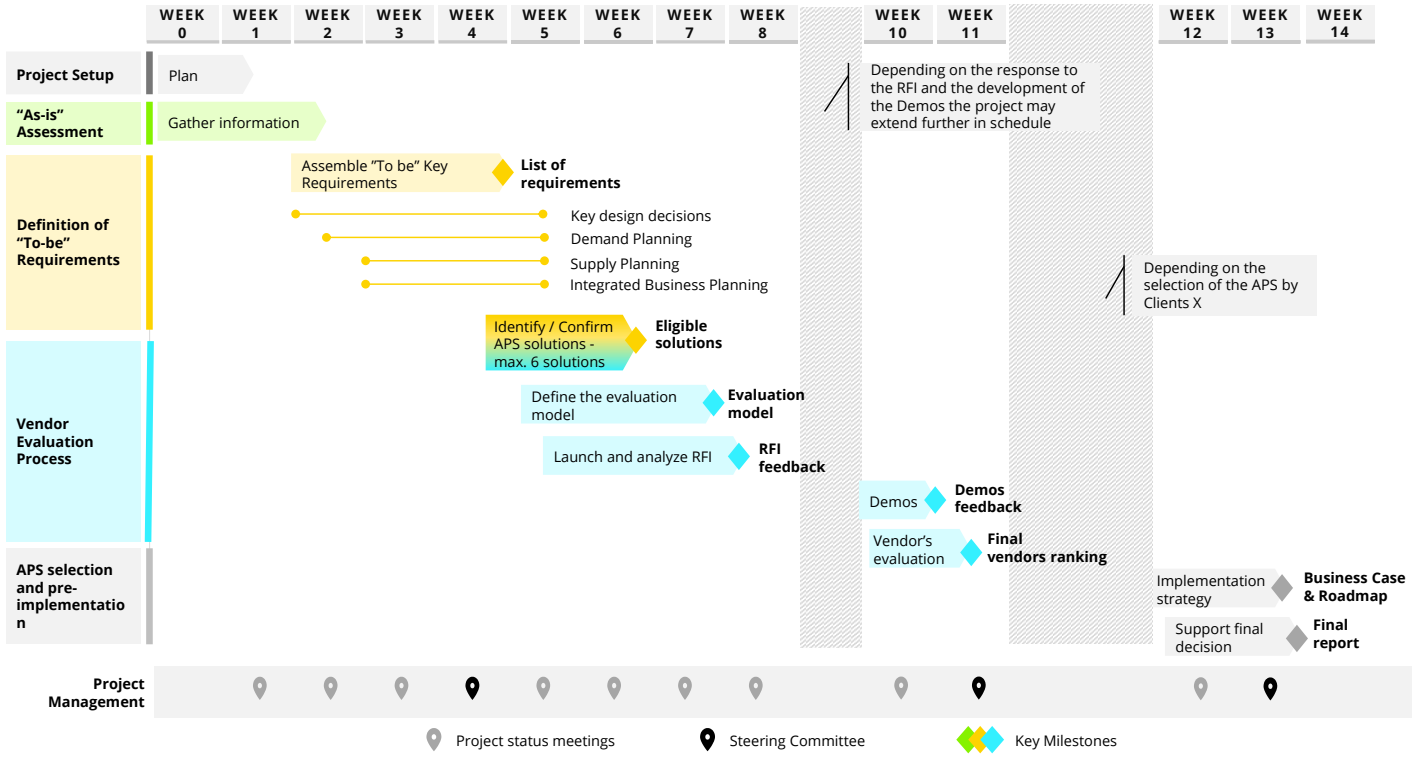

Figure 3.2: Project Plan illustrative Gantt chart

Chapter 4

Methodology

This Chapter, describes how we approached Client X's challenges. The methodology adopted took into account Deloitte's experience on Supply Chain Planning, more specially in projects of similar scope.

Deloitte's four-phase approach "to supercharging Integrated Business Planning" started with the *Project Setup*, followed by the analysis of the current situation, processes mapping and identification of the main opportunities for improvement, during *"As-is" Assessment* Phase. Next, it is described the approach followed on the *Definition of "To-be" Requirements* which included the identification of the future target setup and the functional and non-functional requirements. Finally, the Vendor Evaluation Process is detailed, from the vendor selection until the final score calculation and tool selection. Although it has not yet started, the methodology adopted for the next steps (*Implementation Roadmap*) is mentioned, in order to give visibility to the framework as a whole. Moreover, in spite the fact that in this dissertation we refer to "Integrated Business Planning" concept and process, it is important to highlight that for Client X case it is not totally correct to make use of it, because planning process was mainly a Sales and Operations Planning Process when the project started. Nevertheless, considering that Integrated Business Planning is a "journey" with different levels of maturity, we decided to keep this terminology in some parts of the document when we want to refer to the the future design or more mature stages of S&OP. That said, strategic planning hasn't been considered on the analysis nor in the criteria of the *Vendor Evaluation Model*.

4.1 Phase 0: Project Setup

Prior to the *"As-is" Assessment* and, in order to ensure the efficient start of the project, setup (also called pre-project management) was carried out. It included analysis of the primary documentation, clarifying goals and defining milestones, understanding how the organization works and aligning expectations and activities with business vision. This phase was characterized by discussion and alignment among teams, which result on a detailed project plan where activities,

timings and responsibilities were defined, in order to achieve the expected results. The first milestone meeting, count with the participation of key stakeholders from Client X and Deloitte's team to present and validate project's scope (Figure 3.1), goals, methodology and expected outputs, as well as to show project Gantt chart and work team. In this Kick-off meeting, not only Deloitte's team partnering with Client X was also presented, as well a team of Subject Matter Experts (SME), which included experts from the Deloitte global network with experience in wood-based industry. Taking into account the objectives and methodology defined, templates for the project deliverables were prepared, Deloitte's support documents were collected, among which a Process Dictionary (Checklist) for Process Industry and examples on *Multi-criteria Evaluation Models*. The objective was to have a first Process Dictionary Draft that could be compared to the Client's X process mapping and adjust the existing *Evaluation Models* to the business needs. Part of the next steps, project schedule and deliverables for each phase were also defined. The flow of information was expected to occur during a set of recurring meetings, through which teams engagement in project activities and agility in decision-making would be guaranteed. Internally, Deloitte's team chose to manage the project with the support of the *Microsoft* tools. As far as contact with Client X's was concerned, besides the weekly meetings, *email* and shared folders have ensured the constant tracking of project development. After the kick-off meeting, "As-is" Assessment interviews were prepared and scheduled.

4.2 Phase 1: As-is Assessment

The *"As-is" Assessment* phase focused on evaluating the current processes, in order to diagnose possible pain points, to identify opportunities of improvement and ensure the correct alignment between business needs and future functionalities. To understand organizational structure and end-to-end supply chain planning processes, two plant visits and four interviews with internal key stakeholders have been hold: Key Topics, Demand Planning, Supply Planning and Integrated Business Planning. These meetings followed a systematic approach of mapping current processes (Process Mapping), identifying pain points and improvement opportunities at process, organization and information system levels. The analysis of the information provided in "As-is Assessment Interviews" allowed, among other things, the construction of a draft version of the As-is understanding for the planning processes in scope, which was delivered to Client X and validated during Project Management meeting. Finally, "To-be" workshops to be hold on the next phase were prepared. Project team agreed on the key topics to be discussed during those meetings and the feedback on the "As-is understanding" systematization was incorporated.

4.3 Phase 2: Definition of the "To-be" Requirements

Part of the Deloitte's framework for improvement is the definition of the processes/maturity level the company wants to reach. In that sense, to support "To-be requirements definition", a

benchmarking exercise for processes and requirements was carried out to resume the good practices, considering, for that, inputs from SMEs. . Then, we held four workshop sessions with Client X to rethink processes and discuss tool requirements, to which have been added more 10 hours of discussions. For each planning process under scope, we compared the "As-is" to "Best Practices" – informal maturity assessment–, performed a Gap Analysis[1] and held a discussion on the pain points and opportunities of improvement identified previously. It is also important to emphasize that site visits played an important role with regard to the collection of requirements, once they allowed a better understanding of everyday challenges.

With respect to **Functional requirements**, first we identified the functional groups (i.e. Demand Planning, Supply Planning and Sales and Operations Planning) and, then, based on the what was defined during workshops, we listed Functional requirements with the support of *Excel Files*. For each requirement the following characteristics were identified: *Process group* (Demand Planning, Supply Planning, S&OP), *Process* (e.g. Prepare and Extract Data, Create Unconstrained Forecast), *Sub-process* (e.g.Upload Historical Data, Hand over Unconstrained Forecast to Supply Planning), *Name* (requirement short description) and an high-level *Description*, *Classification* (Data, Analytical, Functionality, User Experience) and whether the requirement is a Must Have, Should Have, Could Have or Wish to Have, by following MoSCoW *Priority* classification. All attributes were defined jointly by Deloitte and Client X's project teams, in line with business needs.

Regarding **Technical requirements**, they were not collected during workshops with Supply Chain team, but, instead, during a specific meeting with Client X's IT and Deloitte's team, who agreed on the most important requirements and dimensions to be included in the evaluation model. Although they are out of the scope of this dissertation, the above mentioned approach was also applied to Technical Requirements. We assigned the following attributes: *Topic/scope* (e.g. Integrations, User Experience, Efficiency, Quality, Security, Traceability), *Name* (requirement short description), *Description* and *Priority*, that is, whether the requirement is a *Must Have, Should Have, Could Have* or *Wish to Have*, by following MoSCoW priority classification.

The difference between MoSCow categories lies in whether the implementation of the requirement is indispensable/mandatory, desirable, optional or not a priority for that specific time frame, respectively. This prioritization was essential to identify to which requirements should be given a greater weighting on the Vendor Evaluation Model. Once requirements were listed and ranked in terms of priority, team aligned on next steps for: discuss and validate Vendor Evaluation criteria and weights, select of a short list of vendors and prepare RFI to be launched.

4.4 Phase 3: Vendor Selection Process

First of all, given that one of the main goals of the project was the selection of an APS to support tactical planning processes under scope, Deloitte developed its own *Multi-criteria decision-*

[1] uses inputs from the company and maturity models to identify gaps in capability, root-causes of sub-optimal performance and run rigorous and competent analysis which is the foundation for opportunity identification and the subsequent business case

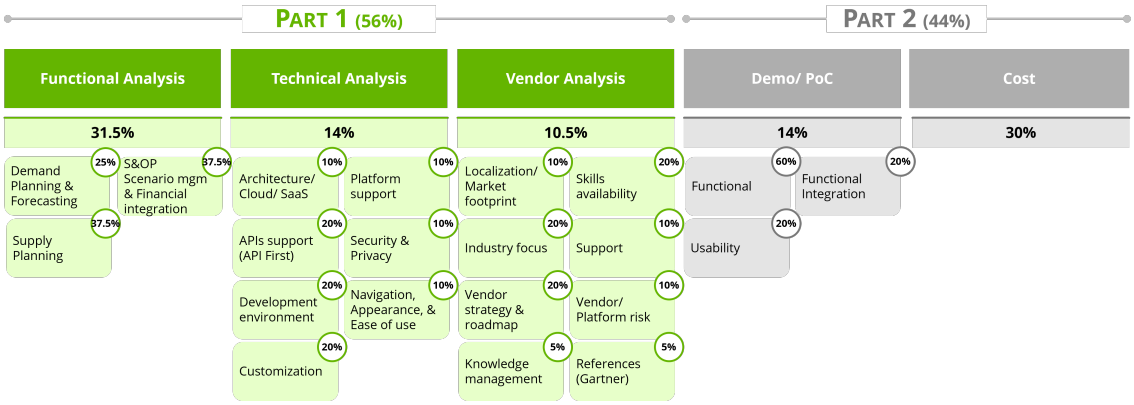

Figure 4.1: Vendor Evaluation Model: Criteria Diagram

making (MCDM) method to compare vendors in an objective and business-oriented manner. Based on Deloitte's experience, research and wide usage of the method, the framework proposed in this project suggested a certain level of confidence in the findings. At the same time it combined simplicity with customization. This approach enabled decision makers to gain a better understanding of the problem, organising and synthesising the entire range of information, while integrating objective measurements with value judgement (weights). However, we should highlight other decision-making methods could have been selected.
The methodology used to obtain a final ranking of vendors/solutions involved the following steps:

1. Identify multiple criteria on which Client X should base its decision;
2. Identify multiple alternative solutions (vendors) to its decision;
3. Provide weighting of criteria, in order to translate business priorities;
4. Provide values (scores) for each criteria.

Figure 4.1 shows the multiple criteria considered in the *Vendor Evaluation Model*, which was the result of consensus between Deloitte's and Client X's team. First, Deloitte's team presented a proposal of the evaluation dimensions, which was adapted from other similar project. Then, Client X's team validated those dimensions, which required, for example, deciding whether or not the Cost dimension should be included in the model. It should be noted that the evaluation model was considered an adequate tool to support decision-making, because, in general terms, it respects the MCDM principles (38), including a multitude of aspects like: single score for every alternative, all criteria are directly comparable, no incomparability, commensurability and discrete alternatives.

Overall, five relevant dimensions were considered: Functional Analysis, Technical Analysis, Vendor Analysis, Demos and Costs (Figure 4.1). Vendors' evaluation considered all of these dimensions in order to obtain a final score between 0-4 (Table 4.1). However, there was the need to divide it in two parts, so that an intermediate evaluation could make it possible to shorten the list of vendors for which demos were requested and cost analysis performed. That said, dimensions were divided in two main groups, for which Client X assigned the following priorities: Part 1 weighed

56% in the total score and Part 2, which was more focus on demos and costs, weighed 44%. Before exploring model criteria into detail, we should point the selection of evaluation dimensions and respective criteria considered the *Process Groups*, previously defined for Functional Requirements (e.g. Demand Planning, Supply Planning), some desk research (e.g. Gartner, vendor, websites) and Deloitte's Experience.

Table 4.1: Scoring Table for *Vendor Evaluation Model* criteria

Score	Qualities
4	Somewhat exceeds requirements; achievable; applies best practices; logically organized and well-integrated.
3	Meets requirements; achievable; suitable; acceptably presented, organized and integrated.
2	Somewhat less than meeting requirements; achievable; somewhat suitable; less than acceptably presented; somewhat unorganized; somewhat integrated.
1	Significantly less than meeting requirements; not fully achievable, suitable or addressed.
0	Does not address, or failed to answer, the question appropriately.

1. **PART I:** First part was related to *fit* dimensions. They aimed to evaluate if the vendor fulfilled Functional and Technical Requirements, collected in Phase 2 and understand whether or not vendor had strong, business-oriented vision and execution capabilities to support Client X's processes.

   (a) **Functional Analysis (31.5%):** quantitative and qualitative evaluation drivers for planning processes under scope, that is, evaluating how it satisfies business needs

   (b) **Technical Analysis (14%):** quantitative and qualitative evaluation drivers for application features and performance to analyse how solutions innovate and drive;

   (c) **Vendor Analysis (10.5%):** qualitative evaluation drivers for providers, in order to analyse how they ensure robustness and trust;

   Starting from Functional and Technical Analysis dimensions, they are structured in criteria and subcriteria. Criteria refers to the factors presented in Figure 4.1 that apply for each vendor. **Functional Analysis** criteria distinguished between *S&OP Scenario Management & Financial Integration*, *Demand Planning & Forecasting* and *Supply Planning*, that, in somehow, coincide with Process Groups; **Technical Analysis** criteria is related to technical specifications of the system itself, such as Cloud-based architecture compatibility with current systems Architecture, solution enabling Software-as-a-Service, API support, Development Environment, Customization, Platform support, Security & Privacy and navigation, Appearance of systems interface & Ease of use. Subcriteria apply to each vendor-requirement and they include the attribute *Priority* of each requirement and the following evaluation parameters: vendor-requirement's *Coverage degree* and *Coverage Method* guaranteed by that vendor. The objective of defining these specific Subcriteria was to assess *how* the identified requirements were covered by the solution.

   - **Priority** (attribute): coincided with requirement's priority levels *(Must Have, Should Have and Could Have)* ;

- **Coverage Degree** (criteria): it was related to whether the solution would cover the functionality or feature. It distinguished between three levels: *1- Full Coverage, 2- Partial Coverage or 3- Not supported*.
  (a) *Full Coverage* applied when the vendor covers 100% of the requirement, either because the solution supports it completely natively (Out of the Box) or with parameterization; it compromises to close the functional gap through ad-hoc development; or it commits to close the gap by integrating an additional software product;
  (b) *Partial Coverage* suited providers that cover a portion of the specified requirement, either through its standard solution or through an ad-hoc development;
  (c) *Not Supported* whether the requirement would not be met by the vendor.
- **Coverage Method** (criteria): it indicates in which way the requirement is supported by the solution proposed. That could fit one of the following categories: *1-100% out of the box, 2- Parameterization, 3- Development or 4-Add-on*.
  (a) *100% out of the box*: the requirement would be covered without any parameterization (completely natively);
  (b) *Parameterization*: requirement could be covered with standard parameterization;
  (c) *Development:* requirement would be covered with further development;
  (d) *Add-on*: requirement could be covered with an additional solution/ software (either add-on belonging to the vendor or external solution).

In order to evaluate whether or not Functional and Technical Requirements could be fulfilled by each vendor, RFI were sent to the shortlist of vendors. We explore this process in the next subchapter, but RFI responses allowed to assign a score for each vendor-requirement combination in a scale of 0 to 4, by applying the formula below:

$$Requirement_{Score} = Fullymeets_{Score} \times (Priority \times CoverageDegree \times CoverageMethod) \tag{4.1}$$

The *fully meets score* corresponded to the highest value a vendor could reach for a specific requirement. Scoring "4" meant the vendor could cover a "Must Have" requirement with the best Coverage Degree and Method (Full Coverage, 100% out of the box). The quantitative scores assigned to Priority, Coverage Degree and Coverage Method qualitative levels are shown in the Table 4.2.

Table 4.2: Scores defined for *Functional Analysis* and *Technical Analysis subcriteria*

Priority	**Value**	**Coverage Degree**	**Score**	**Coverage Method**	**Score**
Must Have	100%	Full Coverage	100%	100% out of the box	100%
Should Have	80%	Partial Coverage	70%	Parametization	90%
Could Have	60%	Not supported	0%	Development	80%
				Add-on	70%

Next, Functional and Technical requirements were grouped according to the criteria they would be allocated to (e.g. Demand Planning) and a weighted average of the vendor-requirements scores allowed to obtain an average score for each vendor at criteria level. For example, to calculate the average score of vendor X at *Demand Planning Forecasting* criterion, it may be considered all Vendor_X-requirements scores related to *Demand Planning Forecasting*.

The Figure 4.1 illustrates the weight of each **Functional Analysis** and **Technical Analysis** criteria in the model.

Finally, **Vendor Analysis** dimension was not so much related to the solution itself, but with the provider in question. In order to reduce the risk of exposure to vendors, criteria focused on vendors' experience in providing the expected functionalities and support, as well as access whether they had stability from a financial, organizational and market presence point of view. It is important to note that, it was important to ensure that vendors would be able to understand the value chain of the Client X, since the easier it is to identify the needs of the business, the more the solution can be adjusted to them. However, it was decided not to include this dimension as a sub-criteria, once it could benefit Client's current partners, just because they are more comfortable with these the latter points due to the fact that they know the organization better. The figure 4.1 shows the *Vendor Analysis* criteria and the respective weights, in which we emphasize *Skills availability*, *Industry focus* and *Vendor strategy & Roadmap* that were considered more important than *Support*, *Knowledge management* and the other factors, when it came to select an APS vendor. Vendor Analysis, as an whole, considered the documents provided by vendors and Gartner (47), responses to RFI vendor, research results and Deloitte's experience to assign scores for each vendor.

Global Evaluation Score (Part I) was calculated considering the Functional, Technical and Vendor Analysis scores, for each vendor, and the respective weights (31.5%, 14% and 10.5%). The weights mentioned above refer to the relative importance of each dimension in the model as a whole, but in this Part I we were only calculating an intermediate score, which corresponds to 56% of the final score. The formula used for this part was the Equation 4.2.

$$GlobalScore_{(PARTI)} = \frac{Functional_{Score} \times 31.5\% + Technical_{Score} \times 14\% + Vendor_{Score} \times 10.5\%}{56\%} \tag{4.2}$$

An intermediate ranking of vendors was made, which allowed Client X to shorten list of vendors for Part II.

2. **PART II**

   The second part of *Vendor Evaluation Model* focused on *Demos* and *Costs* dimensions. Demo sessions with each vendor were requested, as well as some Cost estimates, in order

to have their scores integrating the final model and reach a final ranking of vendors. Before holding Demo sessions, Project Team prepared some use cases

Demos analysis, which had a weight of 14%, considered the following three dimensions. *Functionality and use case coverage* (60%) which aimed to evaluate if functionalities were exhaustively illustrated according to guidelines provided to the vendor and if requirements are satisfied. *Usability* evaluated whether tool was easy to learn/use, it had an appealing look and optimized user experience; and, finally, *Functional Integration* focused on the integration between modules/plans. To drive demos, some Use Cases were prepared by the Project team and sent to Vendors. Live Demo sessions performed by Vendors counted on the participation of Deloitte's and Client X's stakeholders, but it was up to the Client X's project team to evaluate demos[2] considering the use cases and the previously defined criteria. Once we received feedback from Client and discussed some applications' pros and cons, Demo scores were integrated into the final model.

Regarding **Cost Analysis**, while cost is a very important criterion, it shouldn't have a disproportionate influence compared with other criteria. Rather, the key is to assess a vendor's ability to provide both overall business value as well as the appropriate level of technology support for your current-state and future-state needs, which often means not acquiring the "best" or deepest functionality, but rather the right blend of functional and nonfunctional capabilities, thus creating a balanced and appropriate level of investment. That said, Cost, as a criteria, only applied for the top three vendors and it was the last dimension to be considered in the evaluation model, with an weight of 30%. Once we verified which modules/system would have to be implemented for each vendor, we asked Vendors for an estimate of the investment for the next 5 and 10 years, and they distinguished between Licensing, Hosting and Implementation costs. Note that the initial investment, required to procure the solution, could vary based on the pricing model (perpetual or subscription-based) and implementation approach (BigBang, Node by node, etc). On the other hand, ongoing investment is related to maintenance fees, ongoing subscription fees, IT support and training. For both, we opted not to go into too many detail in this phase. Once the final cost for each vendor was obtained, it was necessary to normalize these costs to the 0 to 4 scale used in the rest of the model. Among other options, the Client X preferred that the lowest cost was allocated the highest score (4) and that for the scores of the remaining vendors we applied following formula:

$$CostAnalysisScore_{VendorZ} = 4 \times \frac{Cost_{VendorY}}{Cost_{VendorZ}}, \quad consideringCost_{VendorY} the lowest cost \tag{4.3}$$

By taking the steps listed above, we obtained a final, rounded score for each dimension. Objects' Final scores were calculated considering those dimensions' scores and the respective

[2]Evaluation in a scale of 0 to 4 (0. Not supported; 1. Does not meet; 2. Partially meets; 3. Fully meets; 4. Exceeds)

weights, as the formula below illustrates.Vendor Evaluation Model goal was reached with the ranking of vendors.

$$GlobalScore_{(PARTI+PARTII)} = Functional_{Score} \times 31.5\% + Technical_{Score} \times 14\% + Vendor_{Score} \times 10.5\% + Demo_{Score} \times 14\% + Cost_{Score} \times 30\% \quad (4.4)$$

In this subchapter we explained *Vendor Evaluation Model* as an whole, its dimensions, criteria and how we calculated each score from requirements until the final ranking of vendors. The weights assigned to criteria were shown, but it is important to emphasize that first evaluation dimensions were defined, and only then Client Core Project Team defined weights for each level of the model, which were validated during Project Meetings. To the *Functional Analysis* was assigned the highest relative weight among dimensions, once Client X considered it was a priority to fulfill functional requirements and support tactical planning processes. In the next subchapter we are going to explore the rationale behind *Vendor Selection process*, that is, how Project Team agreed on the objects to the evaluated with the evaluation model proposed.

4.4.1 Selection of Vendors Shortlist

There were many options available in the market, from megasuite vendors to functional vendors. That said among the options considered (Figure 4.2), the project team decided to follow the "Agile Spectrum & Select" methodology. *Agile* approach implies evaluating vendors based on requirements and specific business scenarios, based on RFI responses. RFI is issued for a short list of vendors.The selection of this methodology was justified by the fact that it is more moderate than the others, minimizing the risks associated with selecting a tool without considering alternative solutions (*Proof of Concept*) and taking less time and effort than establishing detailed functional fit (*Full Spec & Select*).

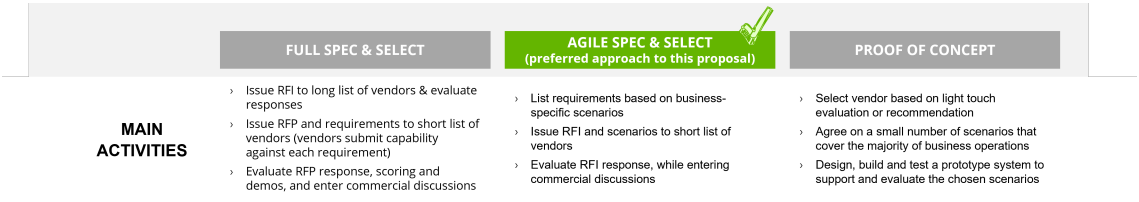

Figure 4.2: Possible project approaches identified by Deloitte's team

The list of potential vendors to be considered for RFI purposes was selected based on:

1. Gartner's magic quadrant and Client X's past demos feedback;
2. Solution's applicability to the industry;
3. Deloitte Benchmark and Experience.

As it was explained in 2.5.2.1, Gartner's magic quadrant for SCP Solutions is an useful tool to compare APS vendors, since it illustrates their market position. Accordingly to Gartner's definition, are considered Supply Chain Planning (SCP) solutions platforms that provide technology support for end-to-end supply chain planning decisions and management, whose core capabilities are demand planning (typically including demand forecasting and consensus demand planning), supply planning (typical including inventory planning, replenishment planning, order promising, production planning and scheduling), as well as support for aligning planning decisions across the enterprise in different time buckets and horizons. All vendors' in the Magic Quadrant sell solutions that enable companies to achieve at least Level 3 maturity[3] in terms of IBP and are categorized under one of the following designations: Leaders, Challengers, Visionaries or Niche Players (Appendix A Table A.1).

Based on Gartner's magic quadrant and Client X's experience with some of the vendors, an initial list of APS was defined. Next, we identified which vendors, from Gartner's magic quadrant, presented solutions more tailored to process manufacturing industry and, finally, we considered Deloitte's enabling alliances and previous experience to confirm the sustainability of the previous selection. This step finished with a final shortlist of vendors for which RFI were sent

4.4.2 Preparation and Launching of RFI

In order to survey which and how requirements can be fulfilled by each vendor of the shortlist, the *Request for Information* (RFI) was prepared. In this Excel file, the Functional and Technical requirements were organized by *Process Group*, *Process SubGroup* and *Process*, followed by the other attributes that we mentioned in 4.3 (*Description, Priority*, etc). It was up to vendors to fill in the below mentioned two columns for each requirement. Afterwards the responses allowed to compare vendors in a agnostic way:
An extra column for comments allowed vendors to include additional information regarding the solution proposed and, if applicable, indicate whether the requirement would be met in future versions of the solution.

4.5 Phase 4: Selection and Pre-Implementation

Once the vendor ranking was obtained (which is presented in Chapter 6), it was presented to the Client X's Board during a Steering Committee session where all the project phases were wrapped up and the next steps were defined. The scope of this dissertation ends here, with the final decision on the Client X's side. However, when the final response is received it is expected of the *Implementation roadmap* and *Business Case* for the vendor's solution selected, which should involve, between others, the following activities listed.

- Identify the implementation structure/approach, sequence and timings;
- Plan considering resources needs and investments levels;

[3] accordingly to Gartner's Maturity Model

- Identify risks, potential impacts, mitigation approaches and possible contingency plans (Risk Management);
- Identify and define interdependencies between the schedule and the other parallel initiatives;
- Align and assign responsibilities to the different stakeholders;

4.6 Conclusion

The methodology proposed in this chapter was applied for Client X requirements and maturity level. It allowed to fulfill the main goals of the project and, in somehow, it has "proven to be successful" in the selection of a tool "to supercharging Integrated Business Planning" at Client X. However, since the *Vendor Evaluation Model* criteria and weights were defined in line with this client needs, there is no significant evidence that its outcome (ranking of vendors) will apply for another company in the process industry. Around 80% of Client X production strategy was MTO and considering the nature of the products, which have long shelf life, Client X didn't have as much pressure on the demand-side as other companies in this industry. That said, the weight given to "Demand Planning & Forecasting" criterion (25%) in this project was lower than the weight given to "Supply Planning", but this consideration should not be generalized to all companies in this industry.

Moreover, the assessment of whether or not the methodology proved to be successful is complex. It will only be possible to evaluate if the APS selected supports business needs with success at the time of implementation, and this evaluation will always be influenced by multi-factors, such as the method of implementation.

Chapter 5

Assessment of "As-is" and Specification of "To-be" requirements

In order to guarantee the viability and sustainability of the technological improvement solution, it is vital to start by carefully assessing the current state of the business and planning processes and how they could be improved to converge with the best practices in the industry. During this chapter, the current situation of the Client X's Demand Planning, Supply Planning and S&OP will be analysed, as well as the existing planning tools. The main goal of this section is to deliver an integrated view of the company's tactical planning processes, through the Phase 1 methodology, explored in the previous Chapter 4.

In this chapter, "To-be" requirements are described which result from the application of methodology described in Chapter 4 for Phase 2. The response to ***Which?*** "To-be" requirements should be considered in the selection of an APS tool are presented.

5.1 Assessment of "As-is"

Phase 1 focused on the "AS-is" context, that we will explore in this section. As mentioned before, "As-is" interviews with the various functional stakeholders aimed to understand the current Demand Planning, Supply Planning and IBP processes, but first an overview meeting allowed to map end-to-end supply chain processes [1] and identify the main challenges, which included the identification of the factors driving complexity in the planning processes. Before each interview, which in some cases was the first close contact between Deloitte's team and the Client's functional team, the goals and the scope of the project were presented, as well as schedules, activities and the team responsible for its development. This introduction aimed to involve and prepare stakeholders for the organization's transformation process, explaining their role not only in the current phase, as well as in the subsequent phases. As it was seen in the Chapter 2, collaboration and involvement of parts in change of processes are keys aspect for a successfully IBP improvement. Regarding

[1] For confidential reasons it will not be described, since it includes the production process

Figure 5.1: Demand Planning "As-is" at Client X

meetings' agenda, it followed a set of questions about "As-is" processes and covered the Mission, Processes, Analytics, Technologies,Integration and Talent dimensions, as it is possible see in Appendix A Figure A.2.

5.1.1 "As-is" Demand Planning

Figure5.1 illustrates how Demand Planning was performed in Client X. The demand forecast was based only on historical data, which was collected, analyzed and validated by the Sales Department. Price and quantities' statistical forecasts were generated for the following 16 months at market-product level on monthly basis.
The unconstrained Demand plan was developed for each plant independently, starting from forecast and adding inputs from Sales and Commercial directors, which were the owners Demand Planning process, to then be handed over to Supply Planning. This unconstrained plan to be discussed on Demand Review Meeting only focus on forecast for month n+2 to n+4[2], instead of 16 months, since S&OP/IBP cycle used to occur on monthly basis. In spite Demand Planning process followed, in general terms, the theoretical good practices, it was possible to identify some pain points, such as business intelligence or customer inputs were manually incorporated into the forecast. The statistical forecast performed in SAP APO was not user-friendly, contributing to gradual discontinuation of historical data cleansing activities.

5.1.2 "As-is" Supply Planning

In line with the Demand Planning process, Supply Planning at Client X also lacked technological support for some steps. The process was triggered upon receipt of the unconstrained plan from the Demand Planning team. Supply team should then compare the plan with the installed capacity, and estimate stock availability. The IBP Optimizer model would then run based on different restrictions and costs (non-delivery, production, transportation), allowing the assignment of demand to plants and the creation of a constrained plan, with the objective of maximization of margin . The output of this Optimizer was analyzed against demand and some adjustments were made manually to the parameterization of the optimization tool, for example, the coverage of specific agreements (e.g. allocation of an order to a specific industrial unit). However, the results provided by this Optimizer were complex, their interpretation was time-consuming and the

[2]That is, if the planning exercise was carried out in April, forecasts would be made for the months of July, August and September.

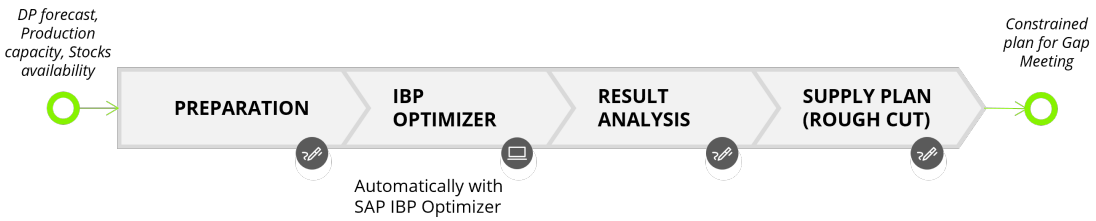

Figure 5.2: Supply Planning "As-is" at Client X

system lacked root-cause analysis and alerts support. In addition, Client X referred the need to distinguish between tactical supply planning and execution, since these processes weren't treated separately in some geographies. Following the theoretical principles described in Section 2.3.1.4 the Supply Planning output is a Rough cut plan. The figure 5.2 illustrates the "As-is" of Supply Planning at Client X.

5.1.3 "As-is" Sales and Operations Planning

When it came to evaluate IBP process at the Client X, it was decided to keep the Sales & Operations Planning terminology, since even IBP beginner level requires balancing supply and demand volume across the end-to-end supply chain and establishing stronger cost-based financial and supply chain alignment, which was not found in this organization. That said, in general terms, tactical demand and supply planning processes at Client X were run on a monthly basis, but it aimed to drive towards a pure IBP process. The overall process followed the theoretical S&OP/IBP process steps introduced in the chapter 2 with some exceptions. This monthly cycle aimed to align supply and demand at market/product group level for quantity and price, in order to generate monthly Sales Quotas. S&OP Quotas for month n+2 were approved by the end of the cycle (around the 20^{th} of the month) and handed over to Sales and Operations Execution, enabling short-term planning (Production Planning and Detailed Scheduling).

1. The S&OP cycle at Client X started at the Sales Department with the Demand Planning process already explained, whose output (Demand Plan) was the object of discussion of Demand Review Meeting. That meeting was held, counting on the presence of the Demand planner, Commercial directors and the S&OP manager of the company, where a single set of numbers and forecasts was validated -consensus- that would guide that month's S&OP exercise in the following stages of the process.

2. Considering the Demand Plan coming from the previous step, the Supply Chain team prepared a Rough Cut Capacity plan at the aggregate level of product, customer and resource (i.e. IBP Market), during Supply Planning process (described in the previous Section). After generating a Supply plan draft, the Supply Review meeting was held to evaluate the unallocated quantities, the root causes for that demand unfulfilled and to determine and approve the changes to be made to it.

Figure 5.3: Sales & Operations Planning "As-is" at Client X

3. Next, a Pre-meeting was held where business details for the period in question are reviewed. This was attended by Sales, Supply chain, Finance, Marketing and Production managers from all regions where the company operates. In this phase of the process they have discussed, for example, the volumes that would remain to be delivered, new products to be developed, or markets to target. Finally, what-if scenarios were developed to be presented to the Client X's management in the next step, with the ultimate goal being informed and reasoned decision-making. Regarding these scenarios, they could vary from reward certain customer or product groups, force setup time for maintenance on certain production lines to restrict storage capacities. Based on the expected outcomes for each of these different situations, strategic decisions were are made in the next phase of the process.

4. Finally, Executive Review was the final meeting, carried out by executive committee. It was where decisions for the following months were made based on the plan developed in this S&OP cycle and the scenarios presented for discussion. In this phase of the process, some performance indicators were looked at, such as production line occupancy levels, planned shutdown days, gaps between demand and supply were analyzed, and the best plan for the plan horizon was chosen and approved.

Although the structure of this supply and demand alignment was close to the good practices, some pain points were identified during "As-is" interviews, for example: collaboration during S&OP was supported by static reports, it lacked the ability to perform real-time simulations and visualize conflicts/impacts, which was introducing the need for offline actions to investigate gap closure options. Moreover, there were improvement opportunities regarding organizational alignment and integration, since different teams were still working in silos and S&OP decisions were not flowing easily and effectively throughout the organization. Considering that planning assumptions (e.g. stock level, lines productivity) volatility during cycle was introducing reworks and S&OP granularity was not sufficient for all geographies, which was requiring manual effort to support subsequent processes (e.g. Operational Planning in R3, which integrated with S&OP, was supported by an *ad-hoc Excel*), we conclude technological improvement/support addressing these key pain points would facilitate cross-functional alignment and confer more operational agility.

Finally, Client X revealed some weaknesses in the integration of Finance in S&OP process. The monetization of plans was little and the focus of the reviews was limited to force-matching the operational plan with the financial budget. As S&OP maturity increases towards an IBP process, finance should build integrity in the operational forecast, define actions to close demand-supply

gaps, based on financial implications, and drive cross-functional consensus aligned to business strategy. However, as it was mentioned, the role of finance in Client X S&OP was one of the key aspects to be address in the "To-be" solution.

5.1.4 "As-is" Systems

An interview with Client X's IT project team allowed to understand the technology planning process and systems with which the future system should integrate or replace. At the Client X, two systems were used to support the execution of the processes under scope, namely SAP Advanced Planning Operations (APO) and SAP Integrated Business Planning (IBP). During Demand Planning process, statistical forecasts were generated in SAP APO, but adjustments were performed in SAP where support collaboration took place.Regarding Supply Planning, SAP IBP was used to run Optimizer and support collaboration and SAP APO to publish S&OP Quotas. As it was mentioned, collaborative part of S&OP was supported by SAP IBP. *PowerPoint* files made from wireframes were used during meetings and the final plan was published for the whole company.
In line with the issues explained at the beginning of this Chapter Case Company's problems, there was a poor integration between SAP systems which comes out from 20 years of development by mostly internal teams, making it very lacy and too customized. Moreover, SAP IBP was showing not only poor performance on S&OP process, with collaboration being supported by static reports instead of integrated plans and no visibility of margins and order contribution, but also limited capacity to run what-if scenarios, whose results were too complex.
Employees used to perform their daily tasks in SAP APO and IBP, but in several processes there was still a lot of manual effort (e.g. order promising) or users feel they do not have the detail needed, therefore resort to workarounds (e.g. using of *Excel*), that is, users were not taking advantage of systems' full potential.

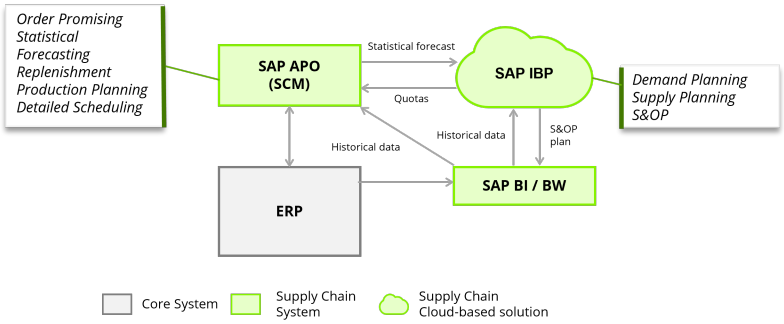

Figure 5.4: Relevant systems for planing in the "As-is" Supply Chain at Client X

5.1.5 Identification of limitations and opportunities for improvement

As a result of "As-is" meetings and the subsequent systematization of the information collected, pain points and opportunities of improvement were identified for each of the processes,

some of them that were already identified in the previous sections. The step of detecting critical points was essential to understand the reasons behind each inefficiency/problem and justify the need to select an APS. Main challenges revolved around having one source of truth, ensuring live-collaboration, having support for S&OP meetings, aligning master data between systems,integrating finance, reducing manual tasks/adjustments and optimizing current planning processes triggered by alerts and root-cause, in order to have enough S&OP monthly cadence for managing the issues that came up in day to day running the supply chain.

5.1.5.1 IBP maturity model

Following the definition and frameworks presented in Literature Review Chapter 2.3.4, *Deloitte's Maturity Model* allowed to identify in which stage Client X was performing and "where" it expected to be in the next 5 years, concerning IBP journey. A maturity model has this two properties: it assesses business current S&OP capabilities and clarifies the milestones the organization has to reach in order to be more mature in IBP process, that is, it allows to "draw" an improvement journey. The Figure 5.5 shows a Deloitte's framework to access IBP Maturity level. During meetings, Client X self-evaluated between "Emerging" and "Capable" levels and defined its five-years milestone the "Advanced Level", which would imply being able to have Artificial Intelligence driving predictive &prescriptive analytics, support end-to-end scenario planning and synchronized decisions across functions. Moreover, it would require improving from a volume-based operational plan, which only considered sales forecast and constrained supply capability, with little alignment with finance to a coordinate process reflecting strategy and ensuring portfolio, demand, supply, execution and finance consensus. Concerning the *Organization*, in order to make this shift, S&OP processes that was coordinated, owned and sponsored almost exclusively by the supply chain team would slightly become a process coordinated by supply chain or finance, but owned by Business Unit leaders and sponsored by C-level executives (57).

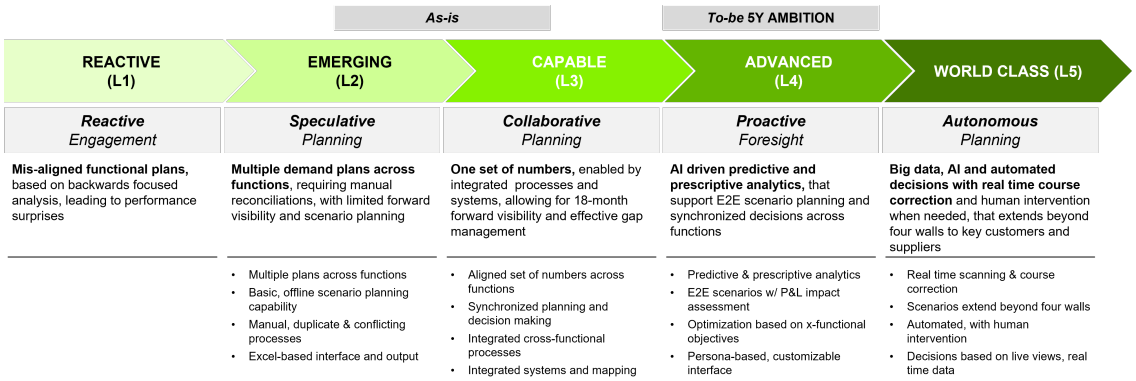

Figure 5.5: IBP Deloitte's Maturity Model

5.1.6 Conclusion:

In this section, we analyzed the "As-is" of Client X planning processes, under the scope of the project. The majority of pain points and challenges seemed to be solvable by the implementation of a planning tool capable. That said, technological improvement seemed to be the right solution. It would provide planning interface and features for reaching the full potential of a value-adding, effective IBP. It is important to add that this analysis will have impact on the requirements to be collected and on the solution to be selected, which will later be worked on the improvement opportunities identified here.

Having completed the"As-is" Assessment Phase, and considering the problems and the corresponding opportunities for improvement identified as a starting point, we proceeded to the collection of requirements that would allow Client X to help reaching the maturity level it intended. In this chapter, "To-be" requirements are described which result from the application of methodology described in Chapter 4 for Phase 2. The response to ***Which?*** "To-be" requirements should be considered in the selection of an APS tool are presented.

5.2 Specification of "To-be" requirements

Having completed the"As-is" Assessment Phase, and considering the problems and the corresponding opportunities for improvement identified as a starting point, we proceeded to the collection of requirements that would allow Client X to help reaching the maturity level it intended. In this section we explore the main activities and outputs of Phase 2 of the project.

5.2.1 "To-be" Requirements Workshops

Following the same approach as the *"As-is" assessment*, the list of "To-be" requirements collected resulted from a team effort between the Deloitte's and the Client X's team. Four workshops, which counted with the participation of experts (SME), have been carried on to identify the best practices for each process taking into attention Client X's vision and needs for improving towards IBP. Throughout the definition of functional and technical requirements, it was sought these requirements had a simple and objective name and description, which could be easily understood by any APS vendor and team member on the project. Moreover, there was an effort to clean up redundancy, which avoid the proliferation of requirements. The objective of this activity was not to obtaining a detailed description of the processes/functionalities, but rather a higher level view, once the end-goal was to select a tool.

Workshops mainly focused on the design of the core functionalities that Client X was expecting to have in the tool to be selected (and implemented). In other words, it focused on the definition of the "To-be" scenario that would allow Client X to improve its S&OP on the technological side, and not so much on the redesign of the Demand planning, Supply planning and S&OP processes. Before each workshop there was a preparation work between Deloitte's team and SMEs

to leverage the best, business-oriented content into each session. After holding the four workshops, the requirements were mapped out, with their description, classification and priority level defined. The priority level reflects the relative importance assigned to each of the requirements and it was defined by the Client. No specific criteria were defined for this categorization, although Deloitte's experience typically indicates 60% *Must Have* requirements and 80% (*Must Have* + *Should-Have*) requirements. Regarding. requirements that correspond to functionalities Client X had already implemented in SAP APO and SAP IBP were considered as *Must Have*.

The next sections explore the outcome of *Key Design Topics, Demand Planning, Supply Planning and S&OP* workshops which together made it possible to obtain the list of Functional requirements.

5.2.2 Key Design Topics

First it was essential to discuss key design topics and agree on design principles of planning processes, as the studies on this topic suggest (Chapter 2.3.2). Regarding Planning dimensions (Master Data) it was defined Client X's plans should be developed, at least, at *Customer, Product, Location* and *LocationProduct* levels. In terms of granularity, since the scope of this project was mid-term planning, Client X agreed on planning at product aggregation level (i.e. product group) and customer aggregation level (i.e. market). Regarding planning time buckets, monthly granularity was defined enough for Demand Planing and S&OP processes, but Supply Planning would be performed on weekly buckets and then aggregated at monthly level. As it was mentioned on Chapter 2, tactical planning is performed on monthly basis (i.e. month buckets) and, although planning horizons depend on e.g. business, industry,process, for IBP they usually range from 6 to 18 months. Considering Client X, Deloitte's team recommended looking for 24 months planning, in order to have a sufficiently long horizon to decide about mid-term capacity adjustment based on the results. With aim to reach a pure IBP Process, monetization of plans is crucial to align traditional S&OP processes with financial planning. In that sense, planning streams were discussed and project team agreed on the need of using conversion factors and exchange rates to valuate forecast (from volume to revenue/profit). Conversion factors are required since Demand Planning, unit of measure matches the level at which sales were performed but, for Supply Planning, the unit of measure should be the most granular production unit, and those units of measure may not coincide. One of the biggest problems Client X reported was the proliferation of SKU, which should be improved/optimized by the tool to be implemented. In that sense, Client X identified as a requirement providing support on reducing complexity through configurable products (e.g. SAP Variant Configuration).

5.2.3 Demand Planning

The following flow of sub-processes (Figure 5.6) illustrates Demand Planning best practices accordingly to Deloitte's experience and benchmark. In this workshop, the design of the future

Demand Planning process, which typically ranges up to 18 months into the future, was discussed and focusing on the following key areas the "To-be Solution" intended to addressed.

1. **Segmentation:** by understanding what are the products/customers, demand can be accurately planned by forecasting algorithms. the 'To-be' solution will help Demand Planners/ Sales Team to focus on applying business intelligence to the forecasting items that will;

2. **Aggregation/ Disaggregation:** the ability to drill up and down across demand forecasting units hierarchies will enable each department/ role to work at the most adequate dimension and level of granularity (e.g.Sales at a more aggregated level in the customer hierarchy vs. Supply Chain at a more granular level in the product hierarchy);

3. **Input Data Quality:** effective data cleansing will ensure that only the representative historical demand will be used to generate the forecast. By including planned data (e.g.open orders), forecasting output will reflect not only the past but also future events driving demand.

Future process should start by preparing and extracting data to prepare forecasts, which is typically performed at *Customer*, *Production* and *Location* levels and includes Sales Orders, Delivery Quantity, Sales Budget, EBIT per unit and Margin per unit as statistical forecast data. Then, "Cleaning Data and Pre-processing" includes the correction of outliers and actuals, as well as making adjustments on the forecast model. Those adjustments should consider segmentation (ABC XYZ) of customers and orders, time series analysis in terms of trends and seasonality and portfolio plan (e.g. new product introduction, product life cycle).
Regarding Statistical Forecast run and validation, SMEs pointed out multiple benchmarked companies in process industry were using *best fit forecast approach* to calculate statistical forecast on some product aggregation (e.g. product family) or customer aggregation (e.g. customer group), which enabled them to reduce the forecast error when compared to other forecast approaches. In that sense, *best fit forecast approach* was the forecast method of Client X's preference whose outcome was expected to be validated via alerts in the APS to be implemented. Next, forecast is expected to be an input for Sales Forecast Plan, which should incorporate sales and customer intelligence to improve vendor's inventory visibility, in case there is a good partnership with strategic customers. The monetization of the plan will then allow comparing it against budget volume and revenue and stakeholders (demand planners) should reach consensus on demand plan. In order to monitor and improve demand planning, performance should be measure by KPI e.g. forecast accuracy, forecast bias, fill rate, days stock on hand and inventory turnover.

Starting from the high-level "ideal" process described above, the *Gap Analysis* exercise allowed to identify the "Outlier correction & adjust actuals", "Manage Forecasting Model" and "Adjust Statistical Forecast" as the processes that Client X did not already have but needed to have (colored with red). It was also identified which processes Client X already had (colored with green) and which ones should be improved with the support of the new tool (colored with yellow).

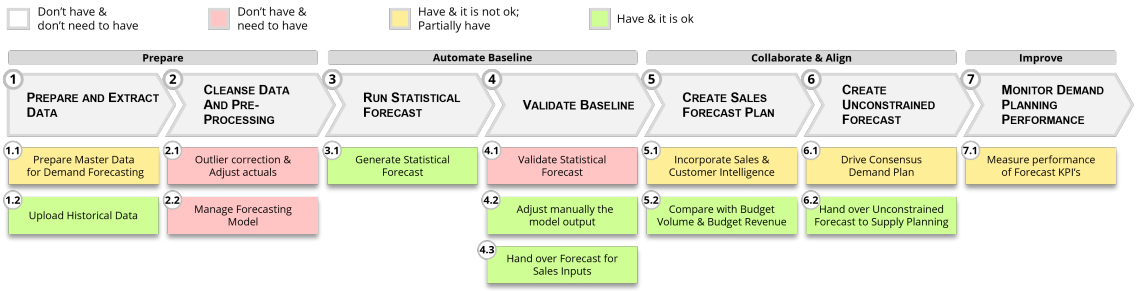

Figure 5.6: "To-be" Demand Planning process

Aligned with industry's best practices and, in order to systematize the topics discussed during workshops, a detailed list of requirements was developed (Figure 5.7), accordingly to the framework explained in Section 4.3.

Process Group	Process	Sub-Process	Requirement name	Description	Classification	Priority (MoSCoW)
Demand Planning	1. Prepare and Extract Data	1.1. Prepare Master Data for Demand Forecasting	Master Data	Use latest master data through live integration with source system	Data	Must Have
Demand Planning	1. Prepare and Extract Data	1.2. Upload Historical Data	Historical and Order Book Data	Upload 3-year history of invoiced quantities and 6-month history of price data, in different currencies (including conversion rates).	Data	Must Have
Demand Planning	1. Prepare and Extract Data	1.3. Upload Planned Data	Sales Pipeline Data	Upload sales pipeline from CRM	Data	Could Have
Demand Planning	1. Prepare and Extract Data	1.3. Upload Planned Data	Product Life Cycle Data	Upload products phase-in/ phase-out/ replacements plans (e.g. product launch date, product discontinuation date)	Data	Should Have
Demand Planning	1. Prepare and Extract Data	1.4. Upload External Data	Market Data	Upload data from external sources (e.g. market evolution data provided by external vendors)	Data	Could Have
Demand Planning	2. Cleanse Data and Pre-	2.1. Outlier correction & Adjust actuals	Outlier Correction	Identify and correct outliers, null values, etc. and detect change points in the historical data by use of a system algorithm	Analytical	Should Have
Demand Planning	2. Cleanse Data and Pre-	2.1. Outlier correction & Adjust actuals	Manual History Cleansing	Allow the user to manually cleanse historical data from one-time events	Functionality	Must Have
Demand Planning	2. Cleanse Data and Pre-	2.2. Manage Forecasting Model	Segmentation	Segment products/ customers by value (ABC) and demand variability/ easiness to forecast (XYZ)	Analytical	Must Have
Demand Planning	2. Cleanse Data and Pre-	2.2. Manage Forecasting Model	Product Life Cycle Management	Model demand during the distinct stages of a product lifecycle (e.g. creating 'fictitious' demand history for new products based	Analytical	Should Have
Demand Planning	2. Cleanse Data and Pre-	2.2. Manage Forecasting Model	Data Realignment	Allow the user to copy or move total/ partial historical data	Functionality	Must Have
Demand Planning	3. Generate Baseline	3.1. Run forecasting algorithms and generate	Forecast Types and Horizon	Generate a statistical forecast in volume and a statistical forecast in price for the next 24 months	Analytical	Must Have
Demand Planning	3. Generate Baseline	3.1. Run forecasting algorithms and generate	Driver-based forecast	Model demand drivers data (planned and external data) on top of the statistical forecast, including variable impact analysis	Analytical	Could Have
Demand Planning	3. Generate Baseline	3.1. Run forecasting algorithms and generate	Best fit	Leverage statistical methods from a broad range of algorithms (at least 3 different forecasts) and select the model based on	Analytical	Must Have

Figure 5.7: Example of some of the Demand Planning Functional requirements

5.2.4 Supply Planning

Following the same structure, the Figure 5.8 illustrates best practices on mid-term Supply Planning whose discussion was centered on the following Client X's key points.

1. **Raw material costs:** by incorporating in the model the effect of raw materials price volatility, in particular for wood, a more accurate computation of product/ customer margin contribution which should result on optimized demand allocation to supply.

2. **Model Results interpretation:** the ability to execute and review a set of pre-defined scenarios with clear constraints/rules in alignment with business decisions (e.g. maximum service level scenario allowing flex capacity utilization), will reduce the manual effort to change model parameters in an iterative process and will make it easier to understand results and impacts. During workshops, Supply team indicated scenarios-planning had to be improved

3. **Financial impacts:** the ability to compute and compare financial impact for each scenario, while resolving supply constraints, will enable trade-off decisions and prioritization of scenarios for both operational and financial feasibility, which is a key step to facilitate the integration of financial planning/team into the IBP process.

Future process, which should ranges up to 24 months, should start by preparing master data and supply planning parameters which may include updating inventory policies and targets, maintaining supply constraints, cost elements and network mapping requirements. Regarding *constraints*, Client X's Supply Team highlighted the need to incorporate not only constraints focusing on capacity plan, but specially on costs, since the pain point was not acquiring resources or contracting more capacity, but the cost of pursuing those decisions (volatile cost of raw materials). That said, capacity constraints highlighted (which could either be considered hard or soft constraints during implementation) were multiple raw materials/sourcing constraints , resources/-manufacturing, labour, storage and shipping/transport constraints.
In the cost side, Client X was looking for incorporating raw materials (and respective forecast), labour, manufacturing, warehousing and transportation costs. Next, before generating the constrained plan, Supply Planning Team will evaluate capacity and inventory performance, which will require measuring and monitoring several key performance indicators (e.g. inventory on hand, days of supply, days sales of inventory, manufacturing capacity utilization, on-time delivery, lead time, etc) and performing root cause analysis. Then, the unconstrained demand plan will be received and supply planning optimization algorithm will run. Project team discussion on optimization algorithm agreed on focusing on maximum profitability, executing scenario planning and generate an optimal allocation of product-customer demand to location, based on *contribution margin maximization* and *supply constraints*. Other options were discussed, for example, infinite or finite heuristics, but, considering that Client X was already running an optimizer algorithm, that is more complex and generates "optimal" demand and supply plans, it was decided to keep running the optimizer algorithm. Another example is, instead of considering contribution margin, it could have opted for Total Costs, Customer Due Date or Inventory Minimization as objectives. However, as we mentioned on the Section 3.1, the wood-based products process industry faces some pressure on profit margins, which is mainly due to the price of raw materials, so it was a strategic, business decision to keep the plans oriented toward this objective.
Back into Supply Planning process, the review of model output will allow comparing current cycle values with previous cycles, which was not possible before and alerts functionality will highlight conflicts between demand, supply and inventory plans. Changes to model's outputs were a common practice which Client X wanted to avoid. Instead, it wanted the tool allowing users to review and update model's parameters specially for contractual obligations/preferred supply points, inventory and supply network requirements, prioritization rules and scenarios configuration. The supply plan, resulting from the optimizer, might need some adjustments to align the solver output with the specific business needs for that period. Good practices point APS should help on this by allowing constraints review, root cause analysis, visibility of financial impact/trade-offs for each

scenario, as well as the permission of make manual adjustments were the most important requirements highlighted on this step. After evaluating operational and financial feasibility, Supply Team will define and run what-if simulations on monthly/quarterly/annually basis, that is, performing a sensitivity analyses to supply chain capacity supported by a cost impact analyses for decision-making purposes. Finally, the comparison between preferred scenarios that was time-consuming and not user-friendly, is expected to be done in a collaborative way, in line with IBP principles, and different scenarios will be discussed in a single dashboard, which would make it faster and easier to receive inputs from stakeholders. Supply team highlighted the importance of making full use of scenario-based planning in order to be reliable and allow comparison of solutions. Final plan will be hand over for review in Demand/Supply Gap Meeting.

Starting from the high-level supply planning process description above, the gap analysis exercise allowed to identify the "Determine financial impact and feasibility of supply plan scenarios" as the process that Client X didn't already have but needed to have. Regarding the remaining sub-processes, with the exception of the receiving unconstrained demand plan and running optimizer, they all reveal opportunities for improvement to be addressed by the APS.

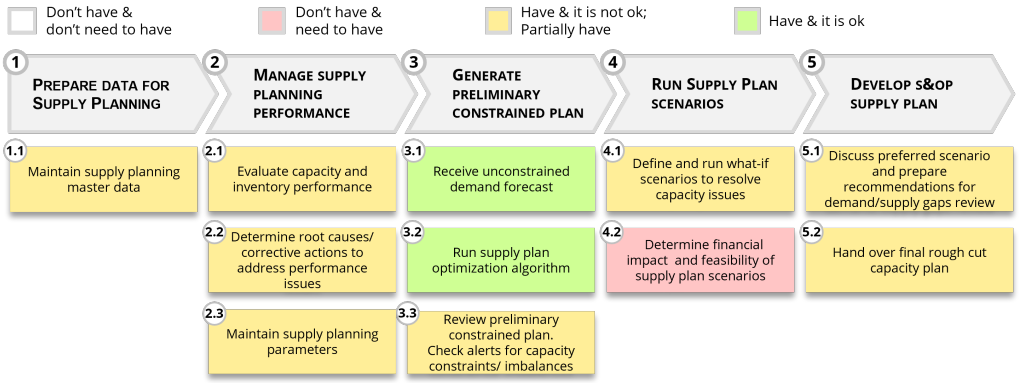

Figure 5.8: "To-be" Supply Planning process

The Appendix A Table A.3 illustrates some of the requirements collected during Supply Planning Workshop.

5.2.5 Integrated Business Planning design

In line with the principles explained in 2, S&OP workshop explored the good practices on each of the five IBP steps: Product Management Review, Demand Review, Supply Review, Pre S&OP Review and S&OP Executive Meeting. The vision for the following five years was to reach "Advanced" level of maturity, improving IBP towards commercial, operational and strategic plan alignment with financial performance, to drive a consensus on a unified go-to-market plan. A better performance in terms of IBP will be led by technological improvement, that is, the selection and implementation of an APS, which is expected to e.g. incorporate all required data to support S&OP cycle, support IBP meetings that were previous conducted offline, trigger and display alerts to manage by exception, allow financial integration through monetized versions of the plans, that

wasn't fully integrated in S&OP, disaggregate the S&OP monthly plan, including sales quotas, to the required level of granularity in downstream processes. Appendix A Table A.3 shows the requirements collect for S&OP/IBP.

5.2.6 Conclusion

Throughout this Section, it was possible to analyze the Demand, Supply and IBP processes best practices, which Client X wants to achieve with the support of the APS whose selection model will be explored in the next chapter. In general terms, the "To-be" solution aims to address the following key areas, promoting the improvement of S&OP towards IBP.

1. **One plan across horizons:** based on the same set of numbers and assumptions, an integrated plan will result cross-functional processes alignment. Plan will be available at the required level of granularity for each process, by applying aggregation/ disaggregation rules, which the customization of solution to the users needs.

2. **Tracking escalations**: APS functionalities will enable increased and real-time visibility on deviations in demand and supply, and an exception-based management approach. From one planning cycle to the another, solution will capture the significant deviations and trends.

3. **Financial integration in S&OP:** better understanding of financial implications and a true integration between operational and financial planning will enable the re-allocation of annual budgets as business conditions change.

It is important to note that, although the theoretical IBP cycle starts with the Portfolio Review, in the Client X context/industry the monthly portfolio review does not apply, since it produces wood-based products whose demand isn't very sensitive to the marketing strategies and to the updates at portfolio level, either by introducing or removing SKUs. The portfolio of functional products are usually stable and the main focus of these enterprises are the collaboration, centralization and the share of information to optimize plans and cut costs.

In line with the final insights of the previous Section 5.1, it is possible to conclude the Functional requirements collected were not too detailed or complex, since Client X did not feel the need to deep dive on specific design aspects, such as the optimizer inputs and logic. Instead, they are sufficient to meet the objective Project Team set itself (Selecting a tool) and are customized to the level of Client X's planning maturity. Moreover, although Technical requirements collection isn't explored in this chapter, it occurred in parallel with the abovementioned workshops. The outcome of those sessions with IT Project team was a list of non-functional requirements and that should be part of the future solution. From this Phase 2, the handover documents with the list of Functional requirements and the respective priorities were sent to the client for validation. Meanwhile, Deloitte's team started preparing the list of vendors and RFI.

Chapter 6

Tool Selection Process

This chapter formalizes the application of the *Vendor Selection* and the *Vendor Evaluation* models proposed in Chapter 4. Foremost, *how* we identified the pool of six vendors is explained. Considering the Functional and Technical requirements[1] collected in the previous phase, an RFI those six vendors, but only four decided to follow-up on the project. A first Global score is calculated for each APS vendor, considering *Functional, Technical and Vendor Analysis* Dimensions, that is, by applying the Part I of the Vendor Evaluation Model. The results are shown and the Part II of the model is applied, considering the *Demos and Cost Analysis*. Finally, the chapter ends with the presentation of the Final Global Score for each of the three finalists.

6.1 Vendors selection

In order to identify the objects (APS vendor/tools) to be evaluated in this phase, weekly meetings with Project Core team focused on the selection of Advanced Planning Systems vendors[2] shortlist. The Figure 6.1 illustrates the methodology adopted. First, it was agreed that the "Leaders" vendors, from Gartner Magic Quadrant (47) would be considered; then, a more detailed analysis of the framework developed by Gartner allowed to extend the list to the vendors we identified as having the most experience in the Process Industry, that are underlined in the figure. Finally, the sharing of experiences within the team, allowed to reach a consensus of six vendors for which RFI was sent, which we have chosen to keep confidential.

6.2 Preparation and Launch of RFI

Vendors Request for Information consisted of an Excel File with the list of Functional and Technical requirements collected in the Phase 2 of the project, to which two more columns were added: Coverage Degree and Coverage Method. To the APS vendors was assigned the responsibility of filling in those two columns, accordingly to their tools capabilities, as it was explained

[1] The collection of the Technical requirements are out of the scope of this dissertation, but that were considered in *Vendor Evaluation Model.*

[2] Some of them are categorized as supply chain planning tools

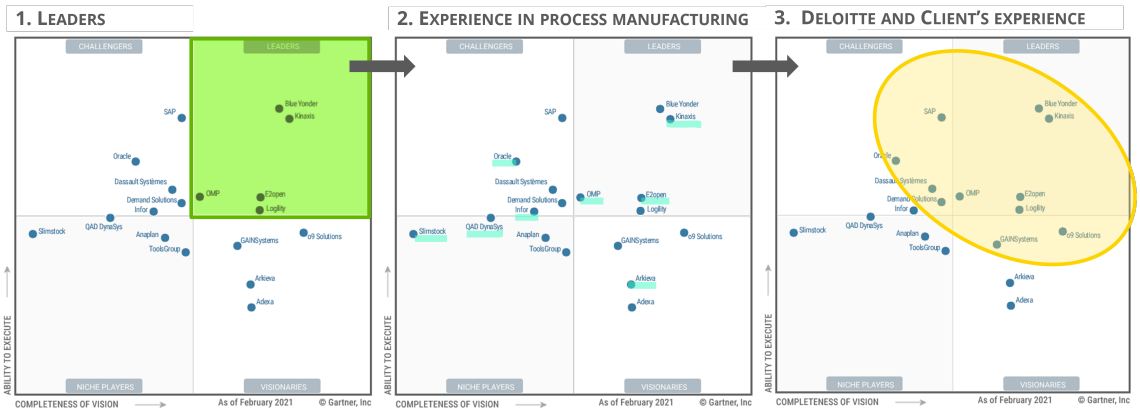

Figure 6.1: Vendor Selection Process (47)

in 4.4. To support scoring APS in terms of "Vendor Analysis" parameters, some questions were also included in the RFI, such as "*How many tool implementations in companies with similar technological environment?*", "*Do you provide training*?", "*What level of customization does the tool offer?*". RFI was sent to the list of six vendors (S1, ..., S6), but only four vendors responded to the RFI (S1, S2, S3, S4). Having only 3/4 of the selected vendors wanting to move forward with the project ends up being a risk of the Agile selection approach, since it presupposes the selection of a shortlist of vendors and, therefore, when only few vendors are on the table, there is a risk associated to end the process with just a few options to choose from.

6.3 Vendors Evaluation

Once the vendors were selected and the answers to the RFI were received, project team had the necessary information to apply the first part of the evaluation model developed.

6.3.1 Part I: Evaluation Model Score

RFI responses were analyzed and scored accordingly to the criteria defined in Figure 4.4 and, for *Functional Analysis* and *Technical Analysis*, the subcriteria defined in Table 4.2.
For example, the "Outlier Correction" requirement which is part of *Process Group*: Demand Planning and *Process:*"Outlier Correction & Adjust Actuals", has *Priority*: "Should Have", which is assigned with the score 80%. Then, S1 RFI's responses for this specific requirement indicated that S1 tool's *Coverage Degree* is "Full Coverage" (assigned with 100%), but in terms of *Coverage Method* it requires "Parametization" (assigned with 90%). That said, the Final score for *S1.Outlier Correction* requirement is: $4 \times 80\% \times 100\% \times 90\% = 2.88$.
"Outlier Correction" score (2.88) was considered in the calculation of the weighted average of all requirements that make up the same evaluation dimension (*Functional Analysis*) and criteria (*Demand Planning &Forecasting*).

Following the same approach for all Functional and Technical requirements, we got the scores presented in Table 6.6, which revealed that S4, compared to the other vendors, was the one that

showed the worst performance in responding to the Client X's requirements. Giving the particular example of Supply Planning *Optimizer*, that was already implemented in Client X's "As-is", S4 mentioned it didn't have that heuristic developed, yet, which would required extra efforts during implementation project . On the other hand, S1, S2 and S3 showed very good performance in their overall response to the requirements. It is important to note that scores presented were first normalized. That is, taking *Functional Analysis* as example: *Demand Planning & Forecasting, Supply Planning* and *S&OP, Scenario Management & Financial* scores for each vendor were normalized based on the average value of all vendors' scores in this dimension (*Functional Analysis*). Then, those normalized values were rounded to the nearest whole number. That was done because, in some cases, results were really close to each other, not allowing to clearly distinguish vendors.

Once Vendor Analysis criteria do not have subcriteria associated, the scores were assigned directly to the criteria (e.g. Industry focus), based on the the RFI responses, Gartner's insights (47), Deloitte's experience and desk research, which allowed to carried out to assess e.g. the characteristics/experience of each vendor in terms for market footprint, industry focus. At the end of this Chapeter, Table 6.6 show APS's results for each of the criterion belonging to PART I dimensions and the respective conclusions project team considered important to highlight. The Global Evaluation Score (Part I) was calculated and presented in Table 6.1.

The PART I scores allowed to rank the vendors in this order: 1-S1; 2-S2; 3-S3 and 4-S4. Once the project team had already agreed that a pre-selection would be made before moving on to PART II, it was decided to exclude vendor S4. S4 was the vendor with the "worst" performance in fulfilment of Client X's requirements, based on the evaluation model considered, although it revealed experience in wood-based products industry and great market footprint. S1, S2 and S3 were part of the pool of vendors that moved forward the second part of the evaluation model, regarded to Demo and Cost evaluation.

Table 6.1: PART I – Global Evaluation Score

Criteria	**Weights**	**Part I Weights**[a]	**S1**	**S2**	**S3**	**S4**
Global Score	56.0%	100.0%	**3.51**	**3.11**	**2.90**	**2.37**
1- Functional Analysis	31.5%	31.50%/56.0%	3.63	3.25	2.63	2.00
2- Technical Analysis	14.0%	14.00%/56.0%	3.40	3.10	3.20	2.50
3- Vendor Analysis	10.5%	10.50%/56.0%	3.30	2.70	3.30	3.30

[a]Normalized weights of PART I dimensions

6.3.2 Part II: Evaluation Model Score

Light demo sessions were requested for S1, S2 and S3 tools. Comparing demos can be become complex without guidance, once there is the risk of vendors only focusing on what they were the very best at, which are often different things. Therefore, a list of use cases was sent to vendors, providing some guidance to demo virtual sessions, as Gartner's good practices highlight (37), and, then, demo sessions occurred guided by those use cases, that are presented in Table 6.2.

Table 6.2: S&OP Process: show the tool standard S&OP

Demo session	**Use cases**
Demand Planning	Statistical Forecasting (quantity and price) Manual input by different teams and creation of consensus Error measures
Supply Planning	Constrained, optimized allocation to plants, e.g. insufficient supply or negative margin Generate one scenario with fewer restrictions Generate one scenario prioritizing, e.g.certain products or markets For each scenario, understand gaps and reasons / constraints
Executive Meeting	Show how scenarios can be presented and compared in the tool

In general terms, Demos were performed accordingly to the expectations, with the exception of S3 tool whose functional functionalities Client X was expecting to be better. The Table 6.4 summarizes how Client X's team evaluated Demos. Project team concluded S1 is stronger in overall supply chain visibility and seemed to be making an interesting move in operational planning with some strategic partnerships, which could be important for future releases. Moreover, it stood out for having a great web-based front end and Excel add-in, that the Project Team agreed it would be crucial for reducing learning curve for some users. S3 was considered stronger in operational planning, although Strategic/Tactical planning seemed to be enough to cover Client X's requirements. Regarding S2, although it had the lowest score, its performance was the best on integrating out-of-the-box functionalities, specially on the integration from ERP to S&OP/IBP module.

As it was mentioned, Demo sessions were hold to assess how tools could fulfill Functional requirements. In addition, vendors predisposed to do some technical sessions in which technical requirements/use cases were tested. Fruit from those sessions, IT Project team proposed new scores for the *Technical Analysis*, illustrated in Table 6.3, which were incorporated in the final score, instead of the PART I scores for *Technical Analysis* dimension. Although this adjustment overrules what had been previously defined for the *Vendor Evaluation Model*, project team agreed that the technical Demos provided a more "real" perception of how each tool fulfill the technical requirements. This decision was taken by the same key stakeholders that had identified the Technical requirements and validated their scores in PART I, so this change was taken into account.

Table 6.3: New Scores for *Technical Analysis*

Technical Analysis	**S1**	**S2**	**S3**
Result	3.50	2.50	3.00

In parallel, Deloitte's team proceeded with the cost evaluation. *Costs analysis* relied on the information provided by the vendors, which Deloitte's team used to calculate 5 years and 10 years investment required. Costs criteria had a weight of 30% in the final score and it considered three cost drivers: *Licensing*, *Implementation* and *Other costs*. By applying the methodology proposed in the Chapter 4, it was possible to reach the scores presented in Table 6.4. Detailed Cost-Benefits analysis was planned to happen at the Phase 4 of the project, during the development of

the business case. Having that in mind, the costs evaluation done at this level has been considerably simplified and served only the purpose of having a term of comparison between Vendors.

Table 6.4: Scores for *Demo* and *Cost Analysis* dimensions

Dimension	**Criteria**	%	**S1**	**S2**	**S3**
Demo Analysis	Functional	60.0%	3.0	3.0	2.5
	Usability	20.0%	4.0	3.5	3
	Functional Integration	20.0%	3.0	2.5	4
Demo Analysis dimension score		100%	**3.20**	**2.90**	**3.00**
Cost Analysis dimension score		100%	**2.95**	**2.80**	**4.00**

Once collected all the above-mentioned scores for each dimension-vendor, it was possible to calculate the final score for each vendor and to rank them.

6.3.3 Final Evaluation Model Score

The final score was calculated by taking into account the following weights: 31.5% for Functional Analysis, 14% for *New* Technical Analysis, 10.5% Vendor Analysis, 14% Demo Analysis and 30% Cost Analysis. Table **??** shows the Global Evaluation Score which allowed to rank the vendors in this order: 1-S1; 2-S3 and 3-S2.

Table 6.5: Global Evaluation Score

Criteria	**Weights**	**S1**	**S2**	**S3**
Global Score	100%	**3.31**	**2.78**	**3.20**
1- Functional Analysis	31.5%	3.63	3.25	2.63
2- Technical Analysis	14.0%	3.50	2.50	3.00
3- Vendor Analysis	10.5%	3.30	2.70	3.30
4- Demo	14.0%	3.20	3.00	2.90
5- Cost Analysis	30.0%	2.95	2.35	4.00

The vendor with higher score was S1 which had 3.31 in a range of 0 to 4. S1 dominates S2 in all dimensions, so S2 was excluded from the selection. Between S1 and S3, S1 dominates in three dimensions – *Functional Analysis*, *Technical Analysis* and *Demo Analysis* –, it performs equally well in *Vendor Analysis*, but is worse in *Cost Analysis* dimension. Since *Cost* only has 30% weight, the remaining factors justify the final choice of S1. Although cost is an important dimension for Client X, from the beginning of the project it emphasized the priority would be to fulfill the Functional requirements in order to have the technological support needed to improve its IBP maturity level. To wrap up, taking into account all the dimensions considered in the evaluation model and business maturity, Deloitte presented the list of the three vendors ordered by score and suggested the implementation of S1, justified by all the considerations mentioned in Chapters 4,, 5 and 6.

6.4 Conclusion

This chapter describes the application of the Selection and Evaluation model and its results. It can be concluded that the application of those model was successful, since it allowed us to rank the APS vendors/solutions through level-oriented criteria. That criteria helped in the assessment of different aspects of a vendor, thereby giving a holistic view of their competency and support across different, important dimensions for Client X.
However, it is important to note that the application of the model underwent some adjustments. In order to be aligned with Client X's intentions and priorities, some specific vendors were considered in the initial pool of APS, Technical sessions were carried on and evaluated by Client X to be considered in the final model, instead of *Technical Analysis* RFI scores. Moreover, although it wasn't expected, on Deloitte's side there was a need to normalize the *Functional* and *Technical Analysis* criteria scores (e.g. Demand Planing & Forecasting scores), in order to distinguish vendors more clearly and avoid the risk of get draws.

Table 6.6: Scores for *Functional*, *Technical* and *Vendor Analysis* dimensions

Dimension	**Criteria**		**S1**	**S2**	**S3**	**S4**	**Highlights**
Functional Analysis	Demand Planning & Forecasting	25.0%	4	4	3	2	S1 and S2 stand out from competitors by covering almost all the requirements out-of-the-box. S1 offers enhanced capabilities such as Machine Learning, Artificial Intelligence and Demand Sensing algorithms
	Supply Planning	37.5%	3	3	3	2	S2 stands out due to the ability to generate price forecasts for raw materials, allowing the user to select prices used for supply planning. S4's supply Planning algorithm is based on heuristics and does not offer an optimization approach
	S&OP, Scenario management, & Financial integration	37.5%	4	3	2	2	S1 has differentiating capabilities for S\&OP workflows, allowing plannersto see, build, and modify scenarios to support decision making, and have revenue and contribution margin analysis supported by advanced analytics functionalities. S4's solution do not have the ability to escalate for order reconfirmation
Functional Analysis dimension score		**100%**	**3.63**	**3.25**	**2.63**	**2.00**	
Technical Analysis	Architecture/ Cloud/ SaaS	10.0%	4	4	3	3	Out of this dissertation scope
	APIs support	20.0%	4	4	4	3	
	Develop. environment	20.0%	3	2	3	2	
	Customization	20.0%	3	3	3	2	
	Platform support	10.0%	3	2	3	3	
	Security & Privacy	10.0%	4	4	4	3	
	Navigation & Ease of use	10.0%	3	3	2	2	
Technical Analysis dimension score		**100%**	**3.40**	**3.10**	**3.20**	**2.50**	
Vendor Analysis	Localization/ Market footprint	10.0%	3	3	4	4	S2 and S4 have strong worldwide and local presence.Well-established companies in the Portuguese market, with strategies for engaging with clients and partners
	Industry focus	20.0%	4	4	3	4	S1, S3 and S4 have implementations with similar technological environment (S2) and their focus on process manufacturing and wood industry is proven by several use cases shared by the vendors
	Vendor strategy & roadmap	20.0%	3	1	2	2	S1 scores high in terms of innovation and vision for digital supply chain and was the only vendor providing details over the evolutionary roadmap
	Knowledge management	5.0%	4	4	3	4	S1, S3 and S4 provide extensive training and certification plans for partners and customers
	Skills availability	20.0%	3	2	4	3	S2 has an extensive network of partners, portfolio of projects and products developed built over the course of many years operating in the Portuguese market. While S3 has a smaller footprint in the national market
	Support	10.0%	3	2	4	4	Apart from S3 which has a limited partner offer in Portugal, other competitors have a good network of partners allowing to provide smarter end-to-end processes
	Vendor/ Platform risk	10.0%	3	4	4	4	S1 is a relatively new player when compared with other competitors, recognized as stable products in the market
	References (Gartner)	5.0%	4	4	3	2	More than 75\%of peer reviews would recommend S1 and S3
Vendor Analysis dimension score		**100%**	**3.30**	**2.70**	**3.30**	**3.30**	

Chapter 7

Discussion and Conclusions

For many companies, the goal of implementing a new supply chain planning technology is essentially to enable high quality planning decisions using the power of the technology. This includes automating more decisions, so planners can spend time on the most value-adding activities. The project addressed in this dissertation aimed to help Client X improving its tactical planning processes from Sales& Operations Planning towards IBP, this is aligned with the already defined strategy of selecting/implementing an Advanced Planning that could promote a performance of excellence. To this end, a decision-support method – *the Vendor Evaluation Model* – was developed.
Client X presented some weaknesses in developing an Integrated Business Plan, once several processes were done offline, requiring a lot of manual effort and support of ad-hoc Excel files. At the same time, the integration of master data wasn't ideal and financial participation in S&OP was almost nonexistence. Having this context in mind, we could argue that helping the selection of an APS itself, that was one of the goals of the project, will not solve business pain points. However, the process of assessing the "As-is", benchmarking, redesigning, albeit at a high level, of the processes, customizing all selection criteria, objects of evaluation and, finally, applying an evaluation model that allowed to distinguish vendors, is itself part of the improvement framework in the IBP *journey*. That is, improvement through *Technology* development, that is one of the five IBP building blocks, as we analysed in Chapter 2. Moreover, the described phases, from the preparation, current situation assessment to the final suggestion of the vendor-tool to be implemented, consist of the first steps of a successful APS implementation project.

The introduction of an Advanced Planning System in a process company is a strategic decision which affects the routine activities and the practices of Sales and Operations Planning. The case study confirmed the importance of developing a decision process in which the prospective owners and users of the new system were involved. In particular, the evaluation of the alternative APS was performed with respect to a hierarchy of criteria which was built and validated by the participants in the project.

From a methodological point of view, the project followed the good practices explored in the Chapter **??**. Starting by preparing and aligning goals, activities and responsibilities, followed

by "As-is" assessment accordingly to the best practices, identification of the processes and requirements to be supported by the planning tool, finishing with the selection and evaluation of vendors considering multi-dimensions. Also with regard to methodology, treating the Functional and Technical analysis separately from Demos and Costs made it possible, at first, to assess the effectiveness of a solution independently from its appearance and investment. On the other hand, the flow of information between Client X and Deloitte's team, ensured by the recurrent meetings, was crucial, just like the involvement of Client X in strategic decision-making, e.g. from the definition of the most important requirements, to the allocation of criteria weights and evaluation. By taking each step described in this dissertation, we ensured that there was clarity and transparency in the selection process, and that we have crafted a comprehensive assessment oriented to the business needs. This, of course, contributed to customer satisfaction, which is the key driver for any business consulting project.

7.1 Results and Future work:

The framework developed for this project was successful in achieving the three objectives specified. On the one hand, the identification of Functional and Technical requirements required to 1-assess the maturity of the "As-is" processes and then 2-translate the future "To-be" processes into functional and technical requirements. Finally, it allowed to rank the vendors and identify the vendor with the higher score, which Deloitte's team recommended Client X to implement. Multiple different end-uses are expected from the APS system in the Client X planning processes, when it decides whether or not it wants to go ahead with the implementation of this or other vendor's tool. These include Demand, Supply and integration of tactical planning processes in an high-performance IBP process. Benefits might include performance-driven SC management, supported by KPIs follow-up, ability to visualize and atomize the plan creation, and a common reporting tool that removes the use of spreadsheets. APS role in the IBP process can be specially vital in the monthly planning process steps, which translate strategy into operations.
Nevertheless, it is important to emphasize that, as it was highlighted in the Chapter 2, it is difficult to attribute a causal effect between the selection/implementation of software and performance improvements, so it will be fundamental to manage improvements via the definition and measurement of KPI for IBP effectiveness and efficiency. Even if the final decision is not to implement, KPI-oriented management is suggested as a good practice for IBP process.
As expected, the next steps (Phase 4) will be the development of a business case and roadmap for the implementation of the APS selected. As mentioned before, the implementation of a new tool is associated with several risks and requires a considerable investment, in that sense a business case allows not only to have greater visibility of the project's impact on the organization, but also, in the last case, it determine if the project should be undertaken or not. According to Deloitte's framework, it should aim to answer the following questions:

1. How much value will this project/program create?

2. How long will the project take to implement?

In case, Client X decides to proceed, it will also be important to create a common understanding of the current challenges and problems, what future state the organization is trying to move toward and how the new planning system will address the actual and future needs, because, as we analyzed in Chapter 2 an end-to-end SCP software implementation initiative can be a complex undertaking due to the number of stakeholder groups involved, internally and potentially externally, and a good performance on IBP relies on the coordination, process adherence and behavior.

7.2 Lessions Learned

Over the course of this dissertation there were several aspects that were raised which are important to mention. Although some companies refer to their planning processes, at the tactical level, as IBP, in fact, in multiple cases those organizations' planning process haven't already reached matures into IBP that allows them to fully align all functions — commercial, product, supply chain and finance — to an integrated plan that delivers joint value across the planning horizon. That was the case of Client X. In spite of the future implementation of the planning tool will help in planning by conflicts, supported by root-cause analysis and the monetization of the plans, that will allow a broader participation of the financial department in the Supply Chain Planning . There are problems that require structural changes, namely greater coordination and consensus between functional departments, receptiveness to change in order to more effective migration between systems and digitalization of the activities that were performed manually. Furthermore, we find that there is no "one ideal planning tool" on the market. Currently , there are dozens of solutions and an infinite number of business requirements, that could be overwhelming during the selection process, specially in case of organizations with business and operations complexity, producing and selling thousands of SKUs in multiple geographies. Although more and most sophisticated solutions are emerging, the truth is that not all companies are able to take advantage of all the features provided. That happens not only because some processes' maturity is low, but also because of the lack of skills or resistance from users who have been subjected to 20 years of far-fetched software implementations.

7.3 Limitations

As the majority of business consulting projects, there are always limitations associated with time, scope and the goals agreed upon in the proposal. Accordingly to the studies on this topic, maturity assessment could have been done in more detail, for each one of the IBP building dimensions at each location: Meetings and Collaboration, People and Organizational structure, Plan Integration and Information Technology (26). These analysis would allow to design solutions oriented not only to technological improvement, but also for the other dimensions, since, for example, we noticed that the process was essentially centered in the supply chain department and collaboration wasn't optimal. Finally, in the present dissertation project Vendor Evaluation Model

only considered requirements from three of the planning processes (Demand Planning, Supply Planning and Sales and Operations Planning), but other planning processes could have been considered, such as Inventory Policies and Planning parameters, Production and Detailed Scheduling, Transport Planning. In addition, other methodologies for assigning the weights could have been explored, as well as an alternative scoring range (0-4), in order to have more intuitive meaning.

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Appendix A

Appendix

Table A.1: Gartner's Magic Quadrant for Supply Chain Planning Solutions: Quadrant Descriptions (47)

Quadrant Descriptions	Key Capabilities
Leaders	Reasonably broad and deep SCP offerings Proven success in moderate- to high-complexity SCP environments Deployed with the intent to be the long-term SCP technology strategy High customer functional penetration Deployed as a single global instance to support vertical and horizontal alignment A reasonable number of end users at Level 3 or higher maturity Enduring visibility in the marketplace from both a sales and marketing perspective High levels of customer satisfaction Compelling supply chain convergence strategy and capabilities Global scale Strong viability
Challengers	A capable, proven and mature SCP solution with many live customers Large-scale SCP deployments A proven ecosystem of partners Reasonable customer functional penetration Wide range of product features and capabilities Generally lacking the overall thought leadership, innovation or compelling visions for higher levels of SCP maturity
Visionaires	A thought leader on one or more SCP domains that tend to be on the edge of emerging concepts Execution gaps (e.g., viability, growth, global scale or operations) Has articulated a good vision for how it plans to fill gaps in its solution offering through development, acquisition or partnership Relatively lower customer functional penetration Tendency to be used as a regional or local instance
Niche Players	Might focus primarily on a vertical industry or SCP domain Not a generally differentiated offering, although may have some unique capabilities Has growth strategies, either geographic or in other markets, that may be lacking Limited ecosystem of partners Market momentum and product or company viability that is possibly in question

Figure A.1: Project main touchpoints and stakeholders involved

Lever	Key Questions
Mission	• What informs the mission/direction of the org? How is this translated to KPIs established? • What KPIs are part of the demand planning org? Is that the same by region? • How frequently do you review progress against demand planning objectives and KPIs? • How would you define success for the org and what efforts are in place to make improvements?
Process	• Can you describe the demand planning process? What are the internal/external inputs used by the team for planning and what are the outputs? • How frequently are demand plans developed, what is their time horizon, and how frequently are they reviewed? • When are demand plans considered "locked"? • What are the major decisions to be made within the process and how do those decisions get made? • What is the relationship between global and each of the regions for demand forecasting? • Are there duplicative processes? Are there process inconsistencies across planners?
Analytics	• What internal and external data/insights and tools are used to inform the demand planning process? (e.g., is there visibility to store level demand)? What factors and metrics go into creating a demand plan? • How accessible is data and how would you say demand planning turns data into insights? • What analytics are used to help make decisions? Is any of demand planning automated? How frequently are system generated forecasts overridden? • What reports are used to review demand plans or to assist with decision making?
Technology	• What systems are used with demand planning? How frequently is data refreshed in the systems? • At what level are forecasts created and maintained? (weekly, fiscal calendar, style/customer, DC). • What is manual in the system and what is automated? • What are the main pain points with systems? What do you wish it was capable of doing?
Integration	• How are outputs from your process utilized and by whom? How are inputs from other orgs utilized? • How and how frequently are your plans rolled up into global plans? • How is demand forecasting connected to other processes like forecasting and MFP and purchasing? • How frequently does demand forecasting meet with finance and other functions like merch? What is that process like? • How could other cross functional partners improve demand planning operations?
Talent	• What are the main skills/roles needed within this function? How does the organization prepare talent? • Are there any noticeable skills gaps (internal or external to this function) that affect the demand planning process?

Figure A.2: Example of "As-is" processes questions for Demand Planning Interview

ID	Process Group	Process	Sub-Process	Requirement name	Description	Classification	Priority (MoSCoW)	Criteria	Subcriteria
DP001	Demand Planning	1. Prepare and Extract Data	1.1. Prepare Master Data for Demand Forecasting	Master Data	Use latest master data through live integration with source system	Data	Must Have	Functional Analysis	Demand Planning & Forecasting
DP002	Demand Planning	1. Prepare and Extract Data	1.2. Upload Historical Data	Historical and Order Book Data	Upload 3-year history of invoiced quantities and 6-month history of price data, in different currencies (including conversion rates). Upload order book data (open orders)	Data	Must Have	Functional Analysis	Demand Planning & Forecasting
DP003	Demand Planning	1. Prepare and Extract Data	1.3. Upload Planned Data	Sales Pipeline Data	Upload sales pipeline from CRM	Data	Could Have	Functional Analysis	Demand Planning & Forecasting
DP004	Demand Planning	1. Prepare and Extract Data	1.3. Upload Planned Data	Product Life Cycle Data	Upload products phase-in/ phase-out/ replacements plans (e.g. product launch date, product discontinuation date)	Data	Should Have	Functional Analysis	Demand Planning & Forecasting
DP005	Demand Planning	1. Prepare and Extract Data	1.4. Upload External Data	Market Data	Upload data from external sources (e.g. market evolution data provided by external vendors)	Data	Could Have	Functional Analysis	Demand Planning & Forecasting
DP006	Demand Planning	2. Cleanse Data and Pre-Processing	2.1. Outlier correction & Adjust actuals	Outlier Correction	Identify and correct outliers, null values, etc. and detect change points in the historical data by use of a system algorithm	Analytical	Should Have	Functional Analysis	Demand Planning & Forecasting
DP007	Demand Planning	2. Cleanse Data and Pre-Processing	2.1. Outlier correction & Adjust actuals	Manual History Cleansing	Allow the user to manually cleanse historical data from one-time events	Functionality	Must Have	Functional Analysis	Demand Planning & Forecasting
DP008	Demand Planning	2. Cleanse Data and Pre-Processing	2.2. Manage Forecasting Model	Segmentation	Segment products/ customers by value (ABC) and demand variability/ easiness to forecast (XYZ)	Analytical	Must Have	Functional Analysis	Demand Planning & Forecasting
DP009	Demand Planning	2. Cleanse Data and Pre-Processing	2.2. Manage Forecasting Model	Product Life Cycle Management	Model demand during the distinct stages of a product lifecycle (e.g. creating 'fictitious' demand history for new products based on 'like items' to allow these items to be forecasted)	Analytical	Should Have	Functional Analysis	Demand Planning & Forecasting
DP010	Demand Planning	2. Cleanse Data and Pre-Processing	2.2. Manage Forecasting Model	Data Realignment	Allow the user to copy or move total/ partial historical data	Functionality	Must Have	Functional Analysis	Demand Planning & Forecasting
DP011	Demand Planning	3. Generate Baseline	3.1. Run forecasting algorithms and generate initial Forecast	Forecast Types and Horizon	Generate a statistical forecast in volume and a statistical forecast in price for the next 24 months	Analytical	Must Have	Functional Analysis	Demand Planning & Forecasting
DP012	Demand Planning	3. Generate Baseline	3.1. Run forecasting algorithms and generate initial Forecast	Driver-based forecast	Model demand drivers data (planned and external data) on top of the statistical forecast, including variable impact analysis	Analytical	Could Have	Functional Analysis	Demand Planning & Forecasting
DP013	Demand Planning	3. Generate Baseline	3.1. Run forecasting algorithms and generate initial Forecast	Best fit	Leverage statistical methods from a broad range of algorithms (at least 3 different forecasts) and select the model based on user-defined best-fit criteria	Analytical	Must Have	Functional Analysis	Demand Planning & Forecasting

Figure A.3: Functional Requirements

DP014	Demand Planning	3. Generate Baseline	3.1. Run forecasting algorithms and generate initial Forecast	Weighted Model Forecast	Leverage statistical methods from a broad range of algorithms (at least 3 different forecasts) and combine several forecast models, based on user-defined weights	Analytical	Could Have	Functional Analysis	Demand Planning & Forecasting
DP015	Demand Planning	3. Generate Baseline	3.1. Run forecasting algorithms and generate initial Forecast	Model Parameters automatization	Identify automatically the optimal values of model parameters (e.g. for exponential smoothing alpha, beta, gamma, phi)	Analytical	Could Have	Functional Analysis	Demand Planning & Forecasting
DP016	Demand Planning	3. Generate Baseline	3.1. Run forecasting algorithms and generate initial Forecast	Forecast level optimization	Generate forecast at different hierarchy levels and automatically determine the level of granularity which maximizes the statistical demand forecast accuracy	Analytical	Should Have	Functional Analysis	Demand Planning & Forecasting
DP017	Demand Planning	3. Generate Baseline	3.1. Run forecasting algorithms and generate initial Forecast	Train and Test	Separate train and test history periods	Analytical	Should Have	Functional Analysis	Demand Planning & Forecasting
DP018	Demand Planning	3. Generate Baseline	3.1. Run forecasting algorithms and generate initial Forecast	Aggregation/ Disaggregation	Apply aggregation/ disaggregation rules in order to allow the forecast to be outputted at different levels of granularity, with the ability to drill down/ up across demand forecasting units hierarchies	Analytical	Must Have	Functional Analysis	Demand Planning & Forecasting
DP019	Demand Planning	4. Validate Baseline	4.1. Review initial Forecast and update model parameters (if required)	Model Parameters adjustments	Allow the user to manually select a different algorithm and apply changes to model parameters	Functionality	Should Have	Functional Analysis	Demand Planning & Forecasting
DP020	Demand Planning	4. Validate Baseline	4.2. Resolve exceptions through manual adjustments to Forecast	Level of granularity	Allow the user to review and adjust the forecast at the preferred level of granularity in the product/ customer hierarchy, with ability to drill up and down	Functionality	Must Have	Functional Analysis	Demand Planning & Forecasting
DP021	Demand Planning	4. Validate Baseline	4.2. Resolve exceptions through manual adjustments to Forecast	Alerts	Trigger and display alerts to highlight key changes against previous forecasts/ actuals (last cycle, previous year)	Functionality	Must Have	Functional Analysis	Demand Planning & Forecasting
DP022	Demand Planning	4. Validate Baseline	4.2. Resolve exceptions through manual adjustments to Forecast	Manual Adjustments	Allow the user to manually override the forecast at different levels across demand forecasting units hierarchies, through manual adjustments. User overrides to be flagged in the system	Functionality	Must Have	Functional Analysis	Demand Planning & Forecasting
DP023	Demand Planning	4. Validate Baseline	4.2. Resolve exceptions through manual adjustments to Forecast	Comments/ Assumptions	Allow user to add comments to provide context on manual adjustments	Functionality	Should Have	Functional Analysis	Demand Planning & Forecasting
DP024	Demand Planning	4. Validate Baseline	4.3. Hand over Forecast for Sales Inputs	Hand over to Sales	Submit the forecast for sales review, including the relevant comments and assumptions behind it. Users should be notified of plan submission	Functionality	Should Have	Functional Analysis	S&OP , Scenario mgm & Financial integration
DP025	Demand Planning	5. Create Sales Forecast Plan	5.1. Incorporate Sales & Customer Intelligence	Sales review level	Use forecast segmentation to filter (e.g. based on past accuracy) and aggregate data to be displayed to Sales team for review	User Experience	Should Have	Functional Analysis	Demand Planning & Forecasting

DP026	Demand Planning	5. Create Sales Forecast Plan	5.1. Incorporate Sales & Customer Intelligence	Sales review user interfaces	Provide out of the box templates to support sales forecast review	User Experience	Should Have	Functional Analysis	Demand Planning & Forecasting
DP027	Demand Planning	5. Create Sales Forecast Plan	5.1. Incorporate Sales & Customer Intelligence	Sales enrichments level	Allow the user to manually override the forecast at different levels across demand forecasting units hierarchies, through manual enrichments. User overrides to be flagged in the system. Different roles within the Sales team with function-specific views, options and capabilities while enriching the forecast	Functionality	Must Have	Functional Analysis	Demand Planning & Forecasting
DP028	Demand Planning	5. Create Sales Forecast Plan	5.2. Compare with Budget Volume & Budget Revenue	Forecast against Budget comparison	Allow the user to cross check the forecast against budget targets and highlight any relevant deviations	Functionality	Should Have	Functional Analysis	Demand Planning & Forecasting
DP029	Demand Planning	6. Create Unconstrained Forecast	6.1. Drive Consensus Demand Plan	Consensus Demand Collaboration	Provide out of the box templates to support collaboration within the creation of the consensus unconstrained forecast	User Experience	Must Have	Functional Analysis	S&OP , Scenario mgm & Financial integration
DP030	Demand Planning	6. Create Unconstrained Forecast	6.2. Hand over Unconstrained Forecast to Supply Planning	Hand over to Supply Planning	To submit the consensus demand plan to supply planning, including the relevant comments and assumptions behind it. Users should be notified of plan submission	Functionality	Should Have	Functional Analysis	S&OP , Scenario mgm & Financial integration
DP031	Demand Planning	7. Monitor Demand Planning Performance	7.1. Measure performance of Forecast KPI's	Compare multiple forecasts	Allow the user to compare multiple forecasts versions (statistical forecast, forecast before sales enrichment, consensus demand plan, etc.), through value added analysis (FVA)	Functionality	Should Have	Functional Analysis	Demand Planning & Forecasting
DP032	Demand Planning	7. Monitor Demand Planning Performance	7.1. Measure performance of Forecast KPI's	Measure KPI's	Calculate Forecast Accuracy, Forecast Bias and other relevant metrics to monitor forecast performance (including demand forecast drivers impact)	Analytical	Must Have	Functional Analysis	Demand Planning & Forecasting
DP033	Demand Planning	7. Monitor Demand Planning Performance	7.1. Measure performance of Forecast KPI's	Monitor KPI's	Provide out of the box templates to support demand planning performance monitoring for various dimensions and for various forecast lags	User Experience	Should Have	Functional Analysis	Demand Planning & Forecasting
SP001	Supply Planning	1. Prepare Data	1.1. Prepare Master Data for Supply Planning	Master Data/ Planning Parameters	Use latest master data (e.g. BOM, Routing) and planning parameters (e.g. Lead Times) through live integration with source system	Data	Must Have	Functional Analysis	Supply Planning
SP002	Supply Planning	1. Prepare Data	1.2. Maintain inventory management configuration and targets	Inventory Parameters	Incorporate inventory targets (e.g. safety stock) and inventory policies information	Data	Must Have	Functional Analysis	Supply Planning

SP003	Supply Planning	1. Prepare Data	1.3. Maintain constraints data	Supply constraints	Incorporate: - sourcing capacity plan (e.g. changeover lead times, maintenance and shut down plans) - manufacturing capacity plan - workforce capacity plan - warehouse capacity plan - shipping/ transport capacity plan The user should be able to add hard constraints based on S&OP inputs and other sources	Data	Must Have	Functional Analysis	Supply Planning
SP004	Supply Planning	1. Prepare Data	1.4. Maintain cost elements	Supply costs	Incorporate: - raw material cost values over time (differentiated by raw material type, origin, etc) - labor cost values (internal and outsourced workforce) - other manufacturing cost elements (e.g. energy) - warehouse cost values (internal and external capacity) - cost values for transport between two nodes by transportation mode - the cost for each unit of a customer demand that is not met by the supply plan The user should be able to override cost values based on S&OP inputs and other sources	Data	Must Have	Functional Analysis	Supply Planning
SP005	Supply Planning	1. Prepare Data	1.4. Maintain cost elements	Raw material costs forecast	Generate a forecast of raw material prices	Analytical	Should Have	Functional Analysis	Supply Planning
SP006	Supply Planning	2. Monitor Supply Planning Performance	2.1. Evaluate supply KPI's based on previous periods performance	Actuals vs Plan	Calculate discrepancy between real supply and initial supply plan	Analytical	Should Have	Functional Analysis	Supply Planning
SP007	Supply Planning	2. Monitor Supply Planning Performance	2.1. Evaluate supply KPI's based on previous periods performance	Measure KPI's	Calculate relevant metrics to monitor inventory (e.g. days of supply), capacity (e.g. capacity utilization) and service (e.g. On-Time In Full) performance over time	Analytical	Must Have	Functional Analysis	Supply Planning
SP008	Supply Planning	2. Monitor Supply Planning Performance	2.1. Evaluate supply KPI's based on previous periods performance	Monitor KPI's	Provide out of the box templates to support supply performance monitoring	User Experience	Should Have	Functional Analysis	Supply Planning
SP009	Supply Planning	2. Monitor Supply Planning Performance	2.2. Perform variance analysis and root cause analysis for performance metrics	Comments/ Escalations	Allow user to add comments to provide context on reasons for significant variances and create tasks to escalate issues	Functionality	Should Have	Functional Analysis	S&OP , Scenario mgm & Financial integration
SP010	Supply Planning	3. Generate Preliminary Supply Plan	3.1. Receive unconstrained demand plan	Demand forecast readiness	Notify users that consensus unconstrained demand plan was submitted	User Experience	Could Have	Functional Analysis	S&OP , Scenario mgm & Financial integration
SP011	Supply Planning	3. Generate Preliminary Supply Plan	3.1. Receive unconstrained demand plan	Demand Data	Use unconstrained demand plan as an input to supply planning	Data	Must Have	Functional Analysis	Supply Planning

SP012	Supply Planning	3. Generate Preliminary Supply Plan	3.2. Run supply planning optimization algorithm	Time Horizon	Generate supply plan up to 24 months in horizon	Analytical	Must Have	Functional Analysis	Supply Planning
SP013	Supply Planning	3. Generate Preliminary Supply Plan	3.2. Run supply planning optimization algorithm	Contribution Margin	Compute contribution margin at product-customer-location level	Analytical	Must Have	Functional Analysis	Supply Planning
SP014	Supply Planning	3. Generate Preliminary Supply Plan	3.2. Run supply planning optimization algorithm	Optimization Objective	Use contribution margin maximization rule in supply planning	Analytical	Must Have	Functional Analysis	Supply Planning
SP015	Supply Planning	3. Generate Preliminary Supply Plan	3.2. Run supply planning optimization algorithm	Aggregation/ Disaggregation	Model input data (e.g. demand data, constraints data) with different levels of granularity and allow user to define aggregated constraints	Analytical	Must Have	Functional Analysis	Supply Planning
SP016	Supply Planning	3. Generate Preliminary Supply Plan	3.2. Run supply planning optimization algorithm	Optimization Algorithm	Generate an optimal allocation of product-customer demand to location (i.e. what to make where), based on an objective function (margin maximization) and supply constraints	Analytical	Must Have	Functional Analysis	Supply Planning
SP017	Supply Planning	3. Generate Preliminary Supply Plan	3.2. Run supply planning optimization algorithm	Pre-defined scenarios	Execute multiple standard supply scenarios (e.g. maximum service), considering specific rules (e.g. allow flex capacity utilization)	Analytical	Must Have	Functional Analysis	S&OP , Scenario mgm & Financial integration
SP018	Supply Planning	3. Generate Preliminary Supply Plan	3.3. Review model output and identify key variances	Comparison cycle over cycle	Allow the user to review and compare current cycle values with previous cycles values in the same dashboard	Functionality	Must Have	Functional Analysis	Supply Planning
SP019	Supply Planning	3. Generate Preliminary Supply Plan	3.3. Review model output and identify key variances	Alerts	Trigger and display alerts to highlight key changes against previous plans (last cycle, previous year)	Functionality	Must Have	Functional Analysis	Supply Planning
SP020	Supply Planning	3. Generate Preliminary Supply Plan	3.3. Review model output and identify key variances	Model parameters impact	Provide visibility on results of the impact of changing model parameters	User Experience	Could Have	Functional Analysis	Supply Planning
SP021	Supply Planning	3. Generate Preliminary Supply Plan	3.4. Check for changes to model parameters	Hard vs Soft constraints	Allow the user to review and update constraint classification (soft or hard). It should be possible to predefine different parameters for different time periods	Functionality	Must Have	Functional Analysis	Supply Planning
SP022	Supply Planning	3. Generate Preliminary Supply Plan	3.4. Check for changes to model parameters	Parameter adjustments	Allow the user to review and update parameters related with contractual obligations, minimum demand fulfillment requirements or preferred supply points. It should be possible to predefine different parameters for different time periods	Functionality	Must Have	Functional Analysis	Supply Planning
SP023	Supply Planning	3. Generate Preliminary Supply Plan	3.4. Check for changes to model parameters	Inventory requirements	Allow the user to review and update inventory parameters. It should be possible to predefine different parameters for different time periods	Functionality	Must Have	Functional Analysis	Supply Planning
SP024	Supply Planning	3. Generate Preliminary Supply Plan	3.4. Check for changes to model parameters	Supply network requirements	Allow the user to review and update supply network configuration parameters. It should be possible to predefine different parameters for different time periods	Functionality	Must Have	Functional Analysis	Supply Planning

SP025	Supply Planning	3. Generate Preliminary Supply Plan	3.4. Check for changes to model parameters	Scenarios configuration	Allow the user to review and update the set of parameters and rules associated with each pre-defined scenarios	Functionality	Must Have	Functional Analysis	S&OP , Scenario mgm & Financial integration
SP026	Supply Planning	4. Evaluate and Resolve Constraints	4.1. Identify and evaluate constraints (material, resource, transport)	Constraints review	Provide out of the box templates, including the display of relevant metrics (e.g. demand gap, % demand fulfilled) to support planners identifying gaps against demand	User Experience	Should Have	Functional Analysis	Supply Planning
SP027	Supply Planning	4. Evaluate and Resolve Constraints	4.1. Identify and evaluate constraints (material, resource, transport)	Root Cause Analysis	Provide users with insights regarding the cause of the constraint	User Experience	Should Have	Functional Analysis	Supply Planning
SP028	Supply Planning	4. Evaluate and Resolve Constraints	4.2. Resolve constraints	Scenario use to resolve constraints	Allow the user to review and compare scenarios recommending feasible supply solutions	User Experience	Must Have	Functional Analysis	S&OP , Scenario mgm & Financial integration
SP029	Supply Planning	4. Evaluate and Resolve Constraints	4.2. Resolve constraints	Manual adjustments	Allow the user to override values in the plan while resolving constraints	Functionality	Must Have	Functional Analysis	Supply Planning
SP030	Supply Planning	4. Evaluate and Resolve Constraints	4.4. Determine financial impact of supply plan	Financial impact	Compute the financial impact of each scenario	Analytical	Must Have	Functional Analysis	S&OP , Scenario mgm & Financial integration
SP031	Supply Planning	4. Evaluate and Resolve Constraints	4.4. Determine financial impact of supply plan	Trade-offs	Compare costs and profit associated to each scenario	Functionality	Must Have	Functional Analysis	S&OP , Scenario mgm & Financial integration
SP032	Supply Planning	5. Run What-if Simulations	5.1. Define and run what-if simulations	What-if analysis	Allow the user to define and run sensitivity analyses by adding/ moving/ removing capabilities within the supply chain network	Functionality	Could Have	Functional Analysis	S&OP , Scenario mgm & Financial integration
SP033	Supply Planning	5. Run What-if Simulations	5.1. Define and run what-if simulations	Implication simulation	Simulate the cost impact of the different what-if analysis	Analytical	Could Have	Functional Analysis	S&OP , Scenario mgm & Financial integration

SP034	Supply Planning	6. Develop S&OP Supply Plan	6.1. Discuss preferred scenario and review changes and assumptions	Collaboration	Enable the comparison of different scenarios in a single dashboard and allow a real time output followed by changes in values/ parameters	User Experience	Should Have	Functional Analysis	S&OP , Scenario mgm & Financial integration
SP035	Supply Planning	6. Develop S&OP Supply Plan	6.2. Prepare actions/ escalations to address any remaining gaps	Comments/ Assumptions/ Escalations	Allow users to add comments to provide context on manual adjustments as well as on considerations behind the selection of a preferred scenario	Functionality	Should Have	Functional Analysis	S&OP , Scenario mgm & Financial integration
SP036	Supply Planning	6. Develop S&OP Supply Plan	6.3. Hand over final supply plan	Hand over	Submit the final supply plan for review in Demand/ Supply Gap Meeting, including the relevant comments and assumptions behind it. Users should be notified of plan submission	Functionality	Should Have	Functional Analysis	S&OP , Scenario mgm & Financial integration
IBP001	Integrated Business Planning	Sales & Operations Planning (S&OP)	-	Input Data for IBP	Incorporate all required data to support S&OP cycle	Data	Must Have	Functional Analysis	S&OP, Scenario mgm & Financial integration
IBP002	Integrated Business Planning	Sales & Operations Planning (S&OP)	-	IBP Meetings	Provide specific workflows, pages and out of the box templates to support the following IBP meetings: - Demand Review Meeting - Supply/ Demand Gap Meeting - Pre-S&OP Meeting - S&OP Executive Meeting	User Experience	Should Have	Functional Analysis	S&OP, Scenario mgm & Financial integration
IBP003	Integrated Business Planning	Sales & Operations Planning (S&OP)	-	Dimension and granularity	Allow the user to review the plan at multiple dimensions (product, customer and location) and levels by drilling up and down across hierarchies	Functionality	Must Have	Functional Analysis	S&OP, Scenario mgm & Financial integration
IBP004	Integrated Business Planning	Sales & Operations Planning (S&OP)	-	Alerts	Trigger and display alerts to highlight main gaps	Functionality	Must Have	Functional Analysis	S&OP, Scenario mgm & Financial integration
IBP005	Integrated Business Planning	Sales & Operations Planning (S&OP)	-	Simulations	Allow the user to define and run real time simulations	Functionality	Should Have	Functional Analysis	S&OP, Scenario mgm & Financial integration
IBP006	Integrated Business Planning	Sales & Operations Planning (S&OP)	-	Financial integration	Allow the user to review the monetized version of the plan and compare with AOP/ financial targets	Functionality	Must Have	Functional Analysis	S&OP, Scenario mgm & Financial integration

IBP007	Integrated Business Planning	Sales & Operations Planning (S&OP)	-	Assumptions/ Action Items/ Approvals	Allow the user to add and record assumptions/ action items/ approvals and review information from previous cycles and S&OP meetings	Functionality	Must Have	Functional Analysis	S&OP, Scenario mgm & Financial integration
IBP008	Integrated Business Planning	Sales & Operations Planning (S&OP)	-	Manual Adjustments to S&OP Plan	Allow the user to manually override the plan. User overrides to be flagged in the system	Functionality	Must Have	Functional Analysis	S&OP, Scenario mgm & Financial integration
IBP009	Integrated Business Planning	Sales & Operations Planning (S&OP)	-	Publish S&OP Plan	Allow the user to submit final S&OP Plan after approval in S&OP Executive Meeting, along with all the assumptions and decisions. All relevant users should be notified of plan submission	Functionality	Must Have	Functional Analysis	S&OP, Scenario mgm & Financial integration
IBP010	Integrated Business Planning	Sales & Operations Planning (S&OP)	-	Business Intelligence impact	Allow the user to compare different versions of the plan generated throughout the S&OP cycle	Functionality	Could Have	Functional Analysis	S&OP, Scenario mgm & Financial integration
IBP011	Integrated Business Planning	Sales & Operations Planning (S&OP)	-	S&OP Plan Disaggregation	Disaggregate the S&OP monthly plan, including sales quotas, to the required level of granularity in downstream processes, based on pre-defined disaggregation rules	Analytical	Must Have	Functional Analysis	S&OP, Scenario mgm & Financial integration
IBP012	Integrated Business Planning	Sales & Operations Planning (S&OP)	-	Telescopic planning	Allow Demand and Supply Planning to be executed at a more aggregated level further in the future	Analytical	Could Have	Functional Analysis	S&OP, Scenario mgm & Financial integration