OPEN ACCESS
International Journal of Innovations in Science & Technology
IJIST
P ISSN : 2618-1630
E ISSN : 2909-6130
Recognized Journal

Hybrid Integration Model in Industry 4.0 for Lean Management (HIM)

Original Article

Huma Pervez[1]
[1]Pakistan Institute of Engineering and Applied Sciences, Pakistan.
* **Correspondence Email: humapervezakhtar@gmail.com**

Citation | Pervez. H, "Hybrid Integration Model in Industry 4.0 for Lean Management (HIM)". International Journal of Innovations in Science and Technology. Vol 4, Issue 2, 2022, pp:476-489

Received | April 5, 2022; **Revised |** May 13, 2022; **Accepted |** May 26, 2022; **Published |** May 28, 2022.

In many large organizations, there is an Enterprise Resource Planning (ERP) system that needs to be integrated with a third-party system to provide real-time services to their customers. To achieve this, these organizations'(ERP) systems should have inbound (IB) and outbound (OB) integration capability through APIs. In this paper, we have proposed and implemented a Hybrid Integration Model (HIM) in Industry 4.0 for Lean Management. This research was implemented in an Airline Travel Company (ATC) in which an In-house ERP system is real-time-integrated (In-bound) with Global Distribution System (GDS) through API's i-e, soap &rest-based web services for online ticketing as well other Miscellaneous facilities i-e (Auto SMS Email) using Horizontal Integration Model in Industry 4.0 and also integrated (Outbound) with 3rd party General Ledger (GL) system. Integrating an ERP system with GL is an automated business process that requires implementing API's and developing automatic routines to move the data between ERP & GL Systems as per user requirements. Our proposed model is fully automated where no human intervention is involved while transferring data from ERP to GL and following all standards recommended by industry 4.0 for Lean Management.

Keywords: System Integration, Industry 4.0, Lean Management, Inbound and Outbound Integration, ERP, General Ledger, GDS.

Acknowledgments

All praises and thanks be to Almighty Allah. Much Appreciation to the Pakistan Institute of Engineering and Applied Sciences for the research facilities and the supervisor Dr. Anila Usman for her guidance and recommendations. I am deeply grateful to my father, Mr. Pervez Akhtar, for his immense support and high level of motivation throughout my study career

CONFLICT OF INTEREST:

The author(s) declare that the publication of this article has no conflict of interest in IJIST.

Project details.

NIL

Introduction

System integration (SI) talks about the procedure by which numerous individual sub-components or subsystems are amalgamated into one large-scale system, letting the subsystems work together. As such, the relationship established through SI allows the primary system, Enterprise Resource Planning (ERP), to achieve the fundamental functionality required by the organization.[1].

In most organizations that use SI, there is a certainty to increase their practices' throughput, yield, and excellence. The goal is typically to develop the company's several IT systems to interconnect with each other in the background to evade the time and exertion that went through physically offering data to different divisions/segments of the organization, including higher administration. An ERP system is intended to manage business practices and automate several front-end, back-end, or back-office jobs that need not be performed manually. [1].

System integration enables Enterprise Resource Planning (ERP) systems to integrate real-time communication among different methods in which both systems can have additional features & functionalities. Both systems can be run on other tools, techniques, platforms, etc. Results inaccurate, efficient, controlled, cost-effective, authorized information availability among ERP.

Any organization must have inbound & outbound capabilities to get the benefits of integration. Like, systems will not be able to provide real-time services to customers as per customer needs. It will impact the sale/productivity of companies as they will not have real-time data movement and records of sales to provide satisfactory service to organizations. It will take too much time to reach the targeted audience for new business & product services offered to customers. The absence of real-time data movement and consolidation into the central database will delay getting a real-time financial picture by stakeholders to management for making critical decisions on time. Automatic system integration / real-time data movement will remove human intervention and decrease the chances of errors. In case of the absence of real-time system integration and data movement organization, manual work will be required, which increases human resources costs and provides less efficient service. Hence, in case of human intervention or non-real-time integration, organizations will get expensive solutions to manage ERP systems data and functionality.

To avoid the risks mentioned above of serious nature, every organization must have a plan & budget for the cost of the following key resources required for system integration.

I. Each system in ERP must have in-bound / Out-bound integration capability. It means the system must have the ability to utilize any system with integration methods in its ERP system. This is known as In-bound system integration. On the other hand, outbound integration means ERP systems must have the capacity to expose their system to other systems, and they will consume your ERP system via integration methods.

II. Integration Development Time & Cost. While integrating systems, there must be a budget and proper project planning required, including integration development time, cost, and development life cycle details.

In addition, integration is generally a challenging process that requires some aspects of the process to be considered, such as technology, investment, and time. In this research, ERP system integration with third parties, Global Distribution System (GDS) platforms developed by the new Central Airline Booking Systems, first introduced decades ago. For decades, GDS has been the nexus of e-commerce in travel, providing real-time virtual connectivity between thousands of travel inventory providers (airlines, hotels, car rentals, tour operators, cruise lines, etc.) and thousands of retailers of travel products. Each GDS has provided airlines with a network of over fifty thousand stores worldwide and the ability to

customize their offers and prices to meet market conditions. Currently, three major GDS together handle over 1.4 million travel transactions per year [10] and General Ledger (GL) system. A general ledger is the master set of accounts that contains a summary of all transactions within an entity. A subsidiary set of ledgers may exist that summarize into the general ledger. In turn, the general ledger is used to aggregate information into a company's financial statements; this can be done automatically with accounting software or manually by compiling financial statements from information in a trial balance report (which is a summarization of the ending balances in the general ledger) [11], is proposed and implemented.

Scientific contributions of this research are:

I. Real-time integration between GDS & ERP (In-House) model
II. Real-time integration between ERP (In-House) & GL
III. Implementation of the proposed integration model

The rest of the paper is organized as follows: Section II discusses the background, and section III includes the benefits of IT System Integration. Section IV has System integration methods of industry 4.0.

Section V discusses Hybrid Integration Model in Industry 4.0 for Lean Management (HIM). In Section VI, the implementation of the proposed HIM model is discussed. In Section VII, results are discussed, while the conclusions and the future recommendations are provided in the last section.

Background

Industry 4.0

Industry 4.0 is interrelated with the establishment of the fourth industrial revolution. It illustrates the modern development in automation technologies, acquiring recognition in the manufacturing trades. In Figure 1, the industrial revolution is shown [9].

The first industrial revolution in recognition of the development of steam machinery, water, steam power, and all other types of machinery will lead to a business revolution in the world with the mechanization of manufacturing, trains, and mass smog [9]. The second industrial revolution is usually considered when new manufacturing "inventions" such as electricity and assembly lines enabled the field of mass production and, to some extent, automation [9]. The third industrial revolution has been associated with the rise of computers, computer networks (WAN, LAN, MAN, etc.), the augmentation of robotics in connectivity, manufacturing, and the birth of the Internet, a significant change in the way to process and share information, and previously an advancement to the e-anything version of the physical store environment only, which is much more automated [9].In the fourth industrial revolution, from the "mere" Internet and client-server model, ubiquitous mobility, bridging digital and physical environments (manufacturing called cyber-physical systems), OB and IB integration, and all of the technologies mentioned above (Internet of Things, big data, cloud). Further accelerators such as innovative robotics and AI / cognitive enable Industry 4.0 to be automated and optimized in new ways. The next level of technology may be known as the fifth industrial revolution, as the revolution is an ongoing process [9].

The current manufacturing automation and data exchange trendaremade possible by technological advancements such as the Internet of Things (IoT), cloud computing, and cyber-physical systems. This trend is frequently referred to as "Industry 4.0," "smart manufacturing," and "digital factory." [13].

Industry 5.0 is based on the perception or presumption that Industry 4.0 centers less on the first standards of social reasonableness and supportability and more on digitalization and Artificial Intelligence (AI) driven advances for expanding generation proficiency and adaptability. As a result, Industry 5.0 offers a distinctive viewpoint and emphasizes the significance of inquiring

about and developing to help the industry in its long-term benefit to humankind inside planetary boundaries [14].

Industry 4.0 refers to the convergence and application of nine industrial technologies. In Figure 2, nine developments are shown in businesses, particularly manufacturing. Integrating them where they are used independently at present and applying the missing theories permit the industrial unit to be smart, and that is what Industry 4.0 is all about.

Comparative to Industry 4.0, Industry 5.0 will require considerable speculation from government organizations. Notwithstanding the long term of Industry 5.0, its center values – human-centricity, maintainability, and versatility- have become major driving powers for societal advance rather than as a by-product of GDP-driven thriving improvement [15].

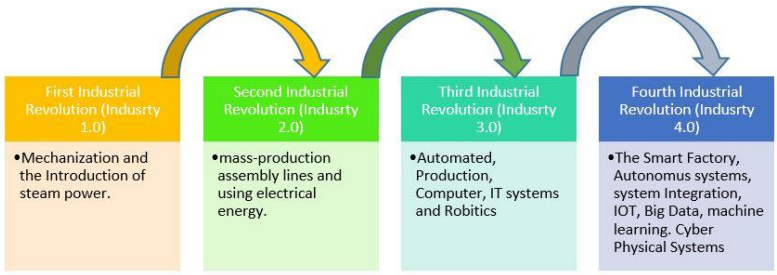

Figure 1: The Four Industrial Revolutions [12]

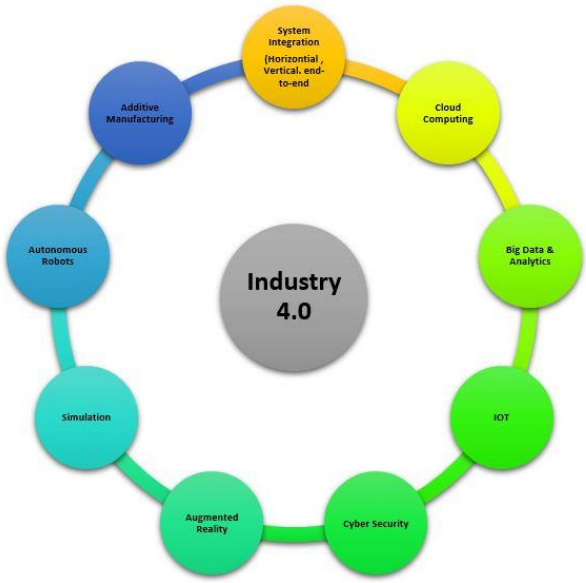

Figure 2: Industry 4.0 refers to the convergence and application of nine industrial technologies

Lean Management

Lean Management or Thinking (LM) is one of the most widely used business approaches in the last three decades. LM thinking is used to separate waste and value within an organization. Waste is defined as "human activity that uses resources but does not create value." On the other hand, the business value is defined as "the features you define in each case, at the right price and time" [9].

Benefits of IT System Integration

Systems integration is critical to the success of a company. In industry 4.0, systems need to be integrated into both dominions, i-e, vertically and horizontally. This research has explained how hybrid system integration helps organizations integrate their ERP systems vertically and horizontally.

It ensures seamless data connectivity and lowers the pronunciation of blunders, enhancing the organization's internal workflow and company's market prospects. Integrating all of the systems in both ways, i-e, hybrid integration of systems into one, helps and reorganization to achieve the following benefits:

Real-time & Online Visibility

When the performance reports across the sales, finance and service departments are not unified, it sometimes takes time to get this information manually, which may not yet be accurate. Over time, some organizations stop aggregating and analyzing their data to focus on other tasks that do not take much time while harming their business. Continuous data connectivity ensures that all staff are up-to-date and base their findings on correct data, which can be accessed anywhere. SI limits hazards and empowers you to settle on basic choices dependent on precise data [3].

Increased Productivity

The utmost main benefit of system integration is that it dramatically improves the company's productivity. Working with different systems and programs can be time-consuming, and employees need to focus on repetitive manual work rather than on-hand projects.

Every minor blunder you make when entering information into different programs can cause serious difficulties. Every time you add a new component, you are more likely to get such an error.

Better Data Management and Analysis

An enormous number of projects make it hard to analyze the method in which an organization works. Performing diverse breakdowns for each program isn't just tedious; it is regularly futile.

It is impossible to investigate this analysis; you need to sort out some ways to get the master plan. With several programs running autonomously, it is nearly impractical. The absence of appropriate analysis can put you behind the competition and lead to excessive expenses.

With SI, you can understand how your business is doing and make well-founded decisions about its future development.

Real-Time Accuracy

Organizations generally observe if the trade performs as per the organization plan based on monthly, quarterly, or annual reports. On the other hand, if the finance, sales, service, and inventory data come from different modules, it will take several days to synchronize the data sets and analyze them in the approved manner, raising errors. With SI, once data is rationalized, it is up-to-date throughout the boards. Continuous updates will keep the organization and its workers in the same boat, and the organization will identify accurately what they need to do afterward. Furthermore, this data is available anytime and from every place, which removes the waste of time if you need definite bits of data immediately [2].

Efficiency

SI guarantees staff productivity. Computerized features like billing and financial consolidation leave opportunities for other valuable activities that will help your business grow. Employees can finally focus on what they should do instead of swimming through a stack of scattered data. Greater job gratification and fewer constraints also guarantee the factual evolution of the organization. This will lead the organization to work with fewer human resources, as most of the labor-intensive jobs will be finished perfectly by the system

itself [2].

Boost in Sales

SI can increase sales by a substantial volume. For example, running an online system requires focusing continuous attention on the data to discover what the customer requires. It also needs a proper inventory checklist to keep track of all orders. If you don't have an integrated system, it's possible somebody will make a fake transaction, and it will transform into a chain response of blunders. In lieu, with an integrated system, staff will be able to provide excellent service to customers. A smooth, real-time data flow guarantees that all queries are handled [2].

Data Collection

Assembling and storing key data is an additional benefit of an integrated system that saves storage space by integrating data and analyzing it to adapt the organization to growth. Any changes in the data stream are automatically saved to the central server, eliminating the possibility of data overlap.

Cost Reduction

Organizations can cut their business costs by a substantial margin if they consider an integrated system. Better working hours and less requirement for employment will spare you a ton of cash over the long run. Automation of needless work and enlarged profit can also be considered a reduction. Integrated systems are a must to survive in the competitive business world. It lets organizations learn more about staff and their business and helps them make the right decision at the right time.

System Integration Methods of Industry 4.0

In this section, system integration methods of industry 4.0 are discussed in detail. In Industry 4.0, the system can be integrated horizontally, vertically, or by end-to-end engineering integrations. Three possible industry 4.0 integration methods are discussed; these are listed below.

I. Horizontal Integration
II. Vertical Integration
III. End-to-End Engineering Integration [4]

Horizontal Integration

Horizontal integration integrates value networks that enable collaboration between companies or organizations within the value chain [5]. For the achievement of the business, more than one association coordinates to convey unrivaled items and services [6]. A novel effective digitized ecosystem is developed with horizontal inter-cooperation integration of organizations through digitization [4], [7].

Vertical Integration

Vertical integration integrates several hierarchical subsystems within the organization to construct a flexible and reconfigurable production system. Several information subsystems within the organization are linked to the ERP system. This will allow a flexible and reconfigurable production system [4], [7]. With vertical integration, smart machines in your organization are autonomously designed to adapt to various products. Big data management can make this process a success [8].

End-to-End Engineering Integration

The end-to-end engineering integration results in integration that allows for the creation of specialized products and services in the value chain [8].

Hybrid Integration Model in Industry 4.0 for Lean Management (HIM)

This section will discuss our proposed Hybrid Integration Model in Industry 4.0 for Lean Management (HIM). Our proposed HIM model is shown in Figure 3. In this model, we worked on an airline travel organization in which the organization has implemented its in-house ERP system [10] and procured a third-party General ledger (GL) system.

This ERP system is named AASoutions [10]; this ERP has an inbound/outbound

integration feature. As shown in Figure 3, ERP system data is vertically moved into GL; thus, integrating ERP with GL vertical Industrial 4.0 integration method has been proposed and implemented in AASolutions [10] ERP system developed for travel, trade, and tourism organization. In addition to that, ERP is also horizontally integrated with GDS, SMS, and Emails.

In Vertical Integration Model, the ERP system is integrated with 3rd Party systems through APIs using SOAP / REST / XM-based web services to provide the following key real-time self-service features to customers and stakeholders.

I. Air Ticket Online Search.
II. Air Ticket Online Booking.
III. Air Ticket Online Ticket Issuance.
IV. Air Ticket Online Booking Cancellation.
V. Air Ticket Online Ticket Cancellation.
VI. Online Payment Features.
VII. Auto Email on every customer self-service activity.
VIII. Auto SMS on every customer self-service activity.
IX. Auto data integration from ERP system to GL system.
X. Real-time information is available to all stakeholders.

In this integration model, the ERP system is firstly integrated (IB) with GDSs, Email integrator Gateway, SMS Integrator Gateway, and Bank Integrator Gateway through API's such as SOAP/REST/XML web services for revenue module real-time self-service activities by customers. The ERP Application is integrated (OB) with the GL system through API's such as SOAP/REST/XML web services automatic routines.

As shown in Figure 3, In Horizontal Integration Model, the ERP system is integrated with the following GDSs [10] and other 3rd Party Gateways through API's for real-time self-service services from the following ticketing consolidators, Banking, and other misc. Services.

I. Galileo [10].
II. Sabre [10].
III. Amadeus [10].
IV. Bank Payment Integrator Gateway.
V. SMS Gateway.
VI. Email Gateway.

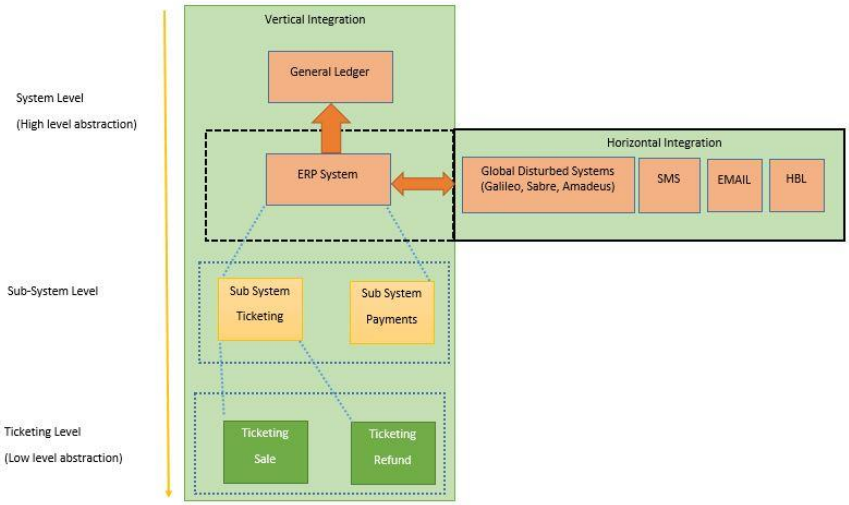

Figure 3: Hybrid Integration Model in Industry 4.0 for Lean Management (HIM)

This research has proposed a hybrid integration model for lean management of ERP systems. For a case study, this model has been implemented on AASolutions [10] and shown in Figure 3. The vertical layer of AASolutions of ERP system is vertically integrated with third-party GL, travel, trade, and tourism ERP modules developed in AASoultions [10]. On the horizontal layer, this system is integrated with all available GDS for online ticketing features, SMS, and EMAIL module to send SMS and EMAIL to users of all key activities performed on this ERP system. HBL payment gateway is integrated with AASolutions[10] ERP system to get payment from users online.

Implementation of HIM model

This section will discuss the implementation and technical model of our proposed HIM. HIM implementation model is shown in Figure 4. In Figure 5, the technical model of HIM is shown. The detail of the HIM technical model.

Figure 4: Hybrid Integration Model in Industry 4.0 for Lean Management (HIM) Implementation Model

Vertical Integration from ERP to GL

In this type of integration, data moved from GDS to GL is routed through the following automated process flow. No human intervention is involved, and the business process followed industry 4.0 through lean management and achieved the required results.

I. Suppliers make available tickets on GDSs for Sale / Booking.
II. Any Agent / Customer can get an online book/purchase ticket from a live web portal.
III. On Successful Booking of the ticket, the data automatically moves GDS to the ERP revenue module through API's.
IV. According to the company chart of accounts requirements, approved transactions moved automatically from ERP to GL based on data consolidation rules and system mappings.
V. All stakeholders can view reports from GL as per their requirements.

In Figure 5, suppliers post tickets on GDSs for booking by their authorized partners. Each of the GDSs exposed API's through web services of all ticketing-related self-services (Lists already mentioned above). Each authorized partner needs to consume API's exposed by GDS for online ticketing facilities. We followed the same procedure and consumed API's through web services provided by GDSs for online ticketing in the ERP system.

In addition to that, we also consumed API's through web services from our other service providers for following online facilities to comply with industry 4.0 using lean management.

I. Online Banking Payment.
II. Auto SMS.
III. Auto Email.

Furthermore, ERP data moved from the ERP system to GL by following automated integration routines through web services.

I. We developed an integration routine that auto-picked the new approved data from the ERP system and moved it into the Bridge database per company requirements, ensuring system mappings and applying discrepancies rules.

II. Data will automatically move from the bridge database to GL by using API's through web services.

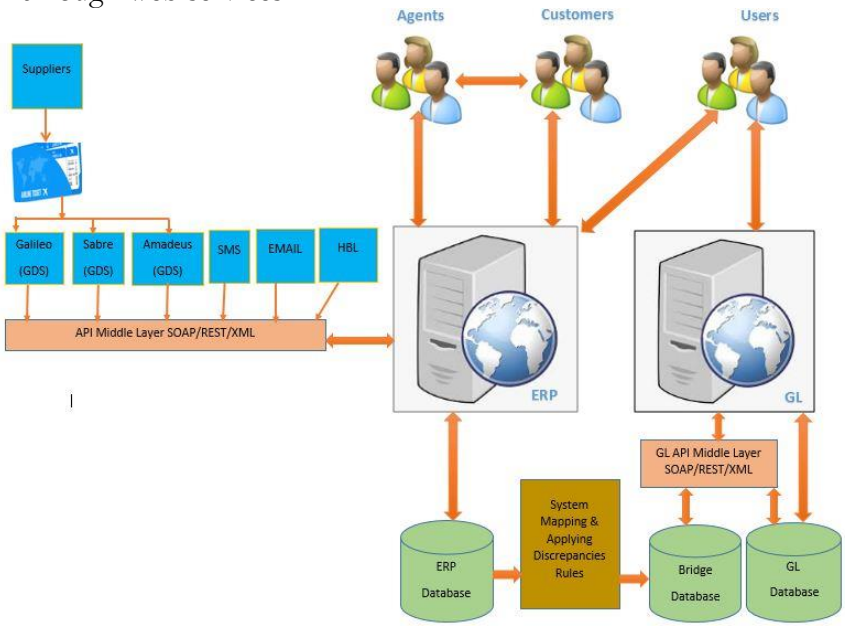

Figure 5: Hybrid Integration Model in Industry 4.0 for Lean Management (HIM) Technical Model

Horizontal Integration between ERP, GDS, SMS, and EMAIL

In this type of integration, data is moved between ERP and GDS through an automated process flow, where no human intervention is involved. The business followed industry 4.0 through lean management and achieved the required results.

There are 3 significant Tickets in GDS (Galileo, Amadeus Sabre), ERP system is integrated with all 3 GDS systems to facilitate online Ticket Booking Purchases facilitates. In addition, the ERP system generated SMS &Emails of each activity to all authorized stakeholders to ensure compliance with company requirements. Table 1 contains a list of API's of all GDSs.

Table 1: API Details Implemented in Horizontal Integration Model

Features / Vendors	GALILEO	SABRE	AMADEUS	HBL	GMAIL	EOCEAN
SEARCH FLIGHT	LOW FARE SEARCH	BARGAIN FINDER MAX	MASTER PRICER TRAVEL BOARD	N/A	SEND EMAIL	SEND SMS
BOOK FLIGHT	AIR BOOK	ENHANCED AIR BOOK	PNR ADD MULTI ELEMENTS	N/A	SEND EMAIL	SEND SMS
TKT ISSUANCE	AIR TICKET	ISSUE TK	DOCS ISSUANCE TKT	N/A	SEND EMAI	SEND SMS

					L	
CANCEL PNR	AIR CANCEL	CANCEL PNR	PNR*CANCELLDOCUMENT*	N/A	SEND EMAIL	SEND SMS
PAYMENT	N/A	N/A	N/A	ONLINE PAYMENT	SEND EMAIL	SEND SMS

Results

In this section, the HIM evaluation is presented. Analysis was conducted by evaluating the relationship between the HIM and the old legacy system of the selected organization. The following illustration is given of each evaluation factor.

Real-time / Online Integration

Customer / Agent Walk-In for Ticket Operations in Old Legacy System

In Old legacy, a real-time integration concept was available. The company was using an old version desktop-based application for Air ticketing operations with the following key activities where customer/agent has to visit branches for Air Ticket Operations.

I. Customer Registration for Air Ticket Operations Facilities by Agents. agent-customer
II. Customer Ticket Issue by Agent / Branches.
III. Customer Ticket Cash Payment by Agent / Branches.
IV. Customer Ticket Cancellation by Agent / Branches.
V. Customer Ticket reschedules by Agent / Branches.
VI. Customer Ticket Refund by Agent / Branches.

Real-time / Online HIM Feature

In the old legacy, there was no API implemented. Customers were using desktop applications for managing ticketing operations. It took Up-to 14 days to finalize the fortnight analysis and its payment. In contrast, after the implementation of HIM, all Ticketing operations were managed in real-time, and fortnight data analysis is readily available for all stakeholders for review and decision making on a timely basis. In addition to that, after implementing HIM, customers/agents don't need to go to branches for any operation.

Online Customers/Agents Registration for Air Ticket Operations by using an online portal without the need for any human intervention.

I. Customer/Agents Ticket Issue through an online portal integrated with GDSs.
II. Customer/Agents Ticket Online Payment via an online portal horizontally integrated with banks.
III. Customer/Agents Ticket Cancellation through an online portal integrated with GDSs.
IV. Customer/Agents Ticket reschedule through an online portal integrated with GDSs.
V. Customer/ Agents Ticket Refund through an online portal integrated with GDSs.

Manual Air Ticket Operations by Central Processing Unit (CPU) in Old Legacy System

In the old legacy, humans carried out all air ticketing operations, i-e, Ticket Booking, Issue, Ticket details posting, Ticket Void, Ticket Cancel, etc. It took too many resources and time to perform their routine workload. But whenever any unforeseen sale came, it became cumbersome to manage it despite having too many very expensive resources that led to customer services degradation and customer services degradation and quality of output of the resources that resulted in financial loss caused loss of additional sale opportunities.

Online Air Ticket Operation in HIM

By Implementing HIM, organizations will be able to cut –down their human resources expenses. In the old legacy system, there was 40-50 person required to perform routine ticket issuance tasks, but after the integrated online system, only 5-10 resources will be needed to monitor the execution of automated processes. Thus, it reduces 80% human resource cost as well.

Productivity

Lack of Productivity in Old Legacy System

It includes the following items.

I. In Old legacy, Up-to 50 persons are required to issue tickets, post tickets, monitor the system performances, extract reports, perform vintage analysis for market strategies, and submit erroneous data for fortnight payments by using too much time.
II. Often several customers remained unable to get their tickets due to the expired ticket limit caused by the delay of manual working by users.
III. Manual / Separate Marketing for new Product / Service offering to customers/agents.
IV. Wrong discount/commission posted by users (human errors/omission) due to manual punching resulted in bad impacts on customers and lost customer trust.
V. Routinely, many phone calls by customers to the customer support center for updates on their Ticketing status and delays due to human manual workings.
VI. No priority for critical / urgent ticketing request (Tickets with a short time limit, i-e, Tickets needs to be issued within 15 minutes) operations that result in a large number of ticket loss that causes financial loss to the company.

HIM - Increase Productivity

In HIM online integration features, no ticket expiresby the time limit because no human intervention is involved. Customer/agents search, book, and issue their required tickets at any time without any dependency on the company.

There is no need for manual/separate marketing for new Product / Service offering to customers/agents in HIM, as everything is available online. The SMS and EMAIL integration feature receive all offers to the desired audience via SMS and EMAILS.

In HIM, there is no more wrong discount/commission posted by s users (human errors/omission) as this system provides an online discount /commission feature in HIM. Customers can view available discounts on the fly within the portal rather than call/ visit branches.

In addition to that, no more phone calls/support section is required for ticket status inquiries as HIM provides an online view over the portal integrated with GDS, and all information is timely delivered on registered mobile numbers and emails. Thus, human resources are also deducted from this section as well.

Data Management & Fortnight Analysis

Manual Data Management and Fortnight Analysis in Old Legacy System

All key data management analysis items were done manually. It took too much cost, time, and resources to complete it; one important thing is that all items were done in Ms. Excel with no automated BI Warehouse model. It includes the following items.

I. Ticket Posting by CPU Team.
II. Suppliers / Vendors Recon by Finance Team.
III. Airline Recon by Finance Team.
IV. Discount / PSF / Commission Verification by Sale Team.
V. Customer Payable / Receivable Verification by Sale Finance Team.
VI. Bank Recon by Finance Team.

Real-time/Online Date Management and Fortnight Analysis in HIM

All key data management analysis items are online and in real-time, integrated with GL.

It reduces cost, time, and resources cut-down and reduces error-free system-generated reports without the need for human work on manual excel processing. It includes the following items.

I. System generated report of Ticket Posting in the system.
II. System generated report Suppliers / Vendors Recon for Finance Team.
III. System generated report Airline Recon for Finance Team.
I. There is no need to validate Discount / PSF / Commission by Sale Team, as it automatically applies as per the system's configuration.
II. Customer Payable / Receivable system generated report.
III. Bank Recon system generated reports.

A summary of the results is also shown in Table 2. In Figure 6 comparison of b/w old legacy system and HIM is shown.

Table 2: Comparison between Old Legacy and HIM

Key Factors	**Old Legacy**	**HIM Model**
Real-time / Online Visibility	0%	100%
Productivity	2000 Tickets / Per Day with 40-50 Human Resources. Exact productivity is difficult to measure promptly by rectification errors/rectification due to manual working & reconciliation.	3000 Tickets / Per Day with 5-10 Human Resources 20% Increase in Sale with 80% reduction cost of human resources.
Real-Time Data Management & Analysis	No - 0%	Yes- 100%
Accuracy	80-85% * 15-20% Human Errors due to manual work	100% (As the system is automated and no human intervention is involved in the generation of system based reports)
Efficiency	60-70% * 30-40% due to not integrated systems and human resources required for data punching	100%
Data Collection	It was delayed (It took up To 14 days to collect data for fortnight analysis and payment).	Timely (real-time available to all stakeholders)
Cost	Very Expansive. At-least 40-50 Human resources to be required to manage 2000 Tickets / Day	Very Cost Effective. Only 5-10 Human resources will be required to monitor the execution of automated processes.

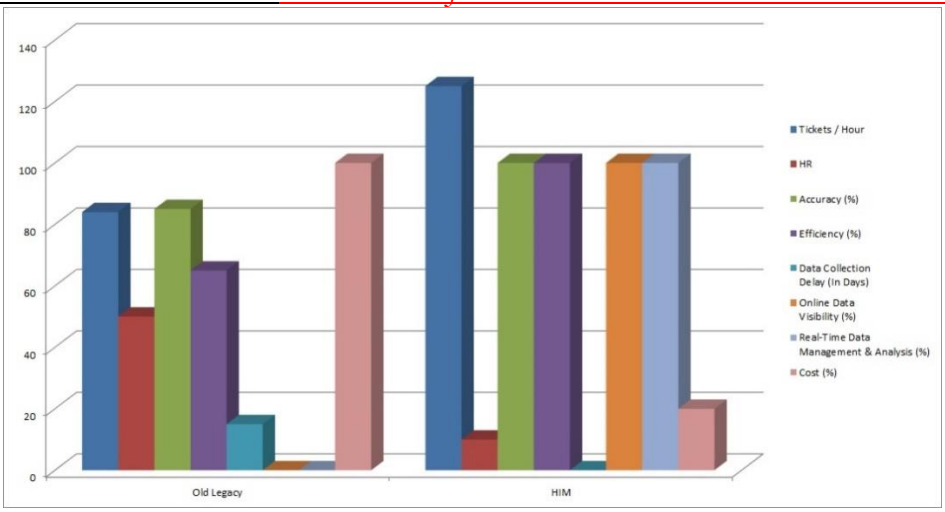

Figure 6: Comparison between Old Legacy and HIM

Conclusion & Future Work

This research has examined the impact and applicability of system integration with industry 4.0 on the travel, trade, and tourism ERP system. This is the core contribution of this research in which the system is integrated into both ways practically.

The Fourth Industrial Revolution has spawned Industry 4.0, which major organizations have applied, and LM is one of the utmost extensively used business approaches in the last three decades. Although LM can contribute to the implementation of Industry 4.0, there is a lack of research suggesting the integration of Industry 4.0 and LM. This study proposes an integrated hybrid model of Industry 4.0 and LM. Vertical and horizontal integration of Industry 4.0 and LM assists organizations during the implementation of Industry 4.0.

This study shows how an ERP system is horizontal and vertically integrated party third-party GDSs and General Ledger systems. After implementing and evaluating the proposed HIM, it is observed that by implementing this hybrid industry 4.0 (HIM) model, organizations can reduce their human resources cost and increase productivity by getting an increment in the sale and MO clientage. Furthermore, he provides a more reliable, accurate, and effective system for the organization to perform its routine task.

As we face the COVID'19 epidemic and many processes need online processing where a physical visit to the office can be avoided, for such an unexpected situation, our proposed HIM model is beneficial for the organization to continue their business from home to avoid human interactions as well. Thus, HIM is an ideal/ best solution to provide business continuity in disasters and epidemics.

References

[1] What is System Integration, and how do you do it? [online] FOLIO3 MICROSOFT DYNAMICS PARTNER Available at: https://dynamics.folio3.com/blog/systemintegration/ [Accessed 10 OCT. 2020].

[2] Advantages of System Integration [online] Fida-E Zaheer Available at: https://www.syncoria.com/blog/advantages-of-system-integration/?cv=1 [Accessed 10 OCT. 2020].

[3] 5 benefits of systems integration [online] Available at: https://headchannel.co.uk/5-benefits-of-system-integration-321 [Accessed 10 OCT. 2020].

[4] Wang, S., Wan, J., Li, D., & Zhang, C. (2016). Implementing smart factory of industrie4.0:
an outlook. International journal of distributed sensor networks, 12(1), 3159805.

[5] Foidl, H., Felderer, M. (2015, November). Research challenges of industry 4.0 for quality

management. In International Conference on Enterprise Resource Planning Systems (pp. 121-137). Springer, Cham.
[6] Sindi, S., & Roe, M. (2017). The evolution of supply chains and logistics. In Strategic supply chain management (pp. 7-25). Palgrave Macmillan, Cham.
[7] Weyer, S., Schmitt, M., Ohmer, M., &Gorecky, D. (2015). Towards Industry 4.0-Standardization as the crucial challenge for highly modular, multi-vendor production systems. Ifac-Papersonline, 48(3), 579-584.
[8] Stock, T., Seliger, G. (2016). Opportunities of sustainable manufacturing in industry 4.0. Procedia Cirp, 40, 536-541.
[9] Sony, M. (2018). Industry 4.0 and lean management: a proposed integration model and research propositions. Production & Manufacturing Research, 6(1), 416-432.
[10] Huma Pervez, Anila Usman; An Innovative B2B ERP Model for Airline Travel Industry; North American Academic Research, 3(9) 127-155, 2020, https://doi.org/10.5281/zenodo.4047195
[11] General ledger definitionMarch 01, 2022 [Online] https://www.accountingtools.com/articles/general-ledger [Accessed 29 Apr. 2022]
[12] Important IT Development l relating to Industry 4.0 in Pakistan [Online] https://cttcnet.typepad.com/cttc_technology_blog/2019/04/important-it-develelopment-in-april-relating-to-industry-40-in-pakistan.html [Accessed 01 May. 2022]
[13] Bousdekis, A., Lepenioti, K., Apostolou, D., &Mentzas, G. (2021). A review of data-driven decision-making methods for industry 4.0 maintenance applications. Electronics, 10(7), 828.
[14] M. Breque, L. De Nul, A. Petridis Industry 5.0: towards a sustainable, human-centric and resilient European industryEuropean Commission, Directorate-General for Research and Innovation, Luxembourg, LU (2021).
[15] Xu, X., Lu, Y., Vogel-Heuser, B., & Wang, L. (2021). Industry 4.0 and Industry 5.0—Inception, conception and perception. Journal of Manufacturing Systems, 61, 530-535.