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Supply Chain Process Improvement for International Airline Industry

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Abstract: In the aviation sector, supply chain management is critical for reducing operating costs. The performance of a corporation is determined by how successfully it implements the supply chain strategy. This research aims to propose the improvement in the field of business process improvement (BPI) and supply chain management (SCM) processes in the international airline industry. Improvisation of efficient SCM has dramatically changed the way organizations conduct business by implementing procedures that can improve process efficiency, reduce costs, and improve the organization's performance. This paper leads to formulating the concept of an effective model of the SCM process for Pakistan Int. Airlines (PIA) taken as an example and obtained results can be implemented on any international airline as well. BPI provides competent strategies for the target organization keeping in view the implementation of the proposed SCM model. Simulation analysis is executed using the ARENA software tool to analyze the performance of the proposed model. T-test has been taken into account to demonstrate the competency of the proposed SCM model. It is observed that the implementation of effective business techniques in the SCM process can lead to enhancing the efficiency of a target organization.

Keywords: Supply chain management process, business process improvement, airline industry, modeling, simulation.

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1. Introduction

In the post-World War II scenario, the importance of improvement in business process was spotlighted. Business workers took on different approaches for the sake of improvement in business processes and time proved that those improvements were very essential to nurture any business. In this regard, the term globalization could play a vital role in enhancing the scopes of multiple industries like textile, communications, automotive, computers, semi-conductors, and airlines. Prior to globalization, national economies were placed apart from one another; however, using the platform of the global economic system (GES), the national economies are conjugating with each other (Hill, 2001). It can be seen in different countries that business moves towards the markets in order to flourish the market share or inclines to move their production units to the countries having the lowest labor cost. For instance, in the airline industry, measurement of execution and service realization are the key factors to gauge the persistent improvement in the overall business process (Nadarajah and Sharifah, 2016). Services and business process improvements in the airline industry are the key elements for the whole procedure improvement(Sidorova & Isik, 2010). In the mentioned scenario, business process improvement (BPI) has achieved the importance of obtaining improved quality at a much lesser cost and time cycle (Reijers, 2021). It is observed that twenty-one century organizations are attempting to maximize the relevant fundamental procedures (Bose and Hattangadi, 2016). It is revealed in the current survey, 45% companies are trying to enhance the connectivity in BPI projects. To substantiate the expansion of information technology, projects including BPI can be taken as the key evidence in this regard (Darma et al., 2021).

Obligations over managers of organizations have been brought on the score of an increasing number of projects having BPI. Hence, prior to project activation, the potential for improvement in the performance should be evaluated (Shannon et al., 2016). In the BPI projects,

improvements in the performance can be measured keeping in view multiple attributes; for instance, quality improvement, cost or time reduction, product enhancement, etc. Performance tracking through these dimensions needs proper methods of management control, which ensure accurate measurement. Quantitative evaluation of the performance of the process is a fundamental entity of the success of the BPI project (Viveros et al., 2018). On the other hand, current businesses have been focusing on BPI on a vast scale (Palma-Mendoza and Neailey, 2015). It is observed that two out of ten reasons for failures in BPI projects are highly associated with the lack of adequate measurements which can be termed as a well-determined measure for performance and absence of monitoring as well (Betty et al., 2017). Precisely evaluated and manageable operational objectives like a decrease in cost or time are demonstrated as essential parameters of achievement. On the other hand, accurate evaluation of these improvements, before their execution, is normally an intriguing task to prove. Another fact complicates the situation additionally is that the supply chain intervenes the BPI processes to the larger extents. Considering several businesses, supply chain has been considered to be a key element for the respective core and supports the overall process (Soni and Rambabu, 2017, Pradabwong et al., 2017).

Demand and supply planning, strategic planning, procuring, production, storage, order processing, and shipping sectors are the basic components of the supply chain management (SCM) process (Croxton et al., 2001). Currently, service industries like airlines make a substantial contribution to gross domestic productivity (GDP) across both developed and developing economies, ranging from 30.4 percent to 87.2 percent (World Bank, 2015). As a result, it's critical to comprehend how service businesses compete (Schmenner, 1986). Due to the fact that the inherent potential resources that promote customer contentment and commitment (Parasuraman et al., 1991) (Prokesch, 1995) may be achieved using the delivery of better services procedures (Ruggles, 2005), service businesses may contest on basis of process skills (Roth, A. and Jackson, 1995). The performance of any firm is assumed to be improved by a clearer understanding of management processes (Boyer et al., 2012). The efficient supply chain process of any industry can be obtained by taking into account the following key elements: customer demand identification, levels and placement of inventory, and conception of appropriate practices and regulations for the synchronization of supply chain operations (Bardi et al., 1996). The requirement for enhanced supply chain process quality has expanded as logistical operations have been incorporated into the integrated supply chain process (Zakir et al., 2022). Improvement in the attributes of all supply chain activities may lead to a reduction in costs, improvement in the utilization of all resources and overall efficiency enhancement (Beamon and Ware, 1998). In this regard, SCM professional improvise the attempts to ensure the product delivery, cost and quality criterion. Supply chain process is the inter-linkage of multiple activities that is required in transformation, purchasing and delivery of goods to end users through the suppliers, mediators and service providers.

The supply chain is a network that ties together all the departments of the organization in order to keep the work of the organization accurate and up the date. Leaders in every organization are responsible for the management of the supply chain network internally and externally. If planning and strategies are not in favor of the organization then the dream of a successful organization could not be materialized. For instance, airline organizations have to deal with demand and supply, manufacturing and distribution, logistics, inventory, and procurement. By the 1980s, the business environment, the globalization process, and new information management technologies had changed inter-company relationships and increased integrated management of supply chains to maintain competitiveness (Juan et al., 2013). The SCM concept changed the management of organizations and chains of organizations by removing barriers both inside and outside the organizations, and by integrating the management of complete supply chains.

The target industry of this research work is the airline industry and the supply chain management process of the Pakistan international airline (PIA) has been taken into account in this regard and obtained results can be implemented on other international airlines as well. The mentioned airline lacks efficient time consumption in different processes within the airline and the utilization of the company's resources done by the managers is not balanced. In this particular research, the SCM process is totally coordinated with the BPI because they meet the basic factors of business which are time and resources. Commercial simulator ARENA is utilized to design the current and proposed modified supply chain process model of Pakistan airline industry. Proper allocations of resources are identified. T-test analysis is executed to verify the significance of the utilization of resources and time for overall performance enhancement of the target industry.

2. Literature Review

In 1997, two additional categories are included: personal credibility and cultural management. It is important to define the process boundaries or limits so that it becomes easy to identify the goals of process improvement projects. Also, it does not proceed without any aim or intention, creating difficulties in place of achieving the required improvement (Sharp and McDermott, 2001). Sidorova and Isik (2010**)** examined business process research from multiple perspectives. They analyzed the abstracts of more than 2700 articles and after that they emphasized on the importance of BPI in achieving the organizational goals. They recommended that different aspects of BPI should be recognized as such, and should be developed in an integrated manner so that they can yield longer lasting results. Multiple BPI methodologies like simulation are recommended as a very handy method for identification of the different alternative scenarios to improve the business process (Keller, 2004). The approach of simulation is utilized for the modeling of the business processes, resource and also the financial constraints (Heinrich et al., 2017, Martin, 2018). BPI techniques attempt to evaluate the recent business environment and goals set by the relevant organization. In case of failure of current process for not providing required outcomes, it is usually re-engineered or eradicated. The last result of the given process which is being re-evaluated should be the incremented success in that organization (Dodds, 2007).

Considering business processes in any organization, betterment normally renders progress in efficiency and effectiveness (Harrington, 2011). Pourshahid et al. (2009) proposed that progress in efficiency and effectiveness can be elaborated while taking into account the quality, cost

and adaptability. BPI contains certain objectives like delivering the change through adequate process execution (Adesola and Baines, 2005). Attainment of competitive advantage via execution of the appropriate process is an additional aim of BPI in any organization (Shahzad and Zdravkovic, 2009). Results of the Gartner survey, which was carried on 2009 and covered almost 1536 CIOS, estimated the BPI as the top priority approach in the top ten available approaches (Auringer, 2009). This is due to the fact that BPI has acquired much significance before management authorities in the last years. Currently, it is not a pragmatic approach that BPI issues are residing now within the most important and common titles in both the literature and applications (Coskun et al., 2008). Additionally, process improvement has been taken as part of routine life tasks and essential entity of the life cycle of processes (Lee and Chuah, 2016). Prior to discussing the process improvement, it is highly imperative to mention the success tools, factors and performance evaluation elements. In this way, an adequate and proper path can be paved to analyze the critical processes which are supposed to be mended. In this regard following factors are usually taken into account: time, cost, staff, flexibility and satisfaction of customer (Newswire, 2011). Modern businesses are increasingly focusing on BPI; the two reasons of unsuccessful BPI initiatives among top ten reasons are because of absence of proper measurements such as lack of well-defined performance measures and lack of monitoring.

Organizations tend to implement a number of formulas to improve their business processes and "get more bang for their buck". People recognize that it is important to their work; they better know that they should have a better understanding of their processes. They should know the mechanics of each and every interlinked process. They are well aware of the importance of understanding their processes. But most of the time they fail to find the proper tools and methods to study their process performance. Therefore, the team will have to probe into the details to make productive decisions about their process. This is a testimony of those capable people who manage to be successful despite the fact they are not having adequate tools. Everyone needs to instill in their organizations a discipline to become masters of their processes than slaves to them (Gächter and Elka, 2018).

Pakistan International Airlines that is also known as Pakistan International or PIA is the flag carrier of Islamic Republic of Pakistan. In her operations, the scheduled operational services contain 23 domestic stations as well as thirty international flight operations in 23 countries across Europe, Asia, and North America (Abbasi et al., 2018). The main spots of PIA in Pakistan are Lahore, Karachi, and Islamabad/Rawalpindi. The hubs on the secondary level contain Faisalabad, Peshawar, Sialkot, Quetta, and Multan. PIA contains remarkable milestones history in the history of aviation. For instance, PIA was the first airline from Asia which operated the Boeing 737 and jet aircraft. Pakistan International Airlines is the largest airline of Pakistan having an aircraft fleet of about twenty-five airplanes and not less than ten are on order for future. In addition, PIA was the customer launch that enables the Boeing 777-200LR model to operate in the country (Ahmed and Nosheen, 2015).

The aviation industry in Pakistan like is experiencing a host of concerns and barriers, including a shortage of concerned persons and qualified people, sky-high transport costs, increasing competition, poor staff morale, drastic aircraft conditions, uncertainty in flights cancellation, and an absence of adequate technology (Azhar et al., 2018). Pakistan's aviation sector is now experiencing difficulties in both inner and outer aspects of Pakistan and due to the lack of up-to-mark supply chain infrastructure, PIA is still struggling in this sector. PIA is providing flight operations all-round the globe; however, poor logistics and other flaws in the system demand SCM process improvement (Zakir et al., 2016).

In Table 1, the ten-year business performance of PIA has been elaborated. It shows the variation of in gained revenues on annual basis. The variations in the revenue were due to the fact that different governments ruled in that era brought different policies. The numbers of employees working in the PIA and the number of aircraft were also changing with the passage of time which causes variations. Every year this organization is taking huge loans from the government to run this white elephant business, but no pragmatic approach or step has been taken into account to meliorate the business policy. That is the reason, the new management team of PIA with the consent of the government, introduced a voluntary separation scheme (VSS) for its employees; consequently, aims to decrease the number of employees to 10,500 staff members.

Table 1. PIA business in last decade

Year	Revenues (PKR mn)	Profit/Loss (PKR mn)	Employees (Ave.)
2020	94,989	34,643	14,500
2019	147,500	52,602	11,000
2018	65,723	48,000	13,000
2017	90,844	44,110	13,000
2016	88,997	45,381	14,000
2015	104,515	34,995	15,000
2014	113,780	34,006	16,000
2013	95,771	44,322	16,604
2012	97,438	33,844	17,439
2011	116,551	26,767	18,014
2010	107,532	20,785	18,019

Fig. 1 describes the comparison between the number of employees and aircraft having a time period of 2016 to 2021. PIA had more than 14500 staff members all over the world to complete its supply chain process in 2020 having only 27 aircraft. In 2016, 37 aircraft were in the airline fleet because many aircraft were taken on long leases from different countries. These aircraft are on wet and dry lease and PIA paid a large amount for that lease program. These leased aircraft are also burdened on the airline's supply chain process and 14000 employees are quite a large number for any organization which is facing loss every

year. In spite of having huge manpower, flaws in the supply chain process of the airline were leading to a huge loss annually as well (Ahmad, 2016).

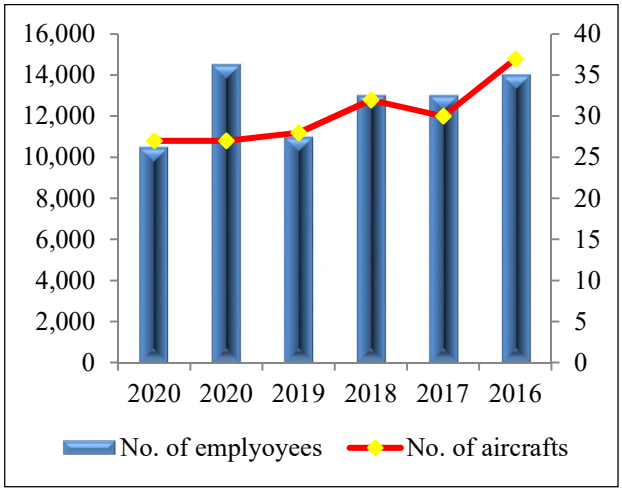

Fig. 1. Comparison between the number of employees and aircraft of PIA from 2016-2020

3. Research methodology

A research question was developed based on the identification of a research problem consisting of the requirement to re-design business processes in the airline industry, that is: *how to improvise and design the efficient supply chain management process to enhance business process improvement* (Palma-Mendoza et al., 2014). To discover a technique for doing business process redesign (BPR) to assist the SCM process, a literature search and review was conducted (Palma-Mendoza and Neailey, 2015). As a result, the concept of mixing diverse approaches to achieve a superior outcome is appealing. It is vital to break diverse techniques into removable pieces when connecting them. Therefore, systematic step-by-step approaches were adopted to redesign SCM process of airline industry: (a)data collection via questionnaire distribution, (a)simulation execution using ARENA software tool and (a)T-test analysis for results validation. Fig. 2 describes the relevant research methodology and concerned approaches that were adopted to conduct this research.

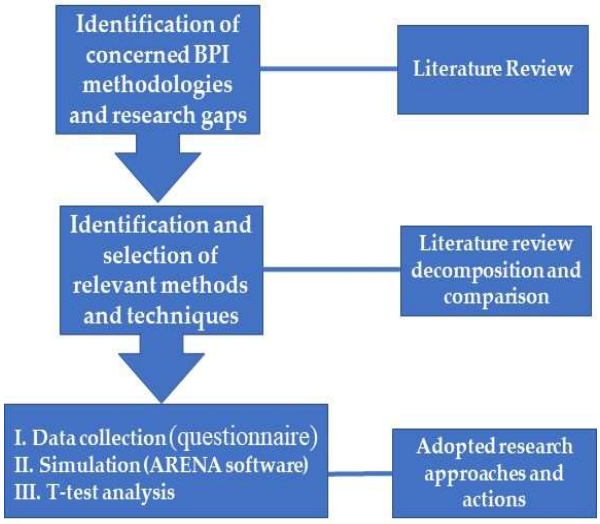

Fig. 2. Research methodology and relevant approaches

3.1 SCM Process Re-Design Methodology: Methods and Approaches

The proposed model of a supply chain can be implemented on international airlines having an average load of passengers per anum. The research results of this paper can be applied to international airlines in lower middle-income countries as defined by the World Bank. The average number of passengers in these countries in 2019 was 6.56 million, based on 27 nations (Global-Economy, 2022). The very reason for selecting PIA for this research is that PIA managed 06 to 08 million passengers per year over the time period of 2010 to 2019. Fig. 3 explains the number of passengers traveling via some lower middle-income countries in the time span of 2010-2019 including Pakistan as well.

Demand is the most important segment of every business and the proposed model is more organized than the current model. In the current model, as described in Fig. 4, there are many laps in the system but the suggested model will help to overcome these lapses. In this regard, discussions, related to SCM process problems, with the managers of different departments of PIA were done, and keeping in view their comments an efficient and effective SCM process model has been proposed which is described in Fig. 5. When the demand arrives from the management, then there should be the proper record about the Demand. Demand quotation should be done carefully. After the demand quotation, there should be a check whether the quotation is ok or not? Market research should be done carefully after that quotation should send to the market.

An organisation should wait for the manufacturer's response and there should be a price and quality check. After satisfying the price and quality purchasing process comes. Transportation, receiving of goods and damage checks come in the next step. Inventory of goods stars and inventory department is responsible for the size, delay, and release of the purchased items according to their feasibility. Before the final customer (department) installation there should be done and the department (customer) has the authority to reject the item. If a customer is satisfied then demand departure comes before the feedback.

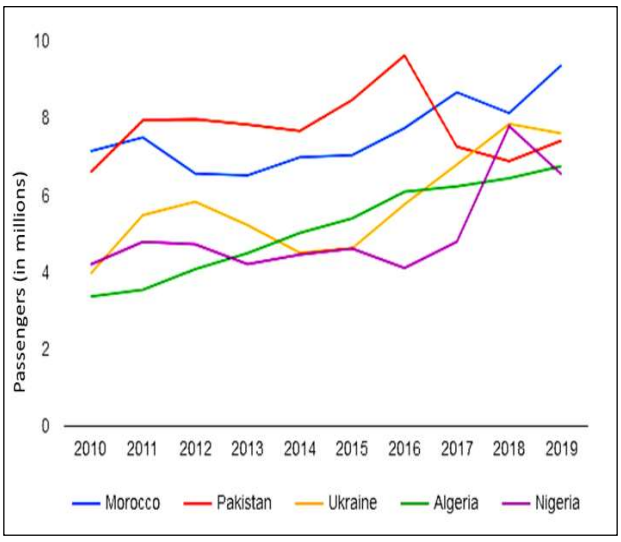

Fig. 3. Airline passengers by locally owned airlines of lower middle-income countries

4. Simulations and Results

Over the last few years, business process simulation tools have been well-integrated and advanced with the accomplishment of major business goals (Fu et al., 2016). Additional information is provided by the simulation to check the details of a business process. Various multinational organizations adopt simulations to enhance their business process and business tools (Ivanov, 2017). There are three levels of the simulations

i. Level 1 is used for the primary analysis

ii. Level 2 is used for the middle line managers

iii. Level 3 is used by the executives

Simulation is taken as the imitation of complex and real processes. It is used in various contexts like modeling; performance optimization. Simulation demands the model to be developed with the key characteristics or functions of the process (Siderska, 2016). The simulation depicts the system's functioning throughout time. ARENA is one of the most innovative pieces of software in recent memory. It not only aids in the creation of a new model but also provides the most accurate analysis of a complicated process. (Abduaziza et al., 2015). ARENA is a simulation software tool that offers an interconnected platform to create models of simulation keeping in view a huge range of applications. ARENA software may be used in integration with Microsoft products. Visual basic for applications is included, allowing simulation designs to be mechanized additionally if specific approaches are required. It analyses the performance of the system using important indicators including expenses, throughput, times of cycle, equipment, technology usage, and availability of multiple resources (Rockwell Automation, 2020). Taking into account the null hypothesis, a t-test is a quantitative measure that follows the t-distribution of students. A t-test is a dataset that includes observing the substantial differentiation between the multiple dataset's mean values that are connected in some way.

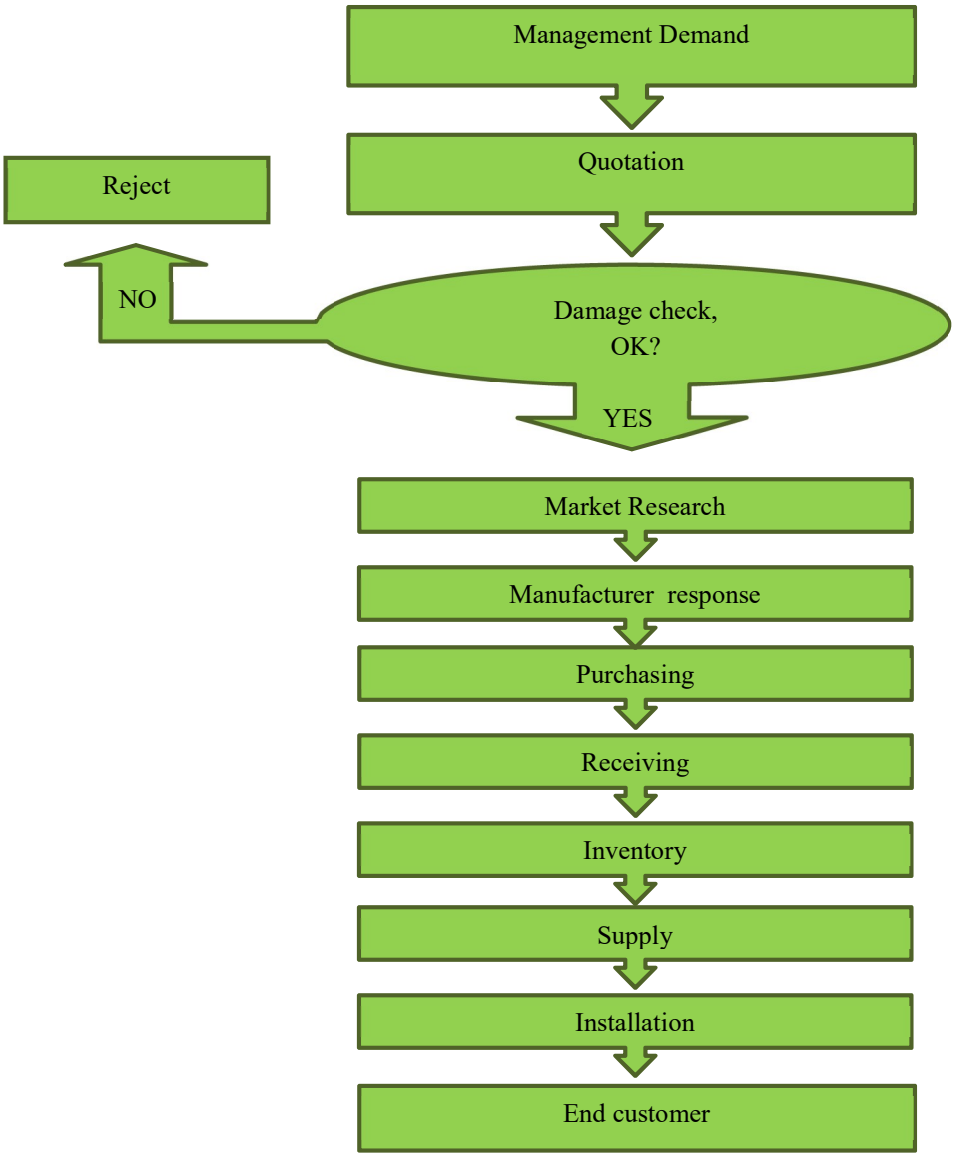

Fig. 4. Current supply chain management process system model of PIA

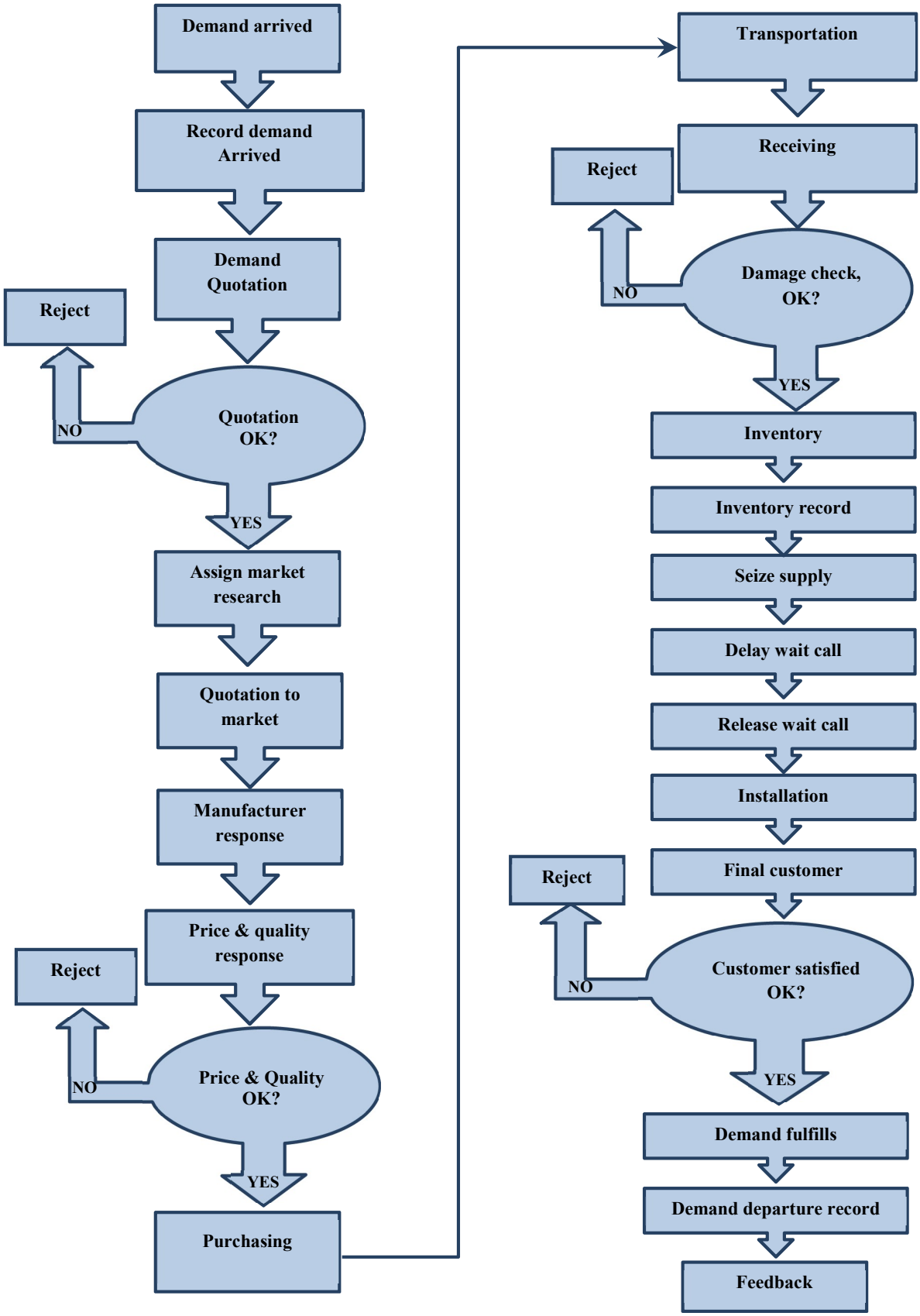

Fig. 5. Proposed model of supply chain management process of PIA

Table 2 demonstrates the allocations of the resources of the proposed SCM model that is obtained through the execution of ARENA; while Table 3 describes the accumulated time for the supply chain process for the proposed model. The proposed module in very first step initiates the create module (demand arrive), the record module appears which is used to record the demand arrive. in that way, another decide module named as demand quotation is created to check and send feedback on rejection while the resource module is assigned for further

proceedings. When the finance director declines the quotation, it is discarded and included into the statistics history. If the quotations decision is favorable, market research will be allocated. The procedure is meant to enter the demand quotation into the market, and a resource has been assigned to it. In this procedure, the manufacturer's reaction is anticipated, and resources are allotted to the logistics general manager. A new process module is built to assess the demand's pricing and quality. The logistics senior manager receives resources from this process module. The decision is then made based on the demand's pricing and quality. The procedure continues if the price and quality are acceptable. If the price and quality are unacceptable and do not meet the requirements, it is discarded. The purchase procedure begins once the price and quality have been agreed upon. This scenario depicts the start of the transportation procedure following the purchase of products. during this procedure, the source is passed to the inventory manager and in the inventory, the receiving process module is turned on. The products will be delivered to the inventory manager. The decided module will run to see if there is any impairment. If there is no harm, the next step is to take action. After the refusal, the items will be discarded. When the damage check decision is acceptable, this process will begin. During the Inventory process, all approved goods will be saved. The senior manager of inventory receives these resources. All records will be listed in the inventory record module in the following step. The information will be sent to the Seize supply module. The Seize module instructs the shop manager to seize the stock until further action. Following an assessment of the supply store's conditions, the store's general manager places them on hold. Following a management delay, the shop manager ultimately releases the stock for further processing. Supply will complete the installation procedure in accordance with the department's criteria. The resource will be assigned to the senior manager in all departments. The installation's records are stored in the record module.

Table 2. Management resource allocation (extracted from ARENA simulation results)

Instantaneous utilization	Avg	Half width	Min avg	Max avg	Min value	Max value
Finance director	0.5970	0.00	0.5361	0.6532	0.00	1.00
Finance general manager	0.2585	0.01	0.1811	0.3279	0.00	1.00
Inventory manager	0.5057	0.01	0.3339	0.6433	0.00	1.00
Logistic general manager	0.2305	0.01	0.1443	0.3213	0.00	1.00
Logistic senior manager	0.3293	0.01	0.2506	0.4031	0.00	1.00
Operation manager	0.1131	0.01	0.0444	0.1798	0.00	1.00
Senior manager	0.2531	0.01	0.1222	0.3389	0.00	1.00
Store manager	0.0050	0.00	0.0023	0.0070	0.00	1.00

This is the end record of the installation and the demand is completed here. In the final stage, the end customer (departments) is inquired about their satisfaction level for desired completion of the demand. If the departments/customers are not satisfied then they will decide to dispose of the demand. At this stage, there will be a true decision about the demand, whether it can fulfill the requirements or not? Rejected items will be disposed-off after the decision. Departments are satisfied after fulfilling their requirements by rejecting undesired items. The record will be updated about the satisfaction level of the final customer/departments. Once the final decision is made and a customer got satisfied with the whole process and products, the Feedback module will be activated. By having the final feedback in disposing module from the customer/department the process will get terminated.

Table 3. Accumulated time for supply chain process

	Avg	Half width	Min. avg	Max. avg
Demand quotation	298.49	2.49	268.04	326.58
Demand quotation to market	129.23	3.01	90.55	163.93
Demand satisfaction	56.51	3.1	22.23	89.91
Final customer satisfied	76.45	2.23	37.17	116.59
Installation	151.12	5.65	70.1	211.65
Inventory	126.52	4.7	67.11	169.47
Manufacturer response	215.06	4.28	157.88	253.08
Price & quality analysis	164.66	3.3	125.29	201.57
Purchasing	115.12	3.45	72.16	160.66
Receiving	126.28	3.24	81.59	165.74
Transportation	126.46	3.65	77.13	173.79

Statistics are useful in determining if the results collected are correct or not. The usual test for proving the outcomes of experimental studies is the T-test (Ruxton, 2006). The difference between the two sets of data is represented by the T-test (Jörn-Henrik and Hoenig, 2011)(Markham and Roy, 2001). To summarize, if the P-value in the T-test is less than.05, the data is robust enough to implement. The relevance of resource and time utilization is demonstrated by the T-test findings. T-tests have been done on a Microsoft® excel sheet on the results of the simulation resources and time. It is obvious from the results that the p-value is $0.0000374<0.05$. T-test verifies that the results are effective and implementable.

5. Conclusion

Implementation of an effective model of supply chain management process in any organization aids the respective managers of different departments for improvisation of profitable business process improvement strategies. To substantiate this theory to every airline industry, an example of the efficient SCM model of Pakistan International Airlines was proposed in this research paper. Simulation results showed that the utilization of resources is distributed equally by the finance director and the mean usage of the resources is about 59% which depicts the equal distribution of the resources. Keeping in view current research in ARENA of management sciences, BPI has gained vital significance for the proper operation of any organization. In this

research paper, SCM has been aligned with the BPI of the airline industry as they coordinated the key business factors which were resources and time. Proper utilization of factors like time and resources leads to a successful business for any organization. It is obvious that SCM plays a critical role in the decision making, strategy formulating, and planning during the process. This study will help the managers to develop more effective and efficient processes in the airline industry in order to achieve the organizational fiscal objectives as the results of the T-test have proven the competency of the proposed SCM model. This paper also reveals the removal of some undesired processes from the organization. If proper resource allocation is followed through, it can reduce the workload from the employee as well as the time consumption. On the other hand, this approach will lead to a decrease the business losses and an increase the overall efficiency. The imposition of the proposed SCM process model has major limitations as it is relatively costly to implement. It necessitates a significant investment of finances, adequate time allocation, and availability of other resources, which a struggling aviation industry like PIA can not afford easily.

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