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| RESEARCH ARTICLE

The Art of Planning the Distant Horizon: Long-Term Capacity Optimization in SAP IBP

Tejaskumar Vaidya
AdvanSoft International Inc, USA
Corresponding Author: Tejaskumar Vaidya, **E-mail**: tejas.scmprofessional@gmail.com

| ABSTRACT
Long-term capacity planning underlies strategic supply chain planning, allowing for the alignment of production capacity against forecasted demand, cycles of investment, and fluctuating market needs. In the face of volatility, uncertainty, and rapidly intensifying technological changes, the ability to plan optimally in the long term is not only preferable, but essential. The paper unravels the methodology and technological landscape of long-term capacity planning in the context of SAP Integrated Business Planning (IBP), a leading platform for enterprise-wide planning unification. By reconciling the latest literature, industry knowledge, and the functional ability of SAP IBP, the study provides a structured framework that guides enterprises in the planning of capacities at the 5–10-year horizon. The paper discusses how plan components, such as the Demand, Supply, and Sales & Operations Planning (S&OP) module, cumulatively yield a harmonized view of the constraints of the supply chain, resource allocation, and scenario-based planning. Optimization methodologies, ranging across heuristic to the constraint-based formulations, are covered in terms of suitability in the application of SAP IBP. Besides, significant challenges, including granularity of data, cross-functionality, and system limitations, are highlighted along with mitigation strategies. The study ends by summarizing the potential of the combination of artificial intelligence, the use of digital twins, and sustainability initiatives in future planning scenarios, placing the application of SAP IBP as a lead application in the development of Industry 5.0-ready, agile, and resilient supply chains.

| KEYWORDS

SAP, Integrated Business Planning (IBP), capacity planning, Sales & Operations Planning, Industry 5.0, resilient supply chains

| ARTICLE INFORMATION

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1. Introduction

In today's fluid global manufacturing and supply chain environment, long-term capacity planning has become a critical facilitator of strategic planning. While short to midterm planning, largely looking at near-term resource balancing and responsiveness to demand, works at a shorter horizon often of a year or less, long-term planning involves a longer-term horizon, sometimes up to five years or more, and deals with infrastructure prep, development of the labor force, allocation of capital, and risk management. The point of the exercise is that a firm's capacity footprint should be scalable, flexible, and cost-effective in the presence of unpredictable market trends, regulatory changes, and global political shifts.

Modern businesses are gravitating toward integrated digital platforms to address this complexity, and one of the strongest tools for aligning demand, supply, and financial planning is SAP Integrated Business Planning (IBP). SAP IBP presents an end-to-end, real-time, and collaborative platform that allows planners to align strategic intentions with operational considerations. Its modular design, consisting of Demand Planning, Supply & Response, Inventory Optimization, and Sales & Operations Planning, offers the versatility and depth required to capture the multi-faceted nature of long-term capacity planning [1].

Nonetheless, whereas SAP IBP is broadly applied at the tactical and operational levels, the use of the system at the long-term capacity optimization level continues to be a developing area. Numerous enterprises fail to optimally use the scenario modeling, constraint propagation, and simulation aspects of the system for supporting long-term decisions regarding capital and labor

forces. The disconnect exists most seriously in industries having long lead times, e.g., heavy manufacturing, aviation, semiconductors, and drugs, whereby the capacity constraints may take years to identify and overcome [2].

This paper aims at bridging the knowledge gap by presenting a systematic methodology of long-term capacity planning in SAP IBP. We explain how companies can calibrate their planning horizon, perform cross-functional data dependency, incorporate high-end optimization algorithms, and formulate capacity trade-offs under various future scenarios. Furthermore, we review implementation challenges and make practical recommendations to enhance planning resilience and strategic fit. The study contributes to the literature body as well as industrial practice by presenting SAP IBP's potential as a long-term supply chain optimization engine for facilitating decisions.

2. Literature Review

Long-term capacity planning has long been characterized as a strategic function in supply chain management, particularly in industries of capital-intensity of processes, fluctuating demands, and long lead times. Traditional methods of Rough-Cut Capacity Planning (RCCP), Capacity Requirements Planning (CRP), and aggregate planning constituted the foundation in the days of MRP-II as well as in the days of Enterprise Resource Planning (ERP). These methods are generally deficient, however, in addressing the increasing complexity, variation, and multi-dimensional trade-offs in the current era of globalized supply chains [3].

Transformation from separate enterprise resource planning systems to unified planning platforms was a seminal development. Here, Sales and Operations Planning (S&OP) served as a link between strategic and operational planning, as well as between cross-functional inputs, to facilitate alignment of supply capability with business objectives. However, the reach of the conventional S&OP remains frequently short-term, being generally between 6 to 24 months, thus creating a gap in the field of long-term planning [4].

Existing work supports the significance of Integrated Business Planning (IBP), a sophistication of S&OP that remains broader yet can extend the planning timeframe and consolidate financial, commercial, and operational perspectives. SAP IBP, being a representative of an IBP solution, has incorporated analysis capabilities, including constraint-based optimization, scenario planning, and real-time collaboration, that are crucial in long-term planning in turbulent markets. However, empirical investigations of the SAP IBP implementation for the aim of long-term optimization of capacity are not numerous [1].

Studies on digital supply chains have highlighted data-centric decision-making in conjunction with the utilization of artificial intelligence and machine learning for predictive capacity planning. The majority of the work, however, has remained at the conceptual level or based on a special use case. One of the notable voids in the literature remains the practical deployment and setup of enterprise systems like SAP IBP in supporting long-term capacity decisions in multiple business units and regions [5].

This literature review therefore identifies a dual need: firstly, for systematic frameworks that direct the execution of long-term capacity planning across integrated platforms; and secondly, for applied studies that assess the practical applicability of software such as SAP IBP in mitigating strategic difficulties and designing robust supply chain architectures.

3. SAP IBP in the Context of Long-Term Capacity Planning

SAP Integrated Business Planning (IBP) is a next-generation, cloud-based solution that can provide end-to-end visibility, real-time collaboration, and deep analytics all the way through the supply network. It has a modular set of applications—namely, Demand, Supply and Response, Sales and Operations Planning (S&OP), Inventory Optimization, and Control Tower—that are each geared to serve different planning layers. Although the solution is commonly implemented for tactical planning cycles, the underlying architecture and functionality of the solution are well-suited to strategic, long-term capacity planning when properly configured [6].

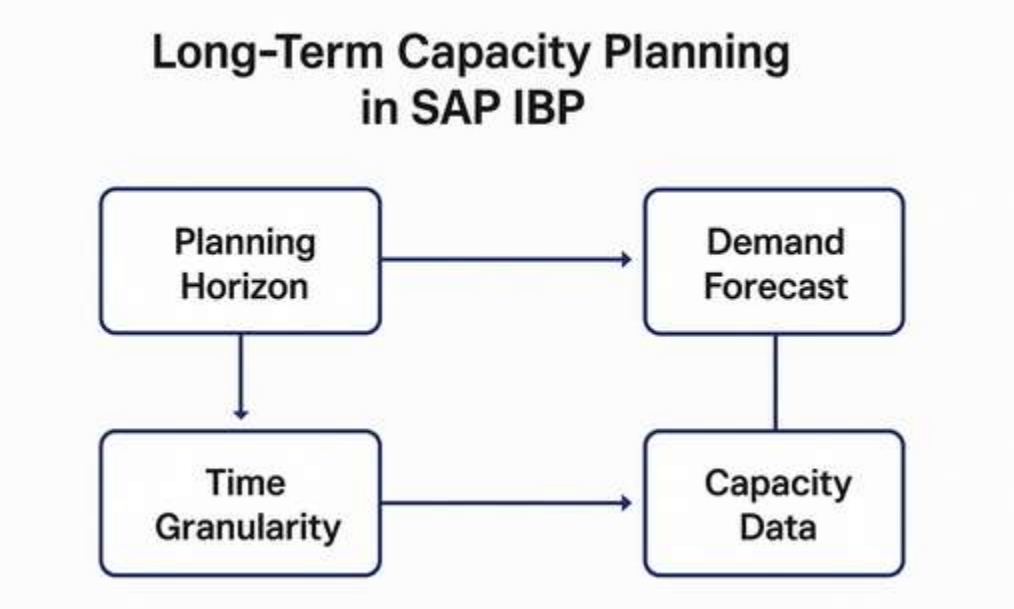

Fig: 1 Long-term capacity planning

Fundamentally, SAP IBP works on a time-series data model that allows the planner to view and simulate supply-demand movements through multiple horizons, from the daily tactical window to the strategic multi-year plan. The ability to specify the time buckets—weekly, monthly, quarterly, or annual—makes the extension of the planning to 5, 10, or even 15 years possible. It is essential for long-term capacity planning, in which the aggregated forecast, macro-outlook, and capital investment cycles need to be aligned [7].

One of the most important advantages of SAP IBP is that SAP IBP integrates without any issues with the enterprise resource planning (ERP) systems, including SAP S/4HANA, as well as external data, such that the capacity models are developed using valid, current data. Integration enables the consideration of master data such as bill of resources, lead times, constraints of production, supplier capacity, location-specific capability in long-term simulations. It also allows constraint-based planning and optimization using the use of finite capacity rules, prioritization logic, and feasible plan generation through the Supply and Response module [8].

In long-term capacity planning, the S&OP module facilitates scenario modeling by simulating the effect of strategic choices like expansion of facilities, outsourcing, or introduction of new products. To compare scenarios based on key performance indicators (KPIs) like utilization of capacity, cost-to-serve, and service levels, SAP IBP differentiates through the built-in layer of analytics to visualize in real-time the trade-offs and the performance figures, thus increasing transparency to facilitate executive-level decision-making [9][10].

In addition, the collaboration features using Microsoft Excel add-ins, notifications, workflow approvals, and integrated machine learning functionality transform SAP IBP into a platform of not only planning, but of strategic alignment of functions. These are particularly worthwhile when linking long-term capacity planning with corporate financial planning, sales strategy, and sustainability objectives [11].

Overall, SAP IBP's solid architecture, modular flexibility, and advanced analytics offer a powerful long-term planning tool. To best utilize all these capabilities, however, companies must tailor the configuration, time horizons, and scenario models uniquely for strategic use, rather than attempting to extend tactical tools to a longer timescale.

4. Framework for Long-Term Capacity Optimization in SAP IBP

SAP IBP long-term capacity planning requires the sort of thinking that extends beyond day-to-day supply-demand pairing and involves broader organizational goals such as capital investments, risk minimization, and talent development. The structure outlined in this paper captures a systematic process of configuring SAP IBP to support multi-year capacity planning. It has five key steps: horizon definition, creation of time profile, alignment of data model, cross-functional integration, and simulation of scenarios.

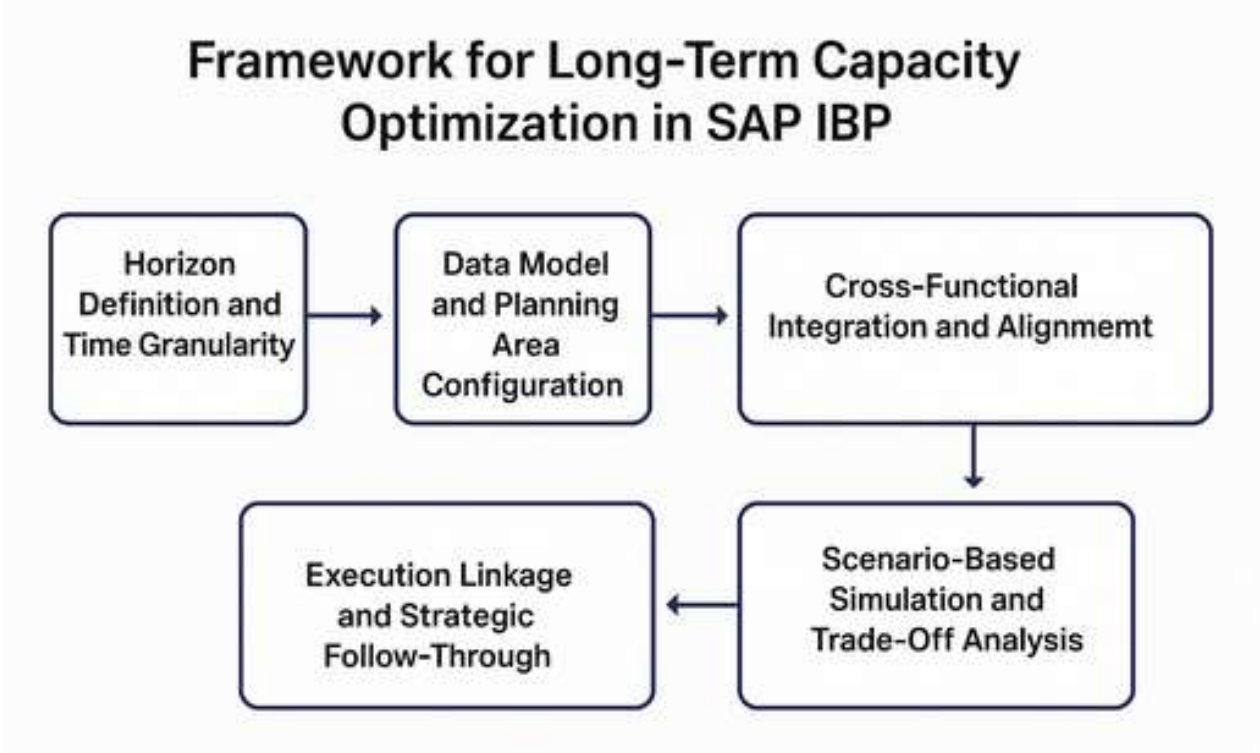

Fig 2: Long-term capacity optimization

4.1 Horizon Definition and Time Granularity

A crucial beginning in long-term planning is defining the right planning horizon and the right level of granularity. For strategic decisions, such as facility expansions, make-versus-buys, or technology upgrades, a 5 to 10 years planning horizon is typical. With SAP IBP, this is accomplished by extending the time profile into long-range buckets (such as quarters, years) and similarly aggregating the history and forecast data. Suitable time granularity avoids overwhelming the system with too much data while making the decision based on relevant trends [12].

4.2 Data Model and Planning Area Configuration

A robust planning area serves the digital spine of long-term capacity planning. To achieve this, data has to be integrated from enterprise systems like SAP S/4HANA, e.g., location master data, bills of capacity, routing patterns, and schedules of manufacturing. For long-term models, grouped capacity resources and lean material flows should be emphasized in order to maintain the model less complex but retain decision-critical information. Lower planning levels like product family, region, and resource group are typically used in order to maintain analysis compact and noise at a minimum [13].

4.3 Cross-Functional Integration and Alignment

Strategic capacity choices are not an individual activity—they require inputs and consequences in several business functions. Thus, long-term capacity plans must align demand projections from the commercial department, budget for investments from the finance department, as well as HR labor strategy. SAP IBP supports this coordination through its S&OP module, in which planning meetings for consensus and review cycles by the executive are aided by real-time KPI monitoring, version management, and comparison of scenarios. This planning structure, through collaboration, assures the final capacity plan is based on a common view [14].

4.4 Scenario-Based Simulation and Trade-Off Analysis

Long-term planning's real value comes in the calculation of strategic trade-offs. SAP IBP's what-if scenario tool enables the simulation of external conditions (e.g., recessions, regulatory changes), internal policies (e.g., shift change or outsourcing), or system disruptions (e.g., supply disruption). Scenarios can be tested on KPIs like resource utilization, lead times, profitability, and CO_2 emissions. Comparing several scenarios in overlays delivers leadership the information they require to choose the best resilient route forward [1][8].

4.5 Execution Linkage and Strategic Follow-Through

The final aspect of the framework entails ingraining long-term plans such that they are not exercises in abstraction but are, in reality, cascaded into the mid-term and short-term execution layers. It is accomplished by linking strategic capacity models with

the Response module and tactical network plans in SAP IBP, hence attaining the closed-loop planning process. Alerts and dashboards can also be established to monitor instances of long-term plans deviating, hence real-time correction and mid-course correction [15].

This coherent framework supplies companies with a real-world blueprint for making SAP IBP a long-term capacity planning engine that can guide high-stakes business decisions and facilitate sustainable growth.

5. Optimization Models and Planning Techniques

Long-term SAP IBP capacity planning derives much of its advantage from the deployment of advanced optimization models and planning techniques. Advanced models mimic tough trade-offs between demand, supply, capacity, and cost over multi-year horizons. Short-term planning may be able to employ heuristic techniques, yet long-term planning needs wider, constraint-oriented techniques that accommodate strategic business goals in addition to practical constraints to create a feasible plan.

5.1 Constraint-Based and Heuristic Optimization in SAP IBP

Both heuristic-based and optimizer-based planning engines are supported by SAP IBP, so users can select the optimal solution for various situations. For long-term planning, the optimizer may be preferred because the optimizer can handle several constraints like lead times, shift, production calendar, and capacity constraints. The optimizer operates by minimizing or maximizing objective functions—usually cost, revenue, or service level—under the constraints that are given.

Heuristics, though quicker and less complicated, are not capable of dealing with highly nonlinear or highly constrained systems. These are usually used for the early-stage simulation or if the data set becomes very large where system performance is paramount. On the contrary, optimization solvers provide greater accuracy as well as strategic goal congruence, although at the price of increased computational complexity.

5.2 Modeling Multi-Constraint Scenarios

Long-term planning of capacity often entails several, usually conflicting, constraints. These may be availability of fixed capital, workforce, tooling lead times, supplier capabilities, and sustainability goals. SAP IBP's modeling functionality enables the planner to specify such constraints expressly in the model setup. Thus, the planner may simulate the effects of labor shortages by the imposition of headcount limits, or model down time of machines as non-productive capacity intervals.

Also, SAP IBP permits the integration of other resources or other sites of production so the network flexibility under stressed capacity can be determined by the planners. It is multi-constraint modeling of this sort that is important in sectors where the capacity cannot be increased in a short time span, and long-term decisions—such as facility expansion or supplier diversification—must be evaluated years into the future.

5.3 Integrating Financial Objectives with Capacity Models

A key element of long-term planning involves synchronizing capacity decisions with financial targets. SAP IBP enables the planner to specify key cost variables—like production, capital spending, transportation rates, and inventory carrying costs—that are employed to direct the optimization process. Synchronization of this kind is important for calculating the total cost of ownership of various planning alternatives and for making strategic plans operationally viable as well as economically viable.

Moreover, SAP IBP KPI monitoring and dashboard functionality provide real-time visibility of the monetary impact, so the planning group as well as the executives can make tactical decisions based on explicit trade-offs between service level, cost, and capacity.

5.4 Handling Uncertainty in Long-Term Planning

It may be unpredictable in the long run. Macroeconomic changes, changing administrative guidelines, new technologies, and disruptive innovation all introduce dimensions of uncertainty. SAP IBP provides scenario simulation and sensitivity analysis capability that allows the planner to probe the uncertain variable's influence. Monte Carlo simulations, probabilistic forecasts, and "worst-case" planning intervals are being paired with the older type of planning models in growing numbers to enhance planning robustness.

Through the integration of these sophisticated optimization methods, SAP IBP converts long-term capacity planning, which was otherwise a static forecasting process, into an intelligent, dynamic, and decision-driven process.

6. Challenges and Implementation Barriers

While SAP IBP possesses a robust long-term capacity planning framework, successful SAP IBP implementation in strategic applications has typically been thwarted by countless challenges. These are not simply technical challenges, however, but organizational, procedural, and behavioral ones as well. Identification of, as well as the solutions too, these issues are crucial in unlocking the full potential of long-horizon planning initiatives.

6.1 Data Granularity and Availability

One of the inherent difficulties in long-term capacity modeling lies in the absence of high-quality, well-structured, granular data. While short-term planning may be accessible at the operation level, strategic data—like forecasted infrastructure growth, multi-year labor availability, or geopolitically weighted risk metrics—typically does not exist or is not consolidated within departments. Capacity data, in general, remains location-centric and sensitive to seasonal, regulatory, and resource restriction variables, complicating aggregation of the data over multi-year periods. It causes considerable difficulty in designing planning areas and key figures within SAP IBP.

6.2 Organizational Silos and Misalignment

Seamless cross-functional collaboration between functions like operation, finance, sales, purchasing, and HR is essential for successful long-term planning. These functions, however, in most companies work in functional silos, employing diverse metrics, planning periods, and data representations. It creates inconsistencies in the assumption base as well as in the integrity of the capacity plan. SAP IBP facilitates collaboration through work-flow approval and common dashboards, yet cultural resistance and absence of cross-functional leadership often hamper its use.

6.3 Planning Fatigue and User Adoption

Long-term planning, by definition, doesn't provide short-term operationally relevant benefits. Consequently, user interest will fade in the long run, in the absence of frequent review of the results or linking to performance incentives. The result—commonly discussed in terms of "planning fatigue," often in negative connotations—may be exacerbated if the tool feels complicated or onerous. SAP IBP's sophisticated functionality can be a blessing or a curse if not well aligned to the needs of the end-users, in terms of being underutilized or even abandoned.

6.4 Technical Complexity and Customization Needs

Although SAP IBP offers several out-of-the-box templates for common planning use cases, long-term capacity optimization usually involves user-defined key figures, planning levels, time profiles, and algorithms. These require experienced consultants and IT resources, further escalating the implementation expense and duration. To add to that, integration with other enterprise systems like SAP S/4HANA, non-SAP ERPs, or HR planning applications involves even more middleware and coordination.

6.5 Change Management and Governance

Strategic planning initiatives frequently fail due to weak governance processes. Without appropriate ownership, definite planning cadences, and escalation procedures, long-term plans can turn into lifeless documents rather than living stimulants of business decisions. Effective change management through leadership endorsement, communication plans, and stakeholder education is required in order to inculcate long-term planning as a standard component of the organizational culture.

In general, while SAP IBP in theory can support long-term capacity planning, the essence of success will always be a combination of data quality, cross-functional collaboration, user enablement, and organizational sophistication. It is by active management of the barriers that the system's full potential, in affecting strategic capacity decisions, can be realized.

7. Future Outlook and Industry 5.0 Alignment

As companies face a new world of complexity through digital disruption, sustainability demands, and rising customer expectations, long-term capacity planning must change from a deterministic, volume-centered process to a real-time, intelligence-driven capability. The advent of Industry 5.0, characterized by a people-oriented, resilient, and sustainable industrial system, creates an opportunity as well as a need for rethinking the planning of, as well as optimization of, capacity. SAP IBP can be an ideal starting platform for next generation planning solutions.

7.1 Integration of Artificial Intelligence and Machine Learning

Applying AI and ML in SAP IBP has moved well beyond the use of demand sensing or forecast refinement. Developing new capabilities now allows the planner to use predictive analytics to uncover long-term capacity risk, foresee bottlenecks, and suggest the best investment strategies. ML can recognize historical deviations, identify nonlinear patterns, and update capacity plans based on changing patterns. The shift towards predictive and prescriptive analytics improves the accuracy of planning as well as enables more adaptive decision-making structures. Constantly changing trends and demand fluctuations get addressed with the level of agility and quality it requires to accommodate the disruptions via integrating AI/ML into IBP platform.

7.2 Digital Twins for Virtual Capacity Simulation

The digital twin concept - making a virtual replica of physical infrastructure and system - has huge long-term potential in the planning of capacity. When coupled with SAP IBP, digital twins make the simulation of several scenarios in a high-fidelity setup possible without long-term, capital investments. For instance, the impact of the introduction of new lines of manufacturing, the movement of facilities, or the change of shift patterns can be virtually simulated without disrupting ongoing operations. These

capabilities increase confidence in strategic choices and make the calculation of trade-offs among resilience, cost, and responsiveness possible.

7.3 Sustainability-Driven Planning and Carbon Optimization

According to ESG objectives and net-zero goals, next-generation capacity plans need to factor in the environment in terms of carbon, water, and energy intensity. SAP has made available sustainability-linked KPIs and optimization constraints that can be integrated into the IBP models. It allows companies to consider the economic as well as the ecological value of capacity-related choices. Building such constraints directly into long-term planning workflows brings the supply chain in line with corporate wide responsibility objectives.

7.4 Human-Centric Design and Collaborative Intelligence

Industry 5.0 has the characteristic of rebalancing the technology of humans with the creativity of humans. While automation and AI are the focus, the work of the planner and the decision-makers remains supreme. SAP IBP user interface, integration with Excel, and collaboration software are being developed in favor of decision augmentation, not replacement. Technologies of guided decision-making, contextual notifications, and user-centric dashboards allow the human planner to make strategic decisions while relegating the machine to mundane calculations.

In general, the combination of AI, digital twins, and sustainability in SAP IBP planning scenarios indicates a new era of long-term optimization of capacity. Long-term thinking, by enhancing strategic flexibility, also ensures harmony with the key values of Industry 5.0—resilience, sustainability, and empowerment of humankind.

8. Conclusion

In a world of uncertainty, long-term capacity planning has emerged as a key component of strategic supply chain resilience. Businesses need to plan for periods further than the next fiscal quarter and instead design systems that forecast demand fluctuations, technological change, regulatory developments, and sustainability commitments for three or four years down the road. SAP Integrated Business Planning (IBP) comes as a compelling platform to accommodate this need, providing a combination of modular adaptability, scenario planning, real-time analysis, and cross-functional communication.

In this paper, we examined the complete lifecycle of long-term capacity optimization in SAP IBP, from designing the planning horizon to data modeling, optimization algorithms, and technologies looking to the future. A framework of structured alignment between strategic requirements and technological possibilities was outlined, through which the planner can simulate, investigate, and respond to intricate trade-offs. Sophisticated optimization methods, AI-aided forecasting, and digital twins further extend SAP IBP's capability to accommodate the dynamic, scenario-rich planning scenarios at the center of Industry 5.0.

But achieving this vision comes with its fair share of challenges. Data quality, organizational silos, planning fatigue, and system complexity are common inhibitors of success. These challenges are best met with not only technical expertise, however, but with governance, leadership support, and cultural maturity. With the evolving nature of organizations, the integration of long-term planning functionality in the likes of SAP IBP will be crucial in maintaining strategic alignment, sustainable growth, and competitiveness in a highly turbulent world.

By bridging the gap between long-term strategy and operational execution, SAP IBP empowers enterprises to plan not just for tomorrow—but for the distant horizon.

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