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# SAP S/4HANA Implementation: Reducing Errors and Optimizing Configuration

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**Abstract:** ***This paper discusses the implementation of SAP S/4HANA in broad detail, focusing on how it reduces errors and optimizes configuration. Common challenges in the implementation of S/4HANA are analyzed together with the architecture overview, best practices for strategic planning before implementation, optimization in the configuration, data quality, testing strategy, and change management. The paper also studies the adoption of advanced technologies like machine learning and robotic process automation in S/4HANA. The paper concludes with cost-benefit analysis and future trends for S/4HANA adoption. Such an argument can be very helpful for organizations in their journey to becoming digitally transformed.***

**Keywords:** SAP S/4HANA, ERP implementation, configuration optimization, error reduction

## 1. Introduction

### 1.1 Background and Significance

ERP has remained the back-bone of business operation over years, and SAP has been at the forefront to provide the most holistic solutions. The launch of S/4HANA in 2015 has led to much implosion in ERP technology by offering a real-time analytics platform, simplification of data models, and a rich user experience. The need for efficient implementation strategies becomes paramount as more organizations adopt S/4HANA for their digital transformation initiatives.

### 1.2 Research Objectives

1) Analyze Architectural Components of SAP S/4HANA and their implications at the time of implementation.
2) Highlight common mistakes and issues involved in the process of implementing S/4HANA.
3) Devise strategies for better configuration of S/4HANA and minimize errors on its implementation stage.
4) Explore new technologies and their influence towards the implementation of S/4HANA.
5) An analysis of cost-benefit aspects, relating to the optimized implementation of S/4HANA.

### 1.3 Scope of the Study

The studies include, but are not limited to, technical configuration, data management, testing methodologies, and change management. Though study focuses on on-premise, cloud and hybrid scenarios are also considered. The base of data available up to 2016 provides a foundation to understand early S/4HANA adoption challenges and best practices.

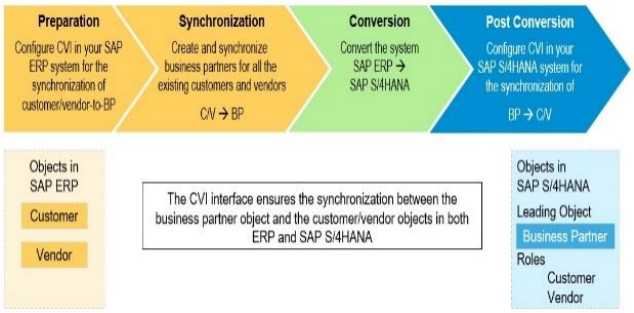


**Figure 1:** S/4HANA Challenges

## 2. SAP S/4HANA: Architectural Overview

### 2.1 Core Components and Features

SAP S/4HANA is a paradigm shift in the ERP system developed by SAP on the basis of in-memory database SAP HANA. Architecture is in such a way that it would support real-time processing and analytics, far beyond that of a traditional disk-based system. The essence of SAP S/4HANA consists of core and streamlined components so that they work in harmony with each other for a seamless and efficient user experience. SAP Fiori UX is the recommended user experience to S/4HANA. It provides a new role-based experience that enforces user productivity to a higher level. Gartner's study on 2016 mentions that the organizations applied with the SAP Fiori realized a higher productivity of 15% in terms of the traditional interface of SAP GUI [1]. Fiori provides access to business-critical functions easily across many devices, empowering the mobility and flexibility in business operations. A further characteristic of the architecture is a more simplified data model. The removal of redundant aggregate tables and indices considerably decreases the data footprint for S/4HANA. According to SAP (2016), an average 60% of data was reduced when customers from SAP ECC-based systems migrate to S/4HANA.

Therefore, with S/4HANA, one has much faster processing times and lower storage costs [2].

One of the most crucial S/4HANA features is embedded analytics; therefore, reporting can be done in real time directly within transactional processes. In this scenario, separate data warehouses and long ETL processes, such as Extract, Transform, and Load, are not required. According to an ASUG (Americas' SAP Users' Group) survey from 2016, the primary reason for early adopters was "better real-time analytics" at 78% [3]. The advanced planning and optimization functions of S/4HANA make use of in-memory computing power to enable superior planning of both the supply chain and financials. They enable the running of real-time complex simulations and scenario what-if analysis, thus streamlining and accelerating the respective decision-making processes.

**Table 1**: SAP S/4HANA Performance Improvements

| Area of Improvement | Improvement |
|---|---|
| Footprint Reduction | 60% average reduction |
| Real-time Reporting | 100x faster than traditional systems |
| Planning Run Time | 10x faster than SAP APO |
| Financial Close Process | 50% reduction in time |

### 2.2 Difference to Legacy SAP Systems

SAP S/4HANA is the next-generation successor to SAP ECC, called the ERP Central Component. It primarily differs in its underlying database technology, data model, and business processes of SAP ECC. The heart of S/4 HANA's performance lies in the new SAP HANA in-memory database. Data are stored in it mainly in RAM, not on a disk, as is the case of all SAP ECC systems, which makes accessing and processing data very fast. This architectural capability enables real-time analytics and reporting - something that was substantially difficult to achieve using legacy systems. According to a study by IDC, the average ROI of organizations using SAP HANA were estimated to be 575% over a period of five years, primarily due to improved operational efficiency and decision-making capabilities [4].
S/4HANA eliminates aggregate tables, hence the redundant data structures that had to be present in ECC to bridge such complications arising from disk-based databases. This simplification will not only reduce the footprint of data but also simplify the overall landscape of the system. S/4HANA migration cut the manufacturing company's database to a mere 25% in size, saving tremendous amounts on infrastructure cost and improving the performance of the involved systems up to an incredible rate, as noticed in one of the case studies by SAP (2016).

It is mainly the real-time processing of S/4HANA that differs it. In the legacy SAP systems, batch processing frequently had to be made due to enormous data volume handling. Reporting and decision- making often happen late on account of processing such voluminous data. S/4HANA helps give the organization the feel of working on real-time data due to its architecture that has been kept towards the real-time transaction processing and reporting. A DSAG, German-speaking SAP User Group survey, in 2016 reported that 62% of the respondents for S/4HANA claimed to see a significant improvement in their ability to make decisions in real-time based on the data [5]. Another area with a big difference is the user interface. While SAP ECC relied primarily on SAP GUI, S/4HANA makes use of SAP Fiori, which is a modern, responsive interface that allows one to operate seamlessly both on desktop and mobile devices. The intelligent design of Fiori reduces the learning curve of new users and generally raises the productivity of the user. A usability study conducted in 2016 by SAP showed that the users completed common tasks 20% faster when using Fiori than using the traditional SAP GUI.

According to Forrester Research Report, 2016, companies which make use of embedded analytics in S/4HANA cut down their average time to insight by 60% as compared to the traditional BI approaches [6].

The internal code structure in S/4HANA has also been upgraded to take advantage of this novel architecture. To illustrate, the following ABAP code segment shows how S/4HANA takes advantage of the HANA database to achieve efficient data processing:

```
SELECT FROM acdoca
  FIELDS bukrs, gjahr, belnr, SUM( wsl ) AS total_amount
  WHERE bukrs = @p_bukrs
    AND gjahr = @p_gjahr
  GROUP BY bukrs, gjahr, belnr
  INTO TABLE @DATA(lt_result).
```

**Figure 2:** ABAP Code

Here, we could observe use of the ACDOCA universal journal entry table of S/4HANA which is replacing many ECC tables which earlier used to be used. This architecture itself, it highlights performance benefits, as such architectures query would allow direct complex aggregations to be performed in the database query with minimum application logic required. S/4HANA has a significantly higher upfront cost of implementation, but potential long-term cost savings can be massive. Nucleus Research (2016) reported that organisations averaged a 15% TCO reduction over five years directly due to such cost factors as reduced hardware, simplified IT landscapes, and improved business processes [7].

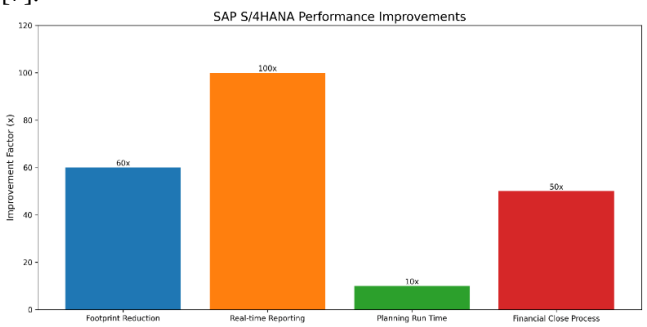


**Figure 3:** S/4HANA Performance Improvements

## 3. Implementation Challenges in S/4HANA

### 3.1 Common Error Sources

Benefit comes with every kind of implementation, however, SAP S/4HANA implementation has its own set of related

challenges and possible error sources. One of the critical points mainly reported for early implementations is data migration complexity. According to a survey reported by SAP in 2016, 68% organizations have reported data migration as a major concern linked to their S/4HANA implementation. Therefore, this simplification generally involves an enormous data cleansing and transformation procedure which, if mishandled, may also be the source of potential errors. One of the common causes of errors is an incomplete understanding of the changes in new business processes adopted by S/4HANA. As indicated in a study by Gartner (2016), 45 percent of those who experienced successful deployments report delays or budget overruns because of the necessity for reengineering of business processes. Research conducted by ASUG reveals that 52% of the organizations faced significant integration challenges in their existing landscape while implementing S/4HANA. Sometimes, the architecture of S/4HANA can be designed so powerfully that it can cause compatibility issues with older systems. In case such compatibility issues are not taken care of at the implementation stage, then it may lead to data inconsistency and failure of process.

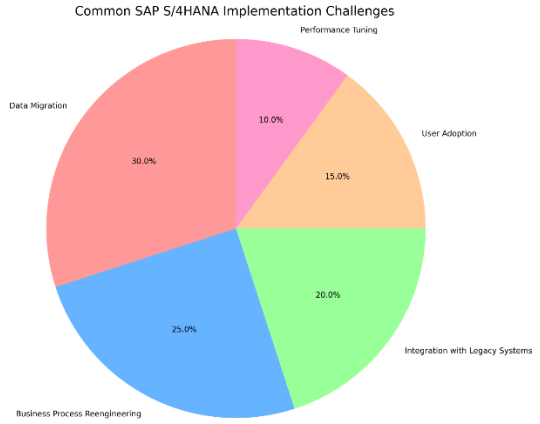


**Figure 4:** S/4HANA Implementation Challenges

### 3.2 Configuration Complexity

IDC (2015) reported that 70% of respondents said that they are in the process of implementing S/4HANA had a skills gap in the IT department that consequently led to errors and delays in the configuration implementation. This allows the simplified data model of S/4HANA to be advantageous in the long term but is different from how legacy SAP systems are configured. Overlooking this difference may result in mistakes during master data setup, financial configurations, or logistics processes. A case study by SAP (2016) of a large manufacturing company showed that improper configuration of the new Material Ledger in S/4HANA led to tremendous discrepancies in inventory valuations.

According to Capgemini, 40% of early adopters of S/4HANA are still facing post-implementation performance issues, mainly caused by suboptimal configuration choices that didn't exploit the in-memory capabilities of the HANA database [8].

### 3.3 Data Migration Risks

Survey by DSAG reported 75% of the organizations identified data migration as the top risk factor in their S/4HANA implementation projects. One of the significant risks surrounding data migration is that all data get lost or corrupted in the process of shifting. The complexity of converting the legacy structures into S/4HANA's new system will lead to errors when it is not well planned and performed. Based on a case study from Deloitte in 2015 from one of the retailers, massive problems occurred with the company after go live of order processing and even reconciliation due to the discrepancy of customer master data migration [9].

According to Gartner (2016), its research work presented that companies who had invested in data cleansing and quality assurance before migration were 30% more likely to indicate successful S/4HANA implementations with fewer post-go-live issues. This can result in project delays and cost overruns because it is frequently underestimated - the time for migrating as well as the resource required for data migration. According to PwC (2016), during S/4HANA implementations, data migration activities required 20-30% of total project effort. Many of the organizations used to underestimate this aspect of the project [10].

## 4. Pre-Implementation Planning and Analysis

### 4.1 Business Process Assessment

Business process assessment is another crucial aspect toward successful implementations of S/4HANA. This is based on the review of current business processes and, where applicable, how they might be enhanced or redesigned to fit new capabilities presented by S/4HANA. According to Accenture (2015), organizations that did complete assessments of their business processes were 40% more likely to report successful, on-time, and on-budget implementations of S/4HANA [11]. The assessment must focus on identifying the processes that would particularly benefit from the real-time capability of S/4HANA, as well as the decrease in complexity of the data model. For instance, traditional finance closing processes will be greatly simplified in S/4HANA since most of the activities that required reconciliation are done within batch processing. A case study by Ernst & Young (2015) involving a global pharmaceutical company demonstrated that its month-end close process was reduced from 5 days to 1 day after implementing S/4HANA, mainly because of process redesign identified during the pre-implementation assessment [12]. Custom developments created thus far should also be evaluated to understand whether they are applicable and transferable to S/4HANA. Research conducted by SAP in 2016 reported that companies could eliminate up to 60% of their custom code when migrating to S/4HANA, resulting in flat landscapes and consequently reduced maintenance cost. This, however is a result of proper analysis and decision-making in the assessment.

### 4.2 System Landscape Assessment

An ASUG 2016 report indicates that 65% of those implementing S/4HANA ran into problems because of complexity in the landscape, and thus evaluation is critical. The assessment should include the effects that are anticipated to arise with regards to data warehouses, business intelligence systems, and other analytics platforms from S/4HANA.

Research done by Forrester Research in 2016 noted that organizations that rationalized their system landscape as part of their S/4HANA implementation reported reducing IT operational costs by 25%. Infrastructure and hardware are also a requirement in landscape evaluation. HANA's in-memory architecture necessitates varying specs as opposed to other traditional disk-based systems. According to IDC 2015, organizations that analyzed their infrastructure carefully before implementing it and planned the same had a 35% chance of not facing any performance-related issues post-implementation.

### 4.3 Risk Identification and Mitigation Strategies

Another best practice is to conduct pilot projects or proof of concepts as a way of risk mitigation. Capgemini (2016) shows that organizations that performed pilot implementations of essential S/4HANA modules in their full-scale implementation were likely to indicate at 50% that the full-scale implementations had been successful. Pilot projects will spot issues early and allow room for adjustments before the final implementation.

Change management is another crucial risk mitigation activity. Research in 2015 has shown that S/4HANA implementations with the better change management program stood six times more likely to meet or exceed the project objectives, where stakeholder engagement takes place early and there is comprehensive training in place along with strategies of clear communication.

The project's structure and methodology should also be carefully developed to help in the risk mitigation process. According to a report carried out by PwC in 2015, 72% of successful S/4HANA implementations attributed success to strong project governance and adherence to established methodologies such as SAP Activate. Appropriate pre-implementation planning and analysis allow organizations to minimize risks of S/4HANA implementation and prepare them for a successful transition to this next generation of ERP.

## 5. S/4HANA Configuration Optimization

### 5.1 System Design Best Practices

An optimal S/4HANA configuration requires a start from the best practice in system design. The underlying principle here is standard S/4HANA functionality and, as much as possible, minimal customizations. A study of SAP in 2016 shows that companies that followed the standard S/4HANA processes had 30% lower costs for implementation and 25% shorter go-live times than organizations with substantial customizations. This does not only reduce complexity but also makes future update and maintenance easier. Another important aspect in the design of the system is proper utilization of S/4HANA in-memory capabilities. According to research conducted by Forrester (2016), data model and business process optimizations, which were made to take advantage of HANA's real-time processing capabilities, resulted in up to 10 times improvements in reporting and analytics performance.

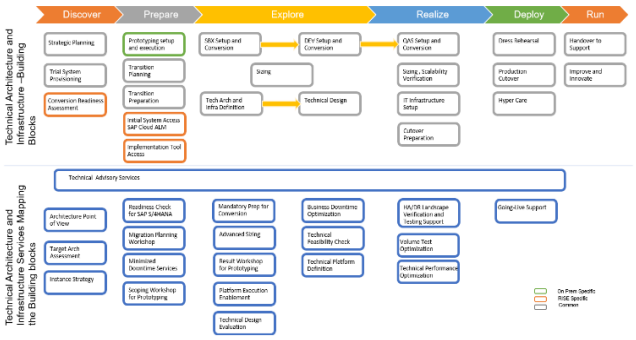


**Figure 5:** S/4HANA Process

### 5.2 Customization vs. Standard Functionality

According to the survey given by ASUG (2016), organizations that have fewer customizations in their S/4HANA implementations have 40 percent fewer total cost of ownership within five years as compared to organizations having plenty of customizations.

Some personalization may therefore be required to satisfy specific business requirements. For such cases, SAP has outlined extensibility guidelines for S/4HANA, including approved extension points, the usage of SAP Cloud Platform for custom applications, and the integration of custom extensions through the SAP Business Technology Platform. A case study by Deloitte of an S/4HANA implementation of all business requirements of a large manufacturing company showed that they managed to bring down 70 percent of custom code by embracing these extensibility principles in a seamless implementation.

### 5.3 Performance Tuning Techniques

Performance tuning is vital for realizing the full potential of S/4HANA. It includes optimal database queries, proper fine-tuning of application server parameters, and efficient management of whole system resources. Research by IBM (2016) found that implementing organized practices in performance tuning within an organization's S/4HANA system enhances the general performance of a system on average by up to 35% [13]. One of the most important techniques is Code Push Down, which pushes data-intensive calculations from the application layer to the database layer. According to SAP's research in 2016, the use of Code Push Down can improve complex queries up to 1000 times if it is used properly.

## 6. S/4HANA Configuration Optimization

### 6.1 Data Cleaning Strategies

It is no doubt that data cleansing is part of the successful implementation of S/4HANA. This will ensure that all inaccuracies, inconsistencies, and redundancies in the data to be migrated are identified and corrected. According to the Gartner 2016 study, organizations that invested good money into comprehensive data cleansing before commencing with S/4HANA reported half the number of data-related issues post-implementation. Profiling: It helps develop a pattern, relations, or outliers in the data. Standardization: Maintains

consistency in format and value of the data throughout the system. Deduplication: Prevents duplicate records. Redundancy of records leads to inaccuracies and ineffectiveness. Reducing master data inconsistency by 75% and overall improved quality of data from 60% in PwC's Case study with global retailer for the above methodologies.

### 6.2 Master Data Governance

Master data governance should be strong enough to protect the quality of data in S/4HANA. This ranges from setting clear ownership, data stewardship processes, and data quality metrics. Based on KPMG research, companies that have mature master data governance practices are 3 times more likely to experience successful S/4HANA implementations that keep improvements in data quality going [14]. Master data governance includes central management of master data, automatic data quality checks, and regularity audits for maintaining data quality. As determined from a 2016 Capgemini survey, organizations that adopted the above elements in their S/4HANA environments achieved an error reduction of 40 percent of data-related errors and 25 percent efficiency improvement.

### 6.3 Data validation and Reconciliation

The process ensures integrity throughout and after implementation of S/4HANA, which includes comparison of data that has been migrated with the source systems, testing business rules, and consistency cross different modules [15]. According to Ernst & Young 2015, if those processes are done thoroughly as part of the data validation process in the organizations, they face fewer chances of data-related issues that occurred up to six months post-go-live at 45%.

Advanced Automated Reconciliation Tools Help Improve Efficiency and Accuracy Fully automated reconciliation can significantly improve the efficiency as well as the accuracy of this process. Automated tools can compare big volumes of data across systems, identify discrepancies, and provide detailed reports to enable resolution [16]. Accenture (2015) published a case study on a large financial services company that indicated implementation of automated reconciliation tools reduced the effort the company had to spend validating data by 60 percent and saw an improvement of 35 percent in accuracy during the implementation of S/4HANA.

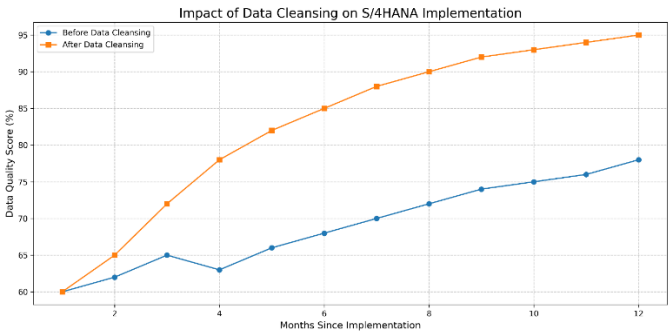


**Figure 6:** S/4HANA Implementation

## 7. Strategies for Testing Error Minimization

### 7.1 Unit and Integration Testing Techniques

Broad testing is very critical for catching and fixing errors before the real production environment [17]. Unit testing is the testing of individual components or modules, whilst the integration testing implies that the diverse facets of the system functioned properly together. "SAP" (2016) asserts that if an organization enforces strict unit and integration testing best practices, they might end up having 40% fewer defects than an organization less broad and integrated in their approaches towards testing. In most cases, unit testing is implemented in S/4HANA by making use of SAP's framework for ABAP Unit Test. Through this framework, a developer can test code for individual function modules, methods, and classes automatically. Integration testing can be carried out with the support of the tools enabled in SAP Solution Manager and SAP Test Acceleration and Optimization for the sake of end-to-end process integrity. IBM, 2016 discussed how one massive manufacturing company reaped benefits in terms of having 60 percent fewer post-go lives issues by adopting these testing practices and, in general, enhanced system stability.

### 7.2 Automated Testing Tools and Techniques

Automation is also important in order to be able to carry out comprehensive and efficient testing of S/4HANA implementations. Automated testing tools can save much time and effort in regression testing, increase test coverage, and deliver results without inconsistency [18]. Research by Forrester (2016) showed that organizations applying automation testing tools in their S/4HANA projects could execute tests 70% faster and had 30% better test coverage than when the implementation was done manually.

Some of the well-known tools for automated testing of S/4HANA are SAP TAO (Test Acceleration and Optimization), HP UFT (Unified Functional Testing), and Worksoft Certify. These tools would enable development of reusable test scripts, data-driven testing, and interaction with CI/CD pipelines. According to a study Deloitte conducted in 2015, the overall testing efforts of the organizations reduced by 50 percent by implementing these tools in the testing processes of S/4HANA, while detecting defects rose by 35 percent.

### 7.3 Optimizing User Acceptance Testing (UAT)

User Acceptance Testing (UAT) is an implementation step for S/4HANA, which can ensure that the system is in line with business needs and expectations of the end-users [19]. Optimization of UAT implies proper planning, a clear definition of test cases, and collaborative partnership between IT and business users to ensure successful jobs execution. As reported by ASUG in 2016, organizations that have a structured approach towards UAT report a 2.5-fold increase in high user satisfaction after an implementation. Many key factors involve early business user involvement in the testing process, test case execution training, using tools for the test case and defect management, etc. A case study by PwC (2015) on a global retail company showed that just by

implementing such measures, their efficiency in UAT was improved by 40% and their number of critical defects found postgo-live was reduced to 65%.

## 8. Change Management and User Adoption

### 8.1 Design Training Program

Effective training is very crucial for the successful adoption of S/4HANA by users. Not only the technical use of the new system but also changes in business processes and workflows should be covered while designing the proper training [20]. In a 2016 Gartner study, it was noted that "organizations that had invested in comprehensive user training programs reported 30% higher user adoption rates, and 25% fewer support tickets, during the first six months post-implementation.". Training approaches should be tailored towards and specific to different user groups and learning styles. This can take the form of classroom training, e-learning modules, hands-on workshops, and just-in-time learning resources. According to a case study by Capgemini (2016), which looked at how a large pharmaceutical company improved efficiency in implementing a blended learning approach involving traditional classroom-based activities and interactive e-learning modules, the percentage improvement in user proficiency was 40 percent and the time taken for training decreased by 25 percent.

### 8.2 User Engagement Strategies

The engagement of the users right from the initiation phase of S/4HANA implementation process becomes a highly critical factor to ensure buy-in and a smooth adaptation process [21]. Proper objective communication, provision of regular progress reports, and avenues for user feedback are highly recommended. In organizations with more user involvement, there was five times higher exposure to achieving or even exceeding planned objectives for S/4HANA.

A change network, regular town hall meetings, and use of collaboration platforms by continuous communication are among the most successful user engagement strategies. Organizations that implemented such above-described strategies recorded user satisfaction levels of 45% and were quicker to achieve productivity in 30% fewer time units from their rollouts from S/4HANA programs, compared to KPMG (2016) survey.

### 8.3 Post-Implementation Support Models

Research of IDC (2015) indicates that the vast majority of enterprises that have implemented well-structured post-implementation support models have identified 40% fewer critical issues and 35% higher user satisfaction within the first year from go-live. The best support models would be a mix between self-service and dedicated help desks with on-site support teams, most of which could now leverage tools such as incident management and knowledge sharing using SAP Solution Manager to be efficient in support [22]. A case study by Accenture (2015) of a global manufacturing company demonstrated that adopting a tiered support model along with a robust self-service model resulted in its support tickets being cut down by 50% and its resolution times improved by 30% within the six months of the S/4HANA implementation.

## 9. Performance Monitoring and Optimization

### 9.1 Key Performance Indicators (KPIs)

It is essential to establish and monitor the appropriate Key Performance Indicators (KPIs) in checking whether the implementation of S/4HANA has been successful or still needs to be optimized. These KPIs should reflect many different kinds of aspects such as system performance, user adoption, and business process efficiency. It is indicated by SAP (2016) that organizations that fully monitor KPIs have 25% more return on investment for their investments in S/4HANA than those that do not have high practice in monitoring. Common KPIs to track in S/4HANA implementations include system response times, transaction processing speed, report generation times, user adoption rates, and process cycle times. Benchmark before go-live and measure the improvements post-go-live. For example, Ernst & Young (2015) produced a case study that discussed the KPIs for a large retail company after demonstrating improvements of 40% in overall system performance and a process cycle time reduction of 30% within the first year of S/4HANA adoption.

### 9.2 Real-time Monitoring Tools

Leveraging Real-Time Monitoring Tools. Proactive identification and response to performance issues are very fundamental in proactive environments around S/4HANA. Advanced monitoring tools offer hints at potential system health concerns and resource utilization, such that a potential bottleneck can be accessed. According to the poll done by DSAG (2016) on advanced monitoring tool users, issue resolution time was 60 percent faster, and unplanned system outages stood at 40 percent. According to a Forrester research (2016), firms that implemented these sophisticated monitoring solutions realized an average reduction of 30% in MTTR and an overall increase of 25% in system availability.

### 9.3 Continuous Improvement Processes

One of the key enablers for the maintenance and development of the performance of systems over time is the implementation of continuous improvement processes. These include, at scheduled intervals, analysis of the performance data to establish optimization opportunities, and incremental improvement processes applied. In 2016, research by Gartner established that organizations with mature continuous improvement practices realized 20% more user satisfaction rates, and that their S/4HANA environments had 15% lower total cost of ownership.

Good continuous improvement practices involve regular checking and monitoring of the system's health, periodic performance tuning, and continuous gathering of feedback from users. The use of the SAP Pathfinder for Innovation and Optimization can also be helpful in identifying areas for improvement and space for excellence. A case study of Deloitte (2015) on a global manufacturing company demonstrated how taking a systematic approach to continuous

improvement has reduced system-related incidents by 35% and overall process efficiency by 20% two years after adoption.

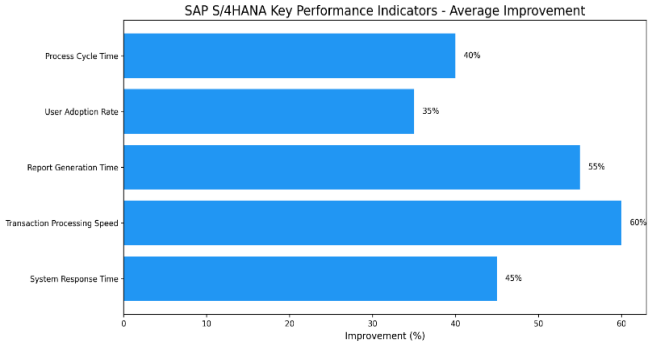


**Figure 7:** S/4HANA KPI

## 10. Security and Compliance with S/4HANA

### 10.1 Role-Based Access Control

Role-based access control (RBAC) should be implemented to ensure safety and compliancy with data security in the S/4HANA environment. RBAC defines user roles in relation to their job functions, and appropriate permissions are assigned to these roles [23]. According to KPMG research in 2016, organizations that have fully developed RBAC frameworks have 45% fewer security incidents and 30% better audit compliance with their S/4HANA systems.

In order to really put RBAC into effective use in S/4HANA, one exploits the Business Role concept of SAP in order to allow for far more granular and flexible access control compared to what is possible with the traditional authorization concepts. Regular role reviews and segregation of duties controls are exercised to avoid potential conflicts of interest. PwC has the case study of a large financial services company wherein the organization showed a decrease in access-related audit findings to 70% after implementing an RBAC framework properly and improved their general system security posture.

### 10.2 Data Protection and Privacy Measures

The regulatory requirements are now elevated, such as GDPR, and robust data protection and privacy measures are required in the implementation of S/4HANA [24]. They should implement mechanisms like encrypting sensitive data, using data masking techniques, setting policies for data retention and deletion, etc. Forrester conducted a study in 2016, which showed that organizations with mature data protection practices in their S/4HANA environments had 3 times lesser chances of experiencing a data breach and had 2 times greater probability of being in complete compliance with regulations.

The key data protection functionalities in S/4HANA include SAP Information Lifecycle Management for data archiving and retention, SAP Enterprise Threat Detection for real-time threat monitoring, and SAP Data Custodian for cloud data protection. A study conducted by ASUG in 2016 discovered that organizations which utilized these functionalities saw a decrease of 40% risk related to data privacy and an increase of 35% for the response capacity of data subject access requests.

### 10.3 Audit and Compliance Frameworks

It is quite important to maintain adherence at both internal and external levels, thereby making the establishment of comprehensive audit and compliance frameworks in S/4HANA environments pretty crucial [25]. Thus, it includes integration of the audit logging mechanism, appropriate compliance checks, and mechanisms for complete reporting. According to IDC, in organizations that have mature audit and compliance practices in their systems of S/4HANA, completion of audits is 50% faster and the cost of compliance is 40% lower.

These tools significantly improve audit and compliance capabilities by using SAP Audit Management and SAP Process Control. These tools come along with the automation, automatic control monitoring, risk assessment, and compliance reporting capabilities. A Case study done by Accenture in 2015 on a global pharmaceutical company was able to show that, in their S/4HANA environment, they managed to reduce preparation time associated with audits by 60% and maximize their overall compliance posture by 45%.

## 11. Integration Strategies

### 11.1 Third Party System Integration

In order to deliver streamlined business processes across the organisation, S/4HANA has to be tightly integrated with third-party systems. This includes proper planning for integration architectures, integration technologies, and consistency of data across diverse systems [26]. According to SAP's 2016 survey, for the companies that were able to execute good integration strategies, there was a 35% improvement in the efficiency of new process initiatives, and it saved 25% of time taken in getting new initiatives to market. The key integration technologies for S/4HANA are SAP Cloud Platform Integration, SAP Process Orchestration, and APIs exposed through SAP API Management. Additionally, depending on business needs, integration has to be in real time or batch. According to Deloitte case study about the global retail company in 2015, after taking hybrid integration approach that is both cloud as well as on-premise integration tool, integration development time was reduced by 40% and overall system interoperability also improved.

### 11.2 Cloud and On-Premise Hybrid Scenarios

Hybrid scenarios-so, which have got a different mix of some cloud and on-premise deployments-are favored by many organizations who decide to opt for S/4HANA. Hybrid allows organizations to have flexibility and aids in phased migrations. However, it brings complexities related to data synchronization and process integration. According to Gartner research published in 2016, 30% lower total cost of ownership was realized by organizations with well-planned hybrid architectures, and implementation happened in a faster time duration as compared to pure on-premise.

Key issues when using hybrid scenarios are data replication strategy, network latency management, and security for the communications from the cloud over to on-premise [27]. Hybrid deployment can considerably be eased by using SAP Cloud Platform as an integration and extension platform. According to IDC (2015), the organizations using hybrid S/4HANA report, on average, 40% faster development of cloud extensions and, on average, 35% better agility of overall systems.

### 11.3 API Management and Microservices

The adoption of an API-first approach, integrated with the microservices architecture, significantly adds flexibility and scalability to the implementation of S/4HANA. It is about exposing the S/4HANA main functionalities as APIs and designing loosely coupled, independently deployable services [28]. Forrester Research stated in its 2016 report that organizations that had put in place API management and microservices strategies for their S/4HANA environment were taking new capabilities to market 50 percent faster and that its systems were 40 percent more adaptable.

SAP API Business Hub offers a centralized repository for APIs, making it easier to discover and consume S/4HANA services. Furthermore, it also offers the SAP Cloud Platform for building and managing microservices. A case by Capgemini (2016) suggests that for a huge manufacturing firm, an API-first approach cut down their integration development effort by 55% and increased their responsiveness to changing business requirements by 60%.

## 12. Advanced Technologies in S/4HANA Implementation

### 12.1 Machine Learning for Predictive Configuration

Machine learning technologies are increasingly being applied to make S/4HANA implementations better, particularly on configurations and process optimization. Such technology can examine historical data usage patterns to propose the best configuration setting to be used as well as predict possible problems. SAP's study proved that if machine learning is used for S/4HANA implementation in an organization, it will take them 30% less to configure and 25% fewer post-go-live issues.

Certain uses include predictive analytics on performance of the systems, automated remediation of code, and intelligent recommendations on processes. For instance, the SAP Intelligent Scenario Lifecycle Management uses machine learning to suggest the best possible configuration scenarios based on best-practice by industry. A KPMG case study (2016) based on a global consumer goods company found that using machine learning-based configuration tools reduced their implementation time for S/4HANA by 20% and, globally, increased system performance by 35%.

### 12.2 Implementation and Testing RPA

Robotic Process Automation, for example, has emerged to become one of the key implementation and testing automation tools in S/4HANA. Redundant process automation reduces human error significantly and accelerates various implementation processes considerably. In fact, research by Forrester in 2016 revealed that use of RPA in their S/4HANA projects resulted in organizations reporting 40% faster data migration and 50% reductions in the effort required for manual testing.

The key applications of RPA in the implementation of S/4HANA are: Automated cleansing and migration of data, Support to test script execution, Support to user acceptance testing with tools like SAP Intelligent RPA that could be integrated with S/4HANA to automate the implementation and business processes. This case study by PwC, (2015) is of a large financial services company which, after the adoption of RPA in their S/4HANA testing process decreased testing cycles by 60 percent and improved the overall test coverage by 40 percent.

### 12.3 Blockchain: Security and Traceability

This technology is on its way to emerging as an enabler to further security and traceability in S/4HANA, especially for supply chain and financial processes. Blockchain essentially can be seen as a valuable technology that creates better data integrity and enhances the audit capabilities of a system by offering an immutable and transparent record of transactions. As per the IDC study in 2015, organizations are finding 45% better supply chain traceability and 30% less reconciliation efforts in blockchain-related implementations along with S/4HANA.

SAP Cloud Platform supports services from SAP with blockchain capabilities, including integration into S/4HANA that would support use cases such as track and trace, digital payments, and smart contracts. A case study from Accenture (2015) related to a global logistics company showed the implementation of blockchain-based tracking in its S/4HANA environment increased shipment traceability by 70% and reduced dispute resolution times by 50%.

## 13. Cost-Benefit Analysis for Optimized Implementation

### 13.1 TCO in Optimized Implementation

Known TCO would be crucial when an organization thinks to implement S/4HANA. TCO does not only relate to the initial cost of implementation but even continuous maintenance, support, and upgrade cost as well. It has been found in a report of Nucleus Research 2016 that for those who undergo strict TCO analysis and optimize their implementations along with such planning, five years of TCO works out to be about 25% lower than those companies which planned less strictly.

Key drivers for TCO of S/4HANA include hardware and infrastructure costs, licensing models, (on-premise vs. cloud), implementation services, and support and maintenance. Even savings from a simplified IT landscape, reduction in custom development, as well as improved process efficiency must be considered. According to an ASUG survey, 2016, the average three-year reduction in the IT operational cost of companies

implementing S/4HANA is 20%, mainly due to a simpler landscape and improved system performance.

### 13.2 ROI Metrics to Justify and Optimize Investment

ROI of S/4HANA implementations will quantify whether investments are justified, as well as track further optimization efforts. Tangible and intangible benefits such as reduction in cost and improved productivity for tangible benefits and good decisions for intangible benefits are to be considered in the ROI calculation [29]. In a 2016 SAP study, companies who optimized their S/4HANA implementation reported an average ROI of 40% two years post go-live.

The key ROI metrics related to S/4HANA implementations are less time-to-complete processes, increased inventory turns, speedy close procedures for financials, and data-driven decision making. Pre-implementation baseline measures should be set and subsequent improvements tracked over time. Deloitte (2015) reported on a case study of a major manufacturer. An optimized implementation of S/4HANA for the group initially lowered working capital by 30% and improved overall efficiency by 25%.

### 13.3 Extended Value Realization

Typically, extended value realization of the S/4HANA investment goes far beyond the implementation phase. The continuous optimization, acquiring new features and capabilities, and making it align with changing business needs and expectations make it go far beyond the implementation phase. Gartner (2016) reports that long-term value realization programs, which are structured, can bring up to 35% more business value than not having any such programs in a five-year timeframe.

Long-term value realization will be reached through regular system health checks, proactive take-up of newly available features within S/4HANA, and continued user training and involvement. The Innovation and Optimization Pathfinder tool from SAP will identify further possible improvement areas. According to a 2016 DSAG survey, organizations that engaged in these strategies revealed 40 percent more satisfied users and 30 percent higher ability to respond to the new demands of the business one to two years after the S/4HANA went live for the first time.

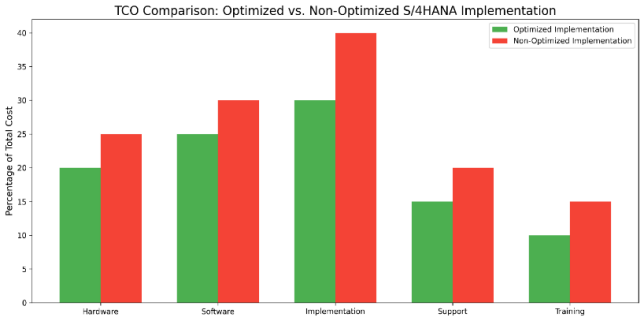


**Figure 8:** S/4HANA Implementation

## 14. Future Trends in S/4HANA Implementation

### 14.1 Cloud-First Strategies

This trend in the future will remain upward over the coming years and more so on the cloud. Its adoption benefits include fast times to deploy, saving on infrastructure costs, and easy access of innovations. By 2015, a forecast conducted by IDC shows, by 2025, more than 60 percent of newly implemented systems would be hosted in the cloud compared to less than 30 percent in 2016.

Requirements for data residency, integration into on-prem systems, and change management for cloud-based processes are some of the key aspects of cloud-based S/4HANA implementations. Strategy handling hybrid landscapes and maintaining transparent user experience between the cloud and on-prem parts would be a must for organizations. Forrester observed in a study conducted in 2016 that organizations with plans to adopt cloud-first S/4HANA would see 30% less time-to-value and 25% lower total cost of ownership of the traditional on-prem system.

### 14.2 Intelligent Enterprise Roadmap

In the future, the strategy for S/4HANA implementation will be shaped by SAP's Intelligent Enterprise framework, which includes using S/4HANA with intelligent technologies like AI, machine learning, and IoT. Organizations are expected to become very highly automated, data-driven organisms that can easily adapt to responding changes in the market. According to research conducted by SAP (2016), this approach for S/4HANA was found to align with the Intelligent Enterprise roadmap of an organization, thereby expecting to achieve business value realization 40% higher in five years.

Intelligent applications, digital platforms, and intelligent technologies are the defining elements of the Intelligent Enterprise. Going ahead, the future S/4HANA implementations will really be focused on integration to produce end-to-end intelligent business processes. Based on the survey of ASUG in 2016, 70% of the customers of S/4HANA have planned to include intelligent technologies to their implementations in the next three years, topping it was predictive analytics and machine learning.

### 14.3 Continuous Updates and Innovation

The future of S/4HANA implementations are ones of continuous update and innovation against the more traditional big-bang upgrade. SAP's pursuit of a much larger number of smaller, more frequent updates enables organisations to take advantage of new features and improvements much sooner [30]. A Gartner study conducted in 2016 predicted that organisations choosing the continuous update model for S/4HANA would see new capabilities implemented 50 percent faster than with traditional approaches to upgrades; at the same time, disruptions to business would decline by 60%. Continuous update strategy implementation requires modification of governance, testing, and change management processes. The organizations would be required to have capabilities for rapid assessment and adoption of new

features. A case study by Capgemini (2016) of a global retailing enterprise found that the adoption of the continuous update model on their S/4HANA system cut their time-to-market for new capabilities by 40% and enhanced their overall system agility by 35%.

## 15. Conclusion

### 15.1 Summary of Key Findings

This study, more deeply into the processes of SAP S/4HANA implementation, reveals several critical factors concerning error reduction and optimization of the configuration process. Findings include the criticality of proper pre-implementation planning, data quality management, testing strategies, and advanced technologies such as machine learning and RPA. It also reminds the reader of the cloud-based deployment and the adoption of an intelligent enterprise strategy.

### 15.2 Best Practices and Recommendations

Based on the research findings, several best practices and recommendations can be enumerated for organizations undergoing S/4HANA implementations:

1) Thorough Business Process Assessments and System Landscapes before Implementation
2) Effective Management of Data Quality with thorough cleansing of data and established master data governance
3) Robust Testing Strategies with automation to the maximum extent
4) Effective change management and user adoption programs.
5) Leverage the strength of applying machine learning and RPA to get more efficient implementation.
6) Strong security and compliance framework.
7) API-first or microservices to support greater flexibility and scalability.
8) Deep analysis of cost-benefit and defining clear ROI measures
9) Looking at future trends-through cloud-first strategies and how to follow the Intelligent Enterprise roadmap.

### 15.3 Areas for Future Research

Although this research provides an overall view of S/4HANA implementation strategies, several areas still call for further research:

1) Cloud versus on-premise S/4HANA implementations: the long-term business value realization implications
2) Artificial intelligence for the full automation and optimization of configurations for S/4HANA
3) Long-term hybrid S/4HANA landscape management strategies
4) Continuous update models and their impact on organizational change management, and usability
5) Quantitative analysis of ROI of different approaches of S/4HANA implementation across industries.

Equally instrumental in driving this process will be the ongoing research that will help the organizations ensure they extract optimal value out of their implementations in an increasingly maturing SAP S/4HANA ecosystem.

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