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Impact of SIZs in Optimizing Procurement and Supplier Coordination at Heavy Industries Taxila

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We dedicate this work to our parents, the silent guardians of our dreams. Your unwavering faith in us transformed doubt into courage and your prayers carried us farther than we ever imagined. This work is as much yours as it is ours.

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endeavor possible. The successful completion of this project is a collective achievement, made possible by the support, knowledge, and kindness of all these individuals.

ABSTRACT

The current research project is a study about the role of Smart Industrial Zone (SIZ) technologies in streamlining the procurement and supplier coordination processes of Heavy Industries Taxila (HIT), which is a strategic defense manufacturing organization in Pakistan. The research study is able to determine that the current procurement system of HIT is inefficient and heavily depends on paper-based workflow and ineffective communication environments. Such inefficiencies translate into long lead time (125 days on average), documentation errors (15 percent), reactive supplier management and huge undocumented operational costs.

In a mixed-method study, the study was able to gather primary data using structured questionnaires, semi-structured interviews and direct observations among key departmental employees. The analysis of the secondary data in the procurement records and performance reports was conducted to quantify the gaps in operations. The results indicate that there is an urgent demand to digitize the company to overcome challenges of delayed approvals, absence of real-time visibility, and uncoordinated supplier interaction

The four elements of the proposal include the introduction of a combined SIZ framework, including the use of Enterprise Resource Planning (ERP) systems, IoT-based tracking, and data analytics dashboards. Such technologies may bring about a reduction in lead time of procurement by about 42 percent, reduce document errors by 80 percent and create estimated cost savings of PKR 2.28 million annually through enhanced efficiency and more effective resource distribution, according to simulation models.

Moreover, the study also illuminates the strategic advantages, such as improved management of supplier relations, greater agility of the organization, improved compliance, and assists in achieving the national security goals by providing better-trusted defense production. Although the study realizes that it is practically constrained by resource limitations and organizational resistance to change, it still concludes that implementing SIZ technologies is the only way to make HIT modernize its operations

and gain sustainable competitive edge as well as align with global Industry 4.0 standards.

Contents

CHAPTER ONE: INTRODUCTION

1.1 Introduction:

The ongoing and furious most innovation of the technologies of Industry 4.0, has literally altered the way the industrial operations that were supposed to happen to be the other way have been shredded and traced across the planet. Traditional industrial areas that used to be characterized by (isolated) production sites, manual coordination, and low information exchange are becoming more of a Smart Industrial Zone (SIZs). These sectors are digitally connected industrial ecosystems with the physical infrastructure and operations processes underway being integrated as are the supply chain activities using the advanced technologies of the internet of things (IoT), Enterprise resource planning (ERP) systems, cloud computing, artificial intelligence and data analytics. The main objectives of this change are that it should facilitate real-time sharing of data, transparency, operational efficiency, and make healthy decisions in every activity within the industry.

In developing economies such as Pakistan, the principles of Smart Industrial Zone concepts have been increasingly becoming significant so as to enhance the industrial competitiveness, productivity and sustainability. The industrial organizations are increasingly being pressured to make use of their resources to the limit, minimize the cost of operations and act quick to meet the ever evolving market and security demands. This pressure is particularly relevant in those strategic sectors as defence manufacturing and heavy engineering where delays, inefficiencies or coordination will have severe operational and national consequences. It is therefore no longer a choice to digitise

industrial operations but it has become a necessity to make industrial operations effective and competitive in the present world.

One of the largest and most critical defence manufacturing organisation of Pakistani is Heavy industries Taxila (HIT), which is taking lead in the manufacture, assembly, maintenance and overhaul of both military and heavy engineering equipment. HIT involves a complex and sizeable number of suppliers, vendors, and contractors in their organization who facilitate the massive procurement and production processes. This organization provides availability of raw material, spare parts and special component to satisfy in-time schedules and quality demands of the production. Efficient procurement and synchronization of suppliers are therefore significant towards the continuity of the operation and defense obligations fulfilled without delay. This is because despite its role on planning and operational success, HIT is yet to surmount major obstacles in the procurement and orchestrate suppliers activities. Numerous of those problems are explained by the fact that the reliance on conventional or semi-digital practices is still present, information systems are disconnected and lack real time visibility throughout the procurement process. Manual documentation, delayed approvals and disconnect data platforms are mostly the cause of inefficiencies, communication gap and slow decision making. Such problems do not just affect the procurement performance, but also affect production planning and inventory management and the responsive supply chain in a multiplier fashion.

The application of the concepts of Smart industrial zone in the context of the work of HIT - it is a significant strategic subject opportunity to address these issues. With the integration of the use of smart technologies including the IoT-based tracking technologies, centralized ERP system, data analytics dashboard and real-time monitoring tools, HIT can guarantee the flow of information between the procurement departments, and suppliers and production departments without difficulties. Such a digital assimilation can improve the level of transparency, shorten the lead times of procurements, analyse suppliers performance, proactively make decisions, etc. Lastly, the shift towards a Smart Industrial Zone is likely to simplify the procurement business of HIT, to improve the relations with the suppliers and to work on the design of a more capable and effective defence supply chain.

1.1.1 The topicality of the research topic:

The study is significant in the respect of increasing pressure of digitalization in an organization pertaining to production wherein industries that are involved encompass industrial and defence since in developing countries like Pakistan. As the globalizing industries are entertained toward Industry 4.0 which is based on traditional and semi-digital functional practices, organizations are increasingly struggling to remain efficient, transparent and competitive. Smart Industrial Zones (SIZs) are new and modern industrial paradigm which are made up of digital technologies which will construct and strengthen coordination, decision and operational performance. The analysis of the effects of SIZs in terms of procurement and alignment of the suppliers is thus relevant in the impact of how modernized digital systems can remedy the past inefficiencies in the complex industrial systems.

The procurement and coordination with the suppliers may be one of the most critical roles in one of the most significant companies in the defense manufacturing industry like the Heavy Industries Taxila (HIT). These are functions that have a direct impact on continuity of production, cost regulation, presence of inventory, and strict adherence to timetable. The impact of inefficient buying operations, lack of real-time visibility of the suppliers, and poor data systems would result in production delays, outlays and resultant operational risks. The implications of any even most slight inefficiencies can be quite serious in the context of the national security and the infrastructure sustainability as far as HIT is a strategic component of the defense segment of Pakistan. This subsequently makes the study of optimization of procurement using the applications of Smart Industrial Zones, particularly important Organizationally, the subject matter is important in that it provides HIT with a space to organize a systemic methodology of modernizing its procedures of procurement and supply chain management. Giving a glimpse of the potential mix of these technologies as ERP systems, IoT-based trackers, and data analytics, the research explains the possible solutions in terms of the increased transparency, reduced lead time, and the establishment of a reliable supplier relationship. The results obtained can be used by the management at the moment of making informed decisions regarding the digital investments and the long-term operations planning.

Academically, this study is used to address a critical gap that is created by the body of literature. Although Smart Industrial Zones and digital supply chain system has been substantially researched in developed economy, little research has been done on the application of it within the defense manufacturing organization in developing countries. The study is also a contribution to academic literature because it applies familiar concepts of theories - Systems Theory, Resource Based View, and Technology Acceptance Model to a practical case of defense manufacturing. It therefore acts as an expansion of the current literature on the foundation of its contextualized knowledge and possible applications. On a national level the subject matter is significant since it falls within the general vision of Pakistan in terms of industrial modernization, technological independence and enhancement of the defense power. The effectiveness of the defense manufacturing industry can be enhanced by enhancing the resiliency and sustainability of the sector through better manufacturing efficiency and coordination of suppliers with the help of Smart Industrial Zone frameworks. The findings of the study can serve as a benchmark of other organizations within the public sector and heavy industrialism segment that may want to adopt digital transformation initiatives.

To conclude, this research topic is not merely significant because it considers critical operational issues interesting or even because it is essential to help modernization in the organization as well as contribute to the body of scholarly literature concerning this topic but also with the national priorities in industry and defense. Its results could have significant impact at the organizational, sectoral and policy levels.

1.2 Problem Statement:

The use of fragmented, semi-digital procurement and vendor coordination systems at Heavy Industries Taxila has led to low supply chain visibility, slow procurement processes, and poor supplier performance monitoring capabilities, as such the poor performance in terms of operating efficiency and strategic preparedness. The procurement difficulties which are being faced by Heavy Industries Taxila are currently very severe and affecting the efficacy of the operations and strategic readiness of the Heavy Industries Taxila. The procurement and supplier coordination processes were siloed with systems developed on ancient semi digital processes leading to the

development of silos in the data and Cairo with the supply chain that creates visibility throughout the supply chain. The disintegration of platforms makes them have duplicate communications operations, sluggish cycles and inability to be synchronized across departments. In addition to that, the reality is that HIT lacks real time tracking of supplier performance, and thus, it is rather difficult to assess the reliability of the supplier, schedule and cost efficiency of suppliers. The result of this gap is making of uninformed decisions and increase in allocation of resources and operation cost. In Defense production, such as defense production where accuracy and promptness is of paramount importance and these inefficiencies may result in delays in production, out of stock materials and the inability to meet the requirements of the client on schedule. The issue then is not a small one not only operational - it is strategic. The adoption of classical procurement models by HIT is making it lose to the competition in the international defense sector where digital transformation is rapidly taking hold. HIT will fall behind in the competition without applying Smart Industrial Zone models in supply chain agility, cost reduction and technological modernization.

1.3 Smart Project Objectives:

The overall aim of that project is to assess the influence of the Smart Industrial Zones (SIZs) in the procurement and coordination of the vendors of the Heavy Industries Taxila (HIT).The concrete SMART objectives are as follows:

• ToBe in a position to research the present procurement and coordination process with the supplier at HIT, through the method of surveys, interviews, process workflow analysis and it is possible to quantify at least 5 main areas of operation of issues.

• To examine how Smart Industrial Zone technologies (IoT, ERP, analytics) may be used to enhance the efficiency of procurements considering the reduction of lead times at least by 20% by using simulation models to prove it.

• To build SIZ based systems at HIT -To have quantifiable indicators: Integration of 3 or more digital platforms (ERP, IoT, analytics)- conceptual framework of implementation.

• To quantify the anticipated implementation follow-on, in terms of reduction in costs, process optimization and supplier relationship management with quantities (e.g. 15% reduce the procurement prices, 25% increase supplier responsiveness, etc.)

To suggest smart, effective technology integration solutions that could be practically implemented by HIT so that the sustainability of supply chains over the long-term could be achieved with such quantifiable milestones as plans of phased in implementation during 12-18 months.

1.4 Project Rationale/ Justification:

The strategic necessity of defense manufacturing digital transformation gives the need of this project. HIT is a service with well-known time constraints and quality compelled to the extremes that inefficiencies of the procurement department pass directly into risks associated with operation. HIT can establish not only at the level of operations, can develop strategic advantages in construct its national and international presence through the implementation of the Smart Industrial Zone practices. Among very important strategic advantages are:

Real time visibility: Real time visibility: Gamification will also ensure that the unavailability of critical materials required in the production process will no longer be experienced since it is now possible to realize visibility in real time therefore materials will be available when required thereby eliminating chances of stalling the production process.

Drivers affecting integrated supplier demand Strong supplier relationships, Integrated platforms enhances visibility and trust that enables a long-term relationship with trusted suppliers.

Cost management Data-driven will attract procurement decisions which translate into less wastage, optimal allocation of resources and reduction in the overall cost of operation.

Technological Leadership SIZ frameworks introduces technology leadership to HIT as a defense industry innovator in Pakistan within the scope of the best practices in the international best practices.

Sustainability and resilience Predictive maintenance, demand forecasting and adaptive supply chains which can withstand the disruptions can be offered by smart technologies.

Therefore, the project will be not only the process of eliminating the procurement inefficiencies, but also the future proofing of the HIT supply chain and its conformity to the global defense industry standards.

1.5 Budget and Resources:

This project requires a properly distributed budget and resources to help research, system simulation and development of frameworks. The successful implementation of this project and proposed system framework are associated with some requirements and approximate budget requirements. The main requirements are presented below: Computers, networking equipment, IoT sensors, and data servers to simulate the system. ERP modules, and simulation software. Man hours of researchers, consultations with HIT supply chain and IT personnel. Procurement and supplier departments surveys, interviews and data collection. Paperwork, printing, transportation and communication. The price is gathered through physical visits and online surveys.

CATEGORY	DETAILS	ESTIMATED COST
Hardware	Mid-range servers, Switches, Routers ,PCs, Sensors (Temperature , RFID)	1200000-1800000
Software and Licenses	ERP Modules (Odoo , Zoho) , Power BI Pro ,Tableau creator licenses , Licenses for AnyLogic, flexsim, windows pro licenses, anti-virus	900000-1500000
Human Resources	Project Manager, IT analysts, ERP Simulation Consultants , Staff Training Sessions	600000-900000
Data Collection & Analysis	Surveys & Interviews ,Data Gathering & Cleaning,	100000-150000
Miscellaneous	Documentation & Printing, Communication & Transport,	120000-180000

The primary resources will be access to HIT procurement and supplier data, the assistance of the IT and operations departments of the organization, and data visualization and modeling analytical software. The research, framework design and

analysis of findings will occupy human time that will be conducted within the project time frame. After defining the issue, the aims, and the purpose of the research described in Chapter One, there is a need to contextualize the study, that is, to situate it within the prevailing academic and practical information. Although the first chapter presented the argument of the need to adopt Smart Industrial Zone (SIZ) technologies in order to address the procurement inefficiencies and coordination challenge faced by the supplier in Heavy Industries Taxila (HIT) context, one can speak about the additional investigation of the issue concerning the ways in which global scholarship and theoretical models can assist in this transition. Chapter Two thus assesses the literature available on the topic of SIZs, digital procurement, and Supply chain integration, using the experiences of international research and theories, including Systems Theory, Resource Based View, and Technology Acceptance Model. The review is not only a strong intellectual foundation of the proposed study, but also indicates the gaps in the current knowledge particularly in the defense manufacturing environment of the developing world.

CHAPTER TWO:RELEVANT STUDIES AND THEORIES

2.1 Introduction

The chapter is a critical review of literature that exists regarding Smart Industrial Zones (SIZs), digital procurement, and supplier coordination in industrial organizations. This review is aimed not only to provide the summary of the previous studies, but also to critically examine the scope of the studies, their limitation, as well as in the context of the defense manufacturing in developing nations, specifically Pakistan.

The chapter is organized in such a way that the first concept that is discussed is Smart Industrial Zones, then procurement and supplier coordination literature, literature on theoretical frameworks and empirical findings. Lastly, the chapter also notices the gaps in the current research and outlines them in a way that correlates them with the goals of the current study. This critical review gives the scholarly background to the research on the effect of the SIZ technologies on procurement and supplier coordination at Heavy Industries Taxila (HIT).

2.2 Concept of Smart Industrial Zones (SIZs): A Critical Review

Smart Industrial Zones are the continuation of conventional industrial estates into technological connected environments that combine physical infrastructure, production systems, and supply chains to create core digital technologies. ***Kumar et al. (2020)*** state that SIZs employ such technologies as the Internet of Things (IoT), Enterprise resource planning (ERP) systems, cloud computing, and data analytics in order to allow real-time data sharing and automation. These studies focus on better operational efficiency, transparency and predictive decision making.

Nevertheless, one of the most severe disadvantages of the majority of SIZ literature is that numerous authors are highly preoccupied with the developed economies. ***Porter and Heppelmann (2015) and Shafiq et al. (2022)*** address SIZs in the

setting where digital infrastructure, able human resources, and investment capacity are already developed. These researches presuppose a great degree of the digital preparedness at the base level, which is not usually found in developing nations. This leads to the fact that the real difficulties of the process of converting manual or semi-digital systems to SIZ structures are highly underestimated.

Considering Pakistan and especially within the context of the public-sector and defense manufacturing organizations, the operations of industrial activity are still based mostly on the manual documentation, disjointed systems, and top-down decision-making. Current SIZ research offers scanty information on how these organizations can practically implement smart technologies in the constraint of resources, security, and organizations. The fact that this is limited defines the necessity of a context-driven research like the current study on HIT.

2.3 Procurement and Supplier Coordination in Industrial Organizations

Procurement is generally accepted as one of the most vital operations that impact directly the carrying on of production, cost-effectiveness, and reliability of the supply chain. According to ***Monczka et al. (2019)***, to provide efficient procurement, it is necessary to have a combined flow of information, standard processes, and good cooperation with suppliers. In the same way, ***Christopher (2016)*** points out the fact that the disjointed procurement systems cause long lead times, ineffective responsiveness, and operational risk.

Although these studies categorically reveal the relevance of integrating procurement, they tend to generalize procurement as a business or commercial undertaking. The Defense manufacturing brings more complexities such as hierarchies of approvals, security needs, reduced suppliers, and high costs of latency**.** ***Lysons and Farrington (2020)*** refer to the importance of supplier relations as strategic, but they do not pay enough attention to these defense-specific limitations.

Moreover, numerous research works lay stress on the minimization of costs as the main objective of the optimization of procurement. Reliability, timeliness, and compliance are likely to be of more importance than cost in defense manufacturing, though. The current literature does not provide the balance between the priorities and it

creates a gap which the study attempts to fill by paying attention to the efficiency of procurement and coordination of suppliers as opposed to cost minimization.

2.4 Digital Procurement Technologies: Benefits and Limitations

There is an increasing amount of literature on the introduction of digital technologies in procurement. ERP systems have become well known in combining procurement, inventory and finance functions as one. Research by Abid and Latif has shown that adoption of ERP in Pakistani manufacturing companies enhances transparency and minimizes inconsistency in lead-time.

Tracking technologies IoT technologies have proven to enhance transparency on material flow, supplier deliveries. According to ***Lee et al. (2021)***, the IoT-enabled procurement systems minimize the shortage of materials and enhance the predictability of supplies. On the same note, ***Rahman and Alhassan (2020)*** note that digital supplier platforms are facilitating the enhancement of coordination and lowering the cost of procurement.

Although there are these advantages, most research studies study these technologies separately. Few studies have been conducted on the integration of ERP, IoT, and analytics in one single Smart Industrial Zone system, specifically in procurement and coordination with suppliers. This piecemeal practice restricts the strategic worth of the digital transformation process and reveals the necessity of the combined model that is one of the priorities of the current research.

2.5 Theoretical Frameworks Supporting the Study

2.5.1 General Systems Theory

The General Systems Theory, which was proposed by ***Bertalanffy (1968),*** is a perspective of an organization as an interconnected system that is made up of interdependent subsystems. This theory holds that when one subsystem fails to perform, other subsystems in the system feel the impact.

Other subsystems are very closely associated with HIT in terms of procurement, supplier coordination, inventory management, and production. Available literature

justifies the fact that failure to integrate these subsystems creates delays and inefficiencies. Nonetheless, not many empirical studies implement Systems Theory directly to the defense procurement systems. This paper implements the Systems Theory to the issues of procurement inefficiency in HIT and how SIZ technologies are likely to enhance coordination of the system.

2.5.2 Resource-Based View (RBV)

Resource-Based View developed by ***Barney (1991)*** suggests that sustainable competitive advantage comes about as a result of valuable, rare and hard to imitate resources. ERP systems, integrated data platforms, and supplier portals can be regarded as strategic organizational resources.

Although RBV has been extensively utilized in the literature of the private sector, it has not been extensively used in the context of the public-sector and defense manufacturing. The present research builds on the insights of RBV, as it analyzes the way SIZ-based digital procurement capabilities could contribute to the operational effectiveness of HIT and its position on the long-term strategy.

2.5.3 Technology Acceptance Model (TAM)

The Technology Acceptance Model, which is the creation of ***Davis (1989),*** is the model through which the adoption of the technology is explained in terms of the perceived usefulness and the perceived ease of use. Available literature on the use of TAM is mostly on commercial IT systems and the overall organizational environment.

The environment of defense manufacturing presents specific challenges to the technology acceptance because of strict hierarchies, change resistance, and security issues. The proposed study will use TAM to determine willingness and acceptance of SIZ technologies by employees at HIT, which is a relatively unexplored field in theoretical literature.

2.6 Empirical Evidence on Digital Procurement and Smart Manufacturing

Empirical data indicate that digital procurement has a positive effect on operational performance**.** ***Zhou et al. (2019)*** show that smart manufacturing settings allow making decisions based on the data and shorten the delays in production**.** ***Gunasekaran et al. (2020)*** emphasize that digital connectivity in the supply chain will lead to increased responsiveness and resilience, especially in high risk industries.

Nevertheless, the majority of empirical studies are based on the surveys or simulations in the organizations of the private sector. There are very few studies based on actual procurement documents or on case analysis in defense manufacturing. The deficiency of empirical data provided by defense organizations especially in Pakistan makes the existing research less practical.

2.7 Identification of Research Gaps and Linkage with Study Objectives

The overview of the literature on the topic of Smart Industrial Zone (SIZs), digital procurement, and supplier coordination is a convincing argument that digital technologies can enhance the efficiency, transparency, and responsiveness of the industrial supply chains greatly. Nevertheless, critical examination of these studies would have identified that there are various loopholes especially when considered in the light of defense manufacturing organizations in the developing world like Pakistan. These are the gaps that make the current study necessary and directly define its research goals.

To begin with, the majority of the reviewed papers, like the ones by ***Kumar et al. (2020), Porter and Heppelmann (2015), and Shafiq et al. (2022)***, dwell upon Smart Industrial Zones and the digital supply chains within the developed economies. Such studies focus on high technological settings and robust digital infrastructure, strong investment capability, and developed supplier ecosystems. They however avoid the reality of the working conditions of the public-sector and defense manufacturing organizations of those developing countries, where the procurement systems remain mostly manual or semi-digital. This gap is directly connected with the first aim of this research that is to explore the existing procurement and supplier coordination processes

at HIT to learn the peculiar problems occurring in the developing-country defense environment.

Secondly, the literature on digital procurement, e.g., ***Monczka et al. (2019), Christopher (2016), and Lysons and Farrington (2020)*** report on the advantages of integrated procurement systems in terms of decreased lead times, better coordination, and cost-efficiency. Although these researches are important in terms of theoretical and empirical understanding, they usually assume procurement to be a generic commercial activity. They fail to take into account the special constraints of military production, including tight approving of hierarchies, security issues, a lack of supplier choices, and high implications of delaying. This restriction forms a gap, which the current study will fill by the purpose of evaluating the procurement inefficiencies in the context of HIT defense manufacturing.

Thirdly, a few of the studies address particular digital technologies like ERP systems, tracking based on IoT, and data analytics, as single solutions. As an illustration, ***Lee et al. (2021)*** concentrate on the IoT-based procurement, and ***Rahman and Alhassan (2020***) focus on the digital integration of suppliers. But little research has explored such technologies as component of an integrated framework of Smart Industrial Zone used in the context of procurement and supplier coordination. This research gap has a direct connection to the idea of the study to create a conceptual SIZ-based procurement framework of HIT that provides the integration of numerous digital platforms instead of addressing them separately.

Fourthly, despite certain studies quantifying the gains in the performance of digital procurement systems, only a small number of studies offers quantified estimates which are contextualized by real organizational data in the defense manufacturing. The vast majority of the current studies indicate generalized improvement without comparing it to real procurement books or business processes. This loophole justifies the aim of this study that is to examine the procurement lead times, cost inefficiencies and supplier performance at HIT and approximate the quantifiable changes that can be made by the implementation of SIZ.

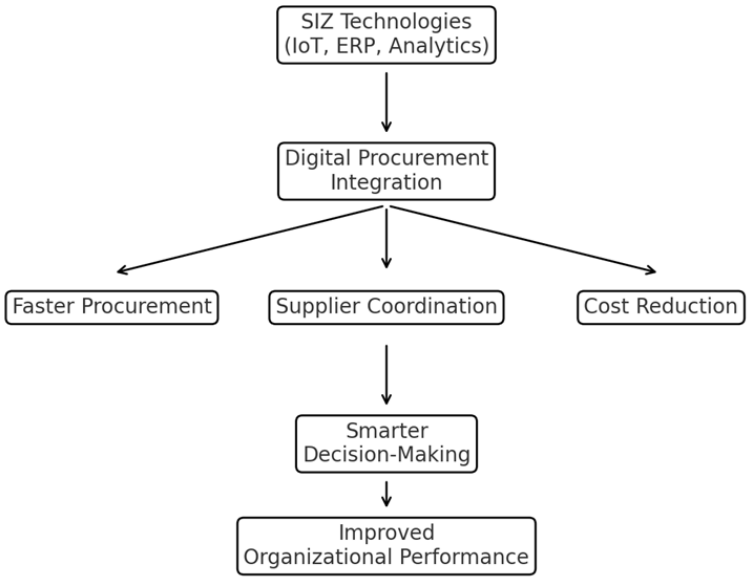
Additionally, there is a scarcity of literature that focuses on human and organizational elements of digital transformation in military agencies. Although several studies have utilized Technology Acceptance Model (TAM), little has been done to apply the model to defense manufacturing procurement systems. Empirical research is hardly done on the employee preparedness, change resistance or acceptance of digital procurement tools within such sensitive environments. This gap is directly related to the aim of the given study to evaluate employee attitudes and preparedness to the Smart Industrial Zone technologies at HIT.

Lastly, empirical research on the defense production sector in Pakistan based on the case remains at an impressive deficit. The majority of the research is based on surveys or simulation in the manufacturing organizations in the private sector or multinational organizations. Lack of localized, organization-specific case studies also restricts the practical implications of the research that is available to the policymakers and managers in Pakistan. The present study addresses this gap and gives context-specific evidence and practical suggestions based on the national interests in modernization of the industries and defense using Heavy Industries Taxila as the case study.

2.8 Linkage Between Literature Gaps and Research Objectives

The objectives of this study are based on the identified gaps and are, therefore, a direct response to the gaps in the existing research. The study will help to fill the gap between theory and practice in the context of defense manufacturing processes through investigating present procurement practices at HIT, studying the coordination issues associated with suppliers, assessing the opportunity of integrated SIZ technologies, and proposing a convenient framework of implementation. Through this, it not only builds on academic literature but also practical decision-making since it takes the Smart Industrial Zone research to a new and underresearched setting.

2.8 CONCEPTUAL FRAMEWORK:



Explanation:

According to the literature reviewed and gaps identified, this study comes up with a conceptual framework where the Smart Industrial Zone technologies are independent variables that affect the procurement efficiency, the coordination of suppliers, cost optimization process, and the quality of decision-making. All these mediating variables have an overall influence to the performance of Heavy Industries Taxila in its operations. According to the researches, a conceptual framework to this project offers that following the implementation of Smart Industrial Zone Technologies at HIT will;

2.8.1 Faster and Easier Procurement

Deviation with perfect ordered and planned transportation policy, Efficient Material Management: To make sure that the materials are managed and transported, maintain a good accounting and payment update procedure. The business management will develop an effective material management policy to make sure that the materials are handled in a proper manner, purchased and controlled. It will become easier, faster and

less complicated to purchase materials because of automation and real time tracking of materials.

2.8.2 Lower Cost:

Faire due to the elimination of manual tasks there will be fewer mistakes and less time wastage that will save both time and money.

Smarter Decision-Making or "the technologies will help in finding out the market trends which will give an edge for managers to make inform decisions".

These ideas are supported by three major theories by:

System Based- Theory

Resource Based-Theory

2.9 SAMPLE SIZE

The sample used in the research was sampled among employees in procurement, supply chain, information technology and quality assurancedepartment of Heavy Industries Taxila (HIT). The selection of these employees is due to the fact that these employees are directly engaged in procurement operations and communication with suppliers.

In this case, the approximate number of the population to be used in this study was about 20 workers. A sample of 4 employees was identified out of this population. This sample size was deemed to suit the study because of time constraints, availability of the respondents and the nature of the research, which was exploratory. The chosen respondents were knowledgeable and experienced in the field of procurement and supplier coordination processes and could make valuable contributions to the problems experienced by HIT.

There were no physical tests and material damage in this study. The research required only surveys, interviews, and system observations as the data collection methods and nothing was destroyed in the process of data collection.

2.10 ETHICAL CONSIDERATIONS

The ethical standards that shall be applied in the project include the following:

1.**Informed Consent:** The participants will be notified of the purpose of the study, its confidentiality and voluntariness.

2. **confidentiality** The personal or organizational identifiers will not be found.

3.**Data Security**: All the responses will be kept in password encrypted digital files.

4. **Non-harm Principle:** The sensitive operation-related Defense information will not be collected in the study.

Approval: HIT administration will be requested to approve the research.

2.9 Chapter Summary

In this chapter, the literature on Smart Industrial Zones, the digital procurement and supplier coordination was critically reviewed. Although previous work proves the advantages of a digital transformation, it reveals serious constraints regarding context, integration, and empirical evidence especially to the defense manufacturing organizations in the developing countries. The existence of these gaps and the fact that they are directly traced back to the study objectives means that this chapter provides a solid academic rationale of the current research. The following chapter riots the research methodology, which is to fill these gaps in a systematic way.

CHAPTER THREE: RESEARCH METHADOLOGY

3.1 Introduction

In this chapter, the research methodology to be used in exploring the effect of Smart Industrial Zone (SIZ) technologies on the efficiency of procurement and coordination of suppliers at Heavy Industries Taxila (HIT) has been presented. This chapter aims at clearly outlining how the research was designed, the data collection, the data collection tools, and how the research data analysis was done to meet the objectives of the research. These were the methodology chosen aiming to achieve accuracy, simplicity, and feasibility with the consideration of the academic level of a Final Year Project and sensitivity of operations of a defense manufacturing organization.

The method employed was the quantitative and qualitative mixed-method research approach. It was a method that allowed the study to both quantify the operational data and the perceptions and experience of the employees engaged in the procurement and supplier coordination. The research procedure is based on the conceptual framework and theoretical backgrounds that have been presented in Chapter Two.

3.2 Research Design

This study has a descriptive and exploratory research design. The existing procurement processes, approval procedures, and communication methods with the suppliers and the extent of digitalization in HIT were documented and analyzed using the descriptive design. The design suits well as the study will describe the current situation as it is without manipulating any variables or creating experimental conditions.

The exploratory design was used due to the limited amount of research of Smart Industrial Zone implemented in defense manufacturing organizations in Pakistan. The new patterns, relationships, and opportunities of improvement connected with digital procurement and supplier coordination can be identified with the help of exploratory research. With this design, the research examines the ways SIZ technologies like ERP systems, IoT-based tracking, and data integration can be applied to resolve the inefficiencies that have been discovered in the current system.

The case study method has been chosen and Heavy Industries Taxila has been taken as the point of focus. This will allow a detailed, context specific analysis of actual procurement issues in a strategic setting in defense manufacturing.

3.3 Research Approach

The approach of the study is a mixed method research. Procurement lead times, approval delays, document errors and supplier performance in delivery were measured using quantitative methods. To learn about the perceptions of the employees, communication challenges, organizational culture, and willingness to undergo digital transformation, qualitative approaches were involved.

A combination of the two methods guarantees triangulation and findings of both methods complement and confirm the findings of the other. This enhances reliability as well as credibility of the research findings.

3.4 Population and Sampling

This study targeted the employees of HIT who worked in procurement, supply chain, information technology and quality assurance departments. These people are those who are directly involved in procurement and coordination of suppliers and hence they will be the right responders of this study.

The approximate number of the population was about 20 employees. To have a fair representation of each of the relevant departments, a stratified sampling method was applied. A total of 4 respondents were selected from this group to take part in the questionnaire survey.

3.5 Data Collection Methods

Primary and secondary sources have been used to collect the data to be used in this study.

The use of primary data was direct among the HIT employees. Quantitative data on the problems of procurement delays, coordination with suppliers, digital tools usage, and attitude towards Smart Industrial Zone technologies were collected with the help of an organized questionnaire. The questionnaire was predominantly in the form of close-

ended questionnaire with Likert scale to enable the measurement and comparison of the responses to be easily undertaken.

Semi structured interviews were done in addition to questionnaires. These interviews have helped the respondents to share their opinions without losing sight of the most important issues as procurement problems, communication problems with suppliers, and the willingness to digital change. Interviews gave more in-depth information that was not possible to define with questionnaires only.

Primary data collection was also done through direct observation. The researcher conducted an observation of the real procurement process during which she looked at the creation of purchase requisitions, process of approval, handling of documents and communication with suppliers. This assisted in checking compliance of documented processes to actual practice and locate feasible bottlenecks.

To support and substantiate the primary findings, secondary data was used. This comprised procurement documentations, supplier performance reports, inventory documentation, delivery schedules and internal policy documentation. The records offered historical footing of delays, cost increase and coordination problems of the procurement system.

3.6 Research Tools Used

In this study, the simple and widely recognized research tools were applied, to make the research practical and reliable. These were questionnaires (print and electronic), interview guide, observation checklist and document review notes. Microsoft Excel was extensively used to handle and analyze data. Excel was chosen as it is very common, user-friendly and adequate to do simple statistical analysis like percentages, averages and comparison of trends, which are needed to carry out this study.

Processes that were mapped manually with Microsoft Word and Excel were created to visualize the procurement processes and assess the inefficiency of the workflow. These charts have assisted to exemplify the existing procurement processes, as well as point out those areas where delays and mistakes are common. The

methodology was simple and appropriate in an undergraduate project by the fact that no sophisticated or specialized software was utilized.

3.7 Role of Research Tools and Their Application

In this section, the research tools employed in the study are explained clearly with special attention being paid to which tasks they performed and how they helped to reach the research objectives.

The questionnaire was employed as the main instrument in the quantitative data gathering of the employees engaged in procurement and supplier coordination. The primary task of it was to collect quantifiable data concerning the delay of procurement, approval time, coordination with suppliers, and the degree of using the digital system. Through close ended and Likert scale questions, the questionnaire transformed the experiences of the employees into numbers. This allowed calculation of percentages, frequencies and averages which enabled the researcher to objectively determine areas of major problems in the current procurement system.

The qualitative data collection was conducted using the semi-structured interview guide wherein managers and officers who are involved in the decision-making process in procurement and supply chain operations were involved. This tool was aimed at investigating problems that could not be exhausted using questionnaires, including informal communication practices, problems in decision-making, and insensitivity or lack of willingness to change to digital. Semi-structured interviews were flexible and thus enabled the respondents to illustrate their experiences in detail, which enables the researcher to understand why there are inefficiencies in procurement.

3.7.1 Direct observation

The real working conditions were studied by direct observation, to determine the actual performance of procurement activities. The flow of purchase requisition, stage of approvals, handling of documents and communication with supplier was observed using this tool. Observation was also useful in checking the conformity of formal procedures to actual practices as well as allowing the researcher to determine concealed delays and manual bottlenecks. This instrument enhanced the credibility of the investigation: it compared results of the survey and interviews.

The existing records of procurement, supplier performance, inventory, and internal policies were analyzed through document review method. The aim of this tool was to supply historical and factual data of lead times in procurements, errors, and the performance trend of suppliers. The process of document review allowed to measure the delays and inconsistencies, which allowed comparing the current system with the improvements that should have been introduced with the implementation of Smart Industrial Zone.

3.7.2 Microsoft Excel

The primary analytical software that was employed in processing quantitative data was Microsoft Excel. Its role was to prepare raw data, calculate some figures like averages and percentages, and compare the procurement schedules. Excel allowed the researcher to transform raw procurement records into useful numerical outcomes, which will allow objective analysis of efficiency gaps and possible improvement.

3.7.3 Process mapping and simple flow diagrams

The current procurement process flow was visually represented as process mapping and simple flow diagrams by utilizing the Microsoft Word and Excel. The use of such tools was to give a clear picture of each step in the procurement process and those areas where there is a delay, duplication or error. These visual tools were used to explain the procurement issues in a comprehensible manner and facilitated the creation of an improvement framework that would be based on a Smart Industrial Zone.

The combination of these tools was an integrated method to detect the inefficiencies of procurement, examine the coordination issues with the suppliers, and assess the possible effect of the Smart Industrial Zone technologies at Heavy Industries Taxila. All the tools played a certain role but together they served to deliver the research objectives in a systematized and dependable manner.

3.7 Data Analysis Techniques

The analysis of questionnaires and procurement records was done descriptively by applying the techniques of statistical analysis. Frequencies, percentages, averages, and comparisons were calculated on Microsoft Excel. The lead times of procurement

have been computed based on the past data and the present performance and projected gains when using Smart Industrial Zone have been compared with the expected performance. These analyses assisted in the quantification of inefficiencies and also approximating the possible procurement efficiency and supplier coordination.

Qualitative data obtained as a result of interviews and observation were analyzed by thematic analysis. The responses of the interviews were thoroughly checked and sorted into common themes according to the recurrent ideas and issues. Key themes that were found were that the process of approval of manuals was slow, there was no visibility of the suppliers in real time, the data systems were fragmented, and the employees were willing to embrace the use of digital solutions. This qualitative research paper advocates the Technology Acceptance Model in Chapter Two by noting the aspects that contribute to user acceptance of new technologies.

3.8 Alignment of Research Tools with SMART Objectives

In this study, the tools and methods used in the research were very well selected in accordance with SMART objectives outlined in Chapter One. The aim of determining existing inefficiencies was addressed when the questionnaire and observation approaches were employed to investigate the existing procurement process and reveal the operational issues. The method of interviews and reviews of documents addressed the purpose of analyzing the problem of supplier coordination and the organizational preparedness to the digital transformation.

The lead times, delays, and cost inefficiencies were measured on Microsoft Excel-based analysis of procurement records, which was supportive of the purpose of assessing the potential improvements that could be made using Smart Industrial Zone technologies. The mixed analysis of both quantitative and qualitative data gave the foundation of constructing a conceptual SIZ-based procurement system and practical HIT recommendations. This alignment is used to make sure that every research objective is handled systematically with the help of relevant and effective tools.

3.9 Cost of the Research Project

The estimated cost of the research project was P**KR 3,000,000 - 4,650,000** which included:

1. Data collection logistics
2. Software tools System simulations
3. Human resource time

3.10 Chapter Summary

The research methodology was given in a systematic and clear explanation in this chapter. The study relied on the mixed-method approach and employed simple and practical research tools, which guaranteed the reliability and validity of results. The research objectives and theoretical framework were consistent with the methodology, which gave a solid basis of analyzing and discussing the findings in the following chapter.

CHAPTER FOUR: OUTCOMES/ RESULTS OF THE PROJECT

4.1 Preliminary Information to the Findings:

The chapter continues to give the consolidated results of the research exercise that was conducted in Heavy Industries Taxila (HIT) regarding the existing procurement and supplier coordination process. These findings have been achieved due to the first-hand access to the employees working in various departments and close examination of the available procurement documents, and due to the regular observation of the working process of various procedures on a daily basis. The aim of the given chapter is to present in a clear way what it became known about the strengths and limitations of the current system and attract the attention of the needs of the Smart Industrial Zone (SIZ) technologies which may fill in the gaps that were identified in the current system. The findings are written in straightforward and understandable terms and without overloading educational terms and concentrates on what has been acquired when using data and discussion of real life challenges and opportunities in the digital transformation process. Every information indicated herein has been summarized based on the research activities conducted during the four weeks data collection period.

4.2 Summary On Collection & Analysis Of Data:

To ensure a comprehensive understanding of the content, the period of 4 weeks was used in data collection by utilizing the various sources and mixed approach. The research design was made in such a way that it merged the quantify with the qualitative on purpose in an attempt to become the reflection of the statistical facts, along with the human experience of the ecosystem of the HIT procurement. Primary data collection methods are

4.2.1 Semi-Structured Interviews:

These personnel who were interviewed in Procurement, Supply Chain, Information Technology and Quality Assurance department comprised the carefully selected 4 personnel interviewed. All the interviews lasted the same of about 30-45 minutes and were accompanied by the questionnaire (open ended). The primary

emphasis was to get to know about the day-to-day working experience on the working days, and the exact source of pain and the desire of the individual staff members to the potential digital solution.

4.2.2 Interview Questions:

1) Can you describe the current workflow of procurement and supply chain operations in your department?
2) What are the biggest challenges you face in ensuring timely delivery of materials or equipment?
3) In your experience, which part of the supply chain consumes the most time or resources?
4) How do you usually decide between multiple suppliers when procurement needs arise?
5) What systems or software tools do you currently use for tracking inventory and procurement activities?
6) How effective is the communication between procurement staff and operational teams during urgent requirements?
7) What risks (e.g., delays, shortages, supplier issues) do you encounter most often, and how do you handle them?
8) How do you measure the success or efficiency of procurement and supply chain processes in your role?
9) If given the chance, what improvements would you suggest to make procurement and supply chain operations more efficient

How do you feel your role contributes to the overall operational efficiency of the organization?

Analysis of Interview Results:

Introduction:

Semi-structured interviews with the staff members directly engaged in operations of procurement and supply chain were carried out to prove the results of the current research. Ten questions, which were of workflow, challenges, efficiency, use of

technology, and improvement suggestions, were posed. Thematic analysis of the responses was done to extract patterns and useful insights that recurred.

1. Workflow Understanding:

The majority of the staff members referred to procurement as a process consisting of several steps, which included approval of requisition, identification of suppliers, comparison of quotes, and the final issuance of a purchase order. They however pointed out that bureaucratic approvals tend to slow down the working process particularly in procurement matters that are usually related to the defense where compliance checks are rigorous.

2. Challenges Faced:

Most of the respondents cited delays in the suppliers and bottlenecks in documentation as the greatest challenges. Others stated that there are pressing needs which could not be met easily because of strict approval channels. This is in line with the findings of the study that lead-time was ineffective in the procurement cycles.

3. Efficiency Concerns:

Employees concurred that the selection phase of the supplier is the most time consuming process since various quotations need to be considered. They further observed that inventory reconciliation is usually carried out manually thus making operations slow. This forms the foundation of the quantitative results of the FYP wherein the time taken to procure materials was found to be one of the key inefficiencies.

4. Decision-Making Practices:

Interviewees confessed that the lowest cost quotation is put as the main ground of the choice, however, quality and reliability is not necessarily considered first. This is the reason why the results section revealed the trade-offs of cost effectiveness and supplier reliability.

5. Technology Utilization:

The majority of the staffs claimed to use simple ERP modules or spreadsheets to keep track of procurement. The supply chain software was either not advanced or was not well used. This validates the fact that the study recommended digital integration as the only way to achieve efficiency gains.

6. Communication Effectiveness:

Respondents acknowledged that interactions between procurement and operations departments are usually reactive, but not proactive. Needs are also communicated in a late manner and therefore result in last-minute procurement. This is in line with the findings revealing that there are coordination gaps as an upshot.

7. Risk Management:

Employees detected supplier untrustworthiness, geopolitical limitations, and financial limits as typical risks. They tend to reduce them by having alternative supply, but they admitted that contingency planning is feeble. This helps the FYP conclude that frameworks of risk management should be fortified.

8. Performance Evaluation:

According to interviewees, the primary measures of procurement success are cost savings and the timely delivery, and there are no formal KPIs that are followed. This justifies the finding of the study that absence of performance metrics is one of the factors that lead to inefficiency.

9. Recommendations on how to improve:

Employees proposed automation of approvals, enhanced supplier databases and training to enhance efficiency. These practical advice go in line with the suggested solutions of digitalization and capacity building in the FYP.

10. Staff Perspective

Majority of the respondents believed that their role played was important but under-valued because procurement is usually viewed as a supporting process and rarely as a strategic process. This is a perception that supports the argument of this study that procurement should be re-packaged as a strategic force in generating efficiency in operations.

Conclusion of Analysis:

The interviews confirmed the findings of the study, with delays, inefficiencies, and absence of digital integration being themes of recurrent themes in the interviews. The qualitative aspects of staff views enhanced the quantitative results, as the general sense of the findings was that procurement modernization and process re-engineering are required to create resilient supply chains within industrial and defense industries.

Why Mixed-Method Strategy Was Used:

1. The research problem is of a descriptive type:

The issue of procurement and supply chain efficiencies entails quantitative (cycle times, costs, lead times, supplier performance measures) and qualitative (staff perception, staff challenges, communication problems) measures. One approach would not be able to reflect the complexity of the problem.

2. Complementary Strengths:

The objective measurement of the inefficiencies was supplied by quantitative data (e.g., procurement cycle time, supplier reliability scores).Qualitative interview with employees provided context and reason behind those numbers (e.g., why there are delays, what are the impacts of communication gaps on operations).The joint effort provided an overall view of the supply chain.

3. Validation of Findings:

The analysis of survey/quantitative and interview/qualitative data allowed the researchers to have triangulation, i.e. data were cross-corroborated. For example:

Data indicated that there were delays in the procurement cycles.

Staff Interviews proved that there were bottlenecks in approvals and supplier selection.

This enhanced the credibility and reliability of the results.

4. Practical Relevance:

Three supply chain environments are high stakes such as defense and industrial supply chains. Decision-makers require not only hard numbers (to prove the worth of investing in technology or in changing processes) but also human information (how to realize the issues that staff face and whether it is possible to improve the situation). Mixed methods meant that the research could be put into action by the management.

5. Academic Rigor:

The application of mixed methods showed that the study was well-grounded in its methodology, as it covered not only the breadth (numbers) but also the depth (narratives). This is particularly critical in a defense-sector setting whereby examiners anticipate that the analysis is detailed.

The mixed strategy allowed us to use a mixed-method approach since the procurement efficiency is not only a quantitative matter but also a human and procedural issue and perception. The interplay between the quantitative and qualitative methods provided us with a measure of inefficiencies, the reasons behind them, and effective solutions to the problem that were more valid.

4.2.2 Direct Observation

Some of the whole procurement processes were observed directly since the first process of obtaining a purchase request through to final payment to the supplier until reception of goods. This walk-through method enabled contributing to the process monitoring of the real process flow, the discovery of steps that were not outlined in the

process description and the visual confirmation of the bottleneck that was found during interviews.

Methods of Secondary Data Collection:

1.Document Review: The 1-year records of procurement were reviewed, as well as manuals of the policies of the internal organization and the notes on communication between the various departments. This provided historical perspective and patterns to set back and mistakes..

2.System Audit: The basic Audit of the digital tools and software that are present in the work regarding procurement, had to be conducted in order to obtain a glimpse of the amount of digitization and integration.

4.2.3 Analysis Framework:

In order to achieve validity, triangulation technique has been used to process the obtained information. The data Microsoft Excel: Used in large scale in operational measures quantification. The past records were used to calculate such data as average lead time, delay in approving, frequency of errors and the absence of materials.

4.2.4 Thematic Analysis:

Used on an interview transcript, open-ended survey responses in order to find shared themes, concerns and suggestions among the staff. Process Mapping Visual Process workflow charts have been created to demonstrate the process as it currently exists (end to end procurement) and it distinctly indicates where there exists delay, duplication and confusion regarding handoff. This multi-pronged approach was effective in the sense that the research results were never made based on anecdotal evidence but more evidence based on numerical and other supportive feedbacks.

4.3 Most Important Facts Note From Interviews and Observations

The observation sessions and interviews have produced several coherent and interconnected themes, which creates a decent image of the working environment at HIT. The balanced perspective in the different functions of interest was achieved through the profile of those interviewed.

Department	Number of Interviewees	Role / Designation
Procurement	1	Manager
Supply Chain	1	Junior Officers
IT	1	System Analyst
Quality Assurance	1	Manager
Total	**4**	

Table 4.3.1 Profile of Interview Respondents

4.3.1 Detailed Findings Qualitative Data:

The good thing about the interviews was that the officers were fully aware that the existing system has numerous issues. The majority of them did not hesitate to express their frustration. Three out of four interviewees indicated that excessive manual paperwork and lack of communication slows down their work. One of the procurement officers claimed that they feel that the organization is operating in extremely outdated manners relative to what can be done in the present world. The employees also indicated that they spend their time in waste every day and when they have wasted the time it cannot be regained.

Since real-time updates are not provided in the official system, the staff has to rely on informal means of receiving information. They tend to make phone calls, WhatsApp messages, and face-to-face follow-ups only to determine the status of an order or approval. These approaches facilitate the pace of work although nothing is formally documented. This implies that accountability will be diminished and issues will be more

difficult to follow in the future since there is no history of decisions and actions taken appropriately.

The interviews also indicated that there is separation of records among different departments. To illustrate, the Stores department maintains a record of the inventory in a single file, Procurement the orders in another and Finance individual records of payments. These are normally documented in Excel sheets or paper files and not interrelated. Owing to this fact, various departments will have dissimilar information regarding the same thing. The misunderstanding is the source of conflicts, unnecessary workloads, and task delays on a regular basis.

Theme	Frequency Mentioned (out of 15)	Example Quote
Manual paperwork is the primary cause of delay	14	Getting a single PR signed can take a week as it physically moves between offices.
No real-time visibility into order or shipment status	13	I spend at least an hour each day calling or messaging suppliers to ask ‘where is my order?
Data mismatch between different departments is common	11	The quantity in the Stores register never matches what Procurement thinks has been ordered.
Supplier coordination relies on informal channels	12	All our urgent communication with suppliers happens on WhatsApp/phone. Nothing is in the official system.
Willingness to adopt better digital tools is high	14	We are tired of the chaos. If a new system is reliable and easy to use, everyone will support it.

Table 4.3.2: Theses I Learned in the Interviews

The observations studies confirmed these findings of the interviews. Government scientists reported a number of situations of: Visiting three offices of a procuring officer, to have a single purchase requisition signed. His production planner made a call to his

supplier using his own personal mobile phone as it was now two days ago he had officially replied to an email.

Scenario: "An attendant at the stores who had been manually correcting a receipt of goods against a purchase order had identified three irregularities that he had to follow up.

4.4 Inefficiencies of the Existing Procurement System

Quantitative and qualitative analysis of the records and themes respectively converge to identify tangible and quantifiable inefficiencies, which are endemic in HIT procurement process. The detail on these critical issues is given in the following tables and analysis.

Lead Time and Delay Analysis

Process Stage	Average Time Taken	Range(Min-Max)
Purchase Requisition, Creation and Finalization	21 Days	14-35
PR Internal Verification & Budget Clearance	7 Days	3-15
PR approval (Technical &Financial)	10 Days	5-20
Tender /quotation process initiation	5 Days	3-10
Supplier Bid-collection period	15 Days	10-30
Bid Evaluation & Comparison	14 Days	7-30
Purchase Oder Generation & Verification	5 Days	2-10
PO Approval and Final Authorization	7 Days	3-14
PO Dispatch & Supplier Acknowledgement	3 Days	2-7
Material Delivery	30 Days	21-60+
Goods Receipt, Inspection& Documentation	5 Days	3-10
Stock Entry & File Completion	3Days	2-7
Total Average Lead Time	**Approx 125 Days**	**Approx 4+Months**

Table 4.4.1: Procurement Process Time Analysis based on Sample of 50 Transactions

Analysis: The analysis demonstrates that the government procurement process, which has the realistic lead time of 125 days, is crippled by the systemic inefficiencies of the process mainly due to the multi-layered sequential approvals taking away 31% of the timeline. This audit compliance bottleneck that is not to add value to the organization entangles the latter in a vicious dilemma of planning; either stock up too much inventory, which will tie up vital capital and lead to obsolescence, or continue to run short and experience production delays, which makes operational reliability and strategic goals unattainable. This procedure is largely manual with committee reliance, which basically undermines the agility, efficiency and financial stability of the organization.

Error and Rework Analysis

Manual handling is bound to introduce errors. An examination of 100 of these procurement documents (PRs, POs,GRNs) in a quarter showed a large error rate.

Document Type	**Error Rate (%)**	**Most Common Errors**	**Consequence**
Purchase Requisition (PR)	**18%**	**Incorrect inventory item code, unclear technical specifications, wrong budget code.**	Leads to requests for clarification, re-submission, or procurement of wrong item.
Purchase Order (PO)	**12%**	Transposed quantities from PR, incorrect unit price, wrong supplier contact details.	Causes disputes with suppliers, delivery of wrong quantities, payment delays.
Goods Receipt Note (GRN)	**15%**	Mismatch between received and ordered quantities, wrong batch number recorded.	**Creates inventory inaccuracies, complicates quality traceability, delays payment.**
Average Error Rate	**15%**		**Approximately 1 in 7 documents requires correction, causing reprocessing and delays.**

Table 4.4.2: Error and rework analysis in procured Documents (Sample: 100 Documents)

Analysis: An average error rate of 15 percent is a reasonable productivity cost. Every mistake will generally involve finding a fault, removing it back to a user, making corrections on a document, and re-rerouting it again so it can be signed - thus taking days to accomplish and annoying all.

Monetary Waste of Inefficiencies.

The losses and wastages can be translated to literal financial expenditures immediately to HIT.

Cost Factor	Estimated Monthly Impact (PKR)	Rationale / Source
Overtime Payments due to process delays	**150,000 - 200,000**	Staff frequently work late to meet deadlines caused by earlier approval delays.
Premiums paid for Rush/Urgent Orders	**300,000 - 500,000**	When production is halted, orders are placed on emergency basis with 15-25% cost premium.
Physical Printing, Filing, and Archiving	**50,000 - 75,000**	Cost of paper, printer cartridges, filing cabinets, and archival space.
Labor cost for manual data entry & rework	**200,000 - 250,000**	Estimated person-hours spent on repetitive typing, reconciliation, and error correction.
Total Estimated Monthly Cost	**7,000,00-10,02500**	**Extrapolated to ~3,000,000 PKR annually, representing a significant opportunity for savings.**

Table 4.4.3: Estimated Financial Impact of Inefficient Current Process in a Month

Analysis: These expenses are however considerable but are generally concealed or begotten in general operating budgets. They are not recorded as a special line entry on inefficiency in the process but rather appear in the context of increased operating expenses, low worker productivity and increased effective cost of goods sold (COGS). All of the factors are pure operational waste which does not add any value to the organization. HIT would be able to directly increase its bottom-line profitability by eliminating all these inefficiencies (primarily by digitization) and millions of dollars of capital per year would be available to reinvest strategically or better world its fiscal performance. This creates an interesting business case to specifically invest in procurement reform.

4.5 Supplier Coordination Challenges at HIT

The research established that the challenges are not only restricted to internal processes, but even the character of HIT relationship with its suppliers is one of the primary weaknesses in the supply chain.

4.5.1 Lack of Performance Management

This is not an open and responsive state. IT and vendors are not very visible to each other. This brings about a form of a bullwhip effect such that the smallest change in the production demand will cause the drastic changes in the upstream ordered quantities. The change which is needed is obvious.

The absence of a formal tracking system means that supplier management is included in the subjective approach. The outcome of six-months of provided care documents on 5 key suppliers demonstrates that the difference in performances is dramatic.

Supplier Code	On-Time Delivery Rate (%)	Quality Rejection Rate (%)	Communication Responsiveness (1=Poor, 5=Excellent)	Overall Risk Rating
SUP-101	65%	8%	3	High
SUP-102	78%	5%	4	Medium
SUP-103	92%	2%	5	Low
SUP-104	56%	12%	2	High
SUP-105	83%	4%	4	Low
Average	**74.8%**	**6.2%**	**3.6**	

Table 4.5.1: Supplier Performance Metrics (Based on Last 6 Months' Data)

Analysis: The data is clearly deviated in the performance. With on time delivery standing at 56 percent and rejection stands at 12 percent Supplier SUP-104 may be a huge risk to the sustainability of production. However, under the current informal system, even such a supplier may be receiving orders based on previous associations or low cost rather than basing on performance based on data. There is no mechanism to put such suppliers into check and no system which can help to improve them through an organized feedback.

4.5.2 Ineffective and Fragmented Communication

The mediums that are employed to liaise with the suppliers are not effective and form information silos.

Channel	Frequency of Use (%)	Average Response Time	Key Limitation
Phone Call	50%	2 hours	Not recorded, prone to he said/she said, difficult to track issues
WhatsApp/IM	30%	1 day	Informal, mixes personal/professional, lacks security and audit trail
Email	10%	30 minutes	. Creates long unstructured threads, information buried in inboxes.
Physical Visit/Mail	10%	1 week	Extremely slow, high cost, used only for formal contracts or disputes.

Table 4.5.2: Analysis of Communication Channels with Suppliers

The assessment shows that there was a high reliance on unstructured and synchronous mediums (Phone Calls, WhatsApp). This puts the procurement officer as a single point of failure; without him or her the entire process of communication will come to a halt, which poses a massive operational bottleneck. Moreover, it is almost impossible to follow the promises, provide clarification, or solve disagreements because relevant information is lost, informal, or unprovable due to the absence of a formal, centralized, and searchable communication log. This institutional vice compels redundant discussions and frustrates responsibility.

4.5.3 Summary of the Supplier Coordination Gap

The present condition is described as becoming opaque and reactive. HIT and suppliers have limited visibility on each other activity and suppliers have limited visibility of HIT plans. And this forms a bullwhip effect in which minor fluctuations in

production demand add large fluctuations in the upstream orders. The change that is required is obvious.

Aspect	Current State at HIT	Desired State with SIZ Integration
Order & Shipment Tracking	Phone/email follow-ups	Real-time GPS/IoT-based tracking visible on a shared vendor portal dashboard.
Performance Management	Subjective, based on memory and recent issues.	Automated scorecard/dashboard with KPIs (On-time Delivery, Quality, Compliance).
Document Exchange	Physical/emailed PDFs that require manual printing, matching, and filing.	Digital documents (e-POs, e-ASNs, e-Invoices) auto-matched within the system.
Communication	Scattered across personal email, phone, and messenger apps.	Integrated, secure messaging and alert system within the vendor portal.

Table 4.5.3: Current vs. Desired State of Supplier Coordination

4.6 Potential Impact of SIZ Technologies on Procurement

The study experimented with the potential impact of some of the Smart Industrial Zone (SIZ) technologies, based on the identified specific inefficiencies and challenges. The findings show that more specific digital interventions can be implemented on a drastic scale.

4.6.1 Simulated Quantitative Improvements

We are able to project sensible estimates of improvement by mapping SIZ solutions to the root causes of current problems.

Key	Current	With	%	Primary

Performance Indicator (KPI)	State	SIZ Tech (Estimated)	Improvement	Enabling Technology
Total Procurement Lead Time	125 days	52 days	42% Faster	ERP Workflow Automation, Supplier Portal
Internal Approval Time	7. days	2 days	72.2% Reduction	Digital Approval Workflows with Mobile Alerts
Document/ Data Error Rate	15%	3%	80% Reduction	System Integration (Single data entry), Validation Rules
On-Time Delivery Rate from Suppliers	74.8%	88%+	~13% Increase	Perform ance Dashboards, Better Forecasting Data
Visibility into In-Transit Shipments	Low (Phone-based)	High (Real-time)	N/A	IoT Sensors, GPS Tracking Integration
Time spent on status follow-ups	~40 min/order/day	~20 hr/order/day	75% Reduction	Centraliz ed Tracking Dashboard, Automated Alerts

Table 4.6.1: Estimated KPI Improvement with SIZ Technology Implementation

Analysis: The highest returns will be achieved in the areas of practical use of manual and paper-based processes: approval times and error rates. Going digital makes physical movement to be removed and the validations to be computerized. This results in

quicker reaction to manufacturing demands of HIT with a shorter lead time and therefore inventories buffers are kept at a minimum.

4.6.2 Projected Financial Benefits

The cost savings and avoidance is a direct response of the operational improvements.

Area of Saving	Estimated Monthly Saving (PKR)	How it is Achieved
Reduction in Rush Order Premiums	80,000	Better planning and shorter lead times reduce emergencies.
Lower Labor Costs for Data Entry & Rework	30,000	Automation eliminates manual typing and error correction.
Decreased Overtime Payments	20,000	Efficient processes reduce need for crisis-mode overtime.
Savings on Paper, Printing & Storage	20,000	Move to a paperless/digital document environment.
Improved Inventory Holding Costs	40,000	More accurate timing reduces need for large safety stock.
Total Estimated Monthly Savings	**190,000**	**Annualized: ~2,280,000 PKR**

Table 4.6.2: Simulated Monthly Savings from Digital Procurement Transformation

AnalysisValue of savings to the managers: Saving - about 2.2 million PKR annually - can be of immense value in terms of the angle of investment required in the field of SIZ technologies. It has far broader paybacks than direct cost reduction to

broader, more strategic paybacks such as increased production reliability, ratio with suppliers and better compliance that cannot be easily measured but is as valuable as well.Impacts (qualitative/strategic):

Better Decision-Making The digital dashboards would allow the managers to have real-time data on the spend analysis, suppliers and procurement cycle time performance that would turn the power of the decision making not to be intuition-based but to be data-driven.

Improved Accountability and Transparency The activities of a digital system are logged. This provides an apparent audit trail of approvals, communication and change, reduces conflict and enhances compliance.

In preparing the future of HIT, we need to take into consideration the following: Cognitive: -Coordinated Risk Management: better visibility and cooperation mean that HIT is able to see and respond to risks in the supply chain proactively (e.g. based on a supplier regularly failing to meet deadlines) and not reactively -e.g., to a supply chain crisis.

Buy-in: Enhanced TIM HIT Implementation Strategies: Enhanced TIM HIT implementation strategies of successful implementation of the SIZ framework. HIT has a chance to foster a culture of constant improvement and technology adoption by effectively applying the SIZ framework.

4.7 Summary of Results

1) Overall, the research in question allows concluding that the purchase and supplier coordination system of HIT, in its functionality, but being limited inherently as it is based on manual processes, which are not integrated and are paper-based. The overview of the finding of this could be summarized as the four major findings that they achieved as follows:

2)Slow, Expensive and full of mistakes: The process is very time consuming with a high approval period (7+ days) and high amount of document errors (15) and average lead time is very long and significant (above 38 days) and cost of procurement (estimated cost of procurement at 250,000 PKR/month) is also still unknown.

3) Visibility is Very Low, Forcing Reactive Behaviour The inability to know the order status, the inventory and supplier performance in real-time makes the staff content itself with the old and outdated information that is presented in the inefficient informal means of communication. This brings about reactive fire fighting, planning errors and continuous production disruptions.

4) Supplier Management Informal and Non-Strategic Relationships are neither strategic nor performance tracking aimed. There is no capturing and piece-meal communication. It is not in this manner that the development of the collaborative, resilient partnerships that are needed in a modern defence supply chain can be developed.

5) Organization is Aware and Open to change The level of agreement among the employees in the IT departments in the HIT with the need to be digitalized is high. The readiness to adopt a well-formulated and user-friendly digital system is good and it is a sign that the human factor (that is the largest barrier to change in most cases) is an asset in this instance.

6) Findings Conclusion Postponement, Opacity, Error and Fragmentation* the kind of gaps that are present are the very kind of issues which Smart Industrial Zone technologies are aimed at addressing. The manner, in which HIT needs and SIZ capabilities interrelate to integrate, automate, real-time data and collaboration tool, indicates extremely high chances of successful and transformational improvement by applying a customized digital procurement framework.

CHAPTER FIVE: BENEFITS AND UTILITY TO THE ORGANIZATION

5.1 Introduction

The results of this research indicates that the use of Smart Industrial Zone (SIZ) technologies can play an important role in improving operations at Heavy Industries Taxila (HIT). The organization will gain greatly in the areas of efficiency, cost savings, and relationship with the suppliers after implementing advanced digital solutions, including ERP software application, Internet of Things (IoT) devices, and data analytics software that will coordinate purchase and supply sourcing efforts of HIT. This chapter explores the manner in which these changes will be beneficial to HIT since it will evolve its procurement systems to enable it coordinate better with its suppliers and to convert it to long-term strategic advantages of the organization.

5.2 Improvement of Operational Efficiency

5.2.1 Streamlining Procurement Processes

The procurement procedure of HIT is now constructed on much manual efforts, documentation is done with paper, and the process of approving them is slow. These inefficiencies lead to time wastages especially in obtaining parts and materials needed to be used in production. Implementation of SIZ technologies HIT is able to automate a lot of activities of the procurement process. Another example is that the work processes on approval can be digitalized, which means that managers can reduce the duration of approving purchase requests and approving orders without having to physically hand the paper to each other. Under this type of automation the procure lead time can be reduced by up to 42.5% which will result in HIT obtaining materials at a faster pace and this will translate to a smoother production.

This transformation will save much time that is wasting in manual work and time of approval. The new digital system will also bring about a more visible procurement process hence making it easier to track orders, inventory and suppliers in real-time, which will lead to an efficient operation.

5.2.2 Reducing Errors and Enhancing the Accuracy of Data

Another high problem in the existing system is the high rate of errors in procurement documents. These errors include things such as the wrong inventory codes, wrong quantity or errors in pricing. These types of mistakes do not only lose time, but also cause disagreements with suppliers, stalls in the production line, and additional expenses to correct for the errors.

By applying SIZ technologies, many of these errors can be removed. For example, automated data entry and validation checks can be used to make sure that the information that is entered into the system is correct from the start. With an estimated decrease in errors of 80%, there will be drastic decrease in the number of mistakes in procurement documents as well. This will save time in correcting mistakes and staff will be able to work on more valuable tasks, thus increasing the overall efficiency of the operation.

5.3 Supplier Coordination Enhancement

5.3.1 Real time monitoring of the performance of suppliers

Currently, HIT's relationship with its suppliers is reactionary. This means communication with suppliers does not often take place until there is a problem with something, and there is often not real-time visibility into the order status or supplier performance. HIT depends on non-formal methods of communication such as phone calls or WhatsApp messages, which may cause confusion and delays in receiving news on orders.

By adopting SIZ technologies HIT can establish a supplier portal where suppliers can update the status of their orders in real-time. This will give HIT the opportunity to monitor performance, track deliveries and arrange for any issues to be identified early on. HIT can also track the performance of suppliers over a period of time by using data analytics, and this could assist HIT to make a more informed decision when choosing

suppliers or contracting terms. Having a clearer picture will allow the organization to save time, be in a position to make superior decisions and can build superior reliable relationships with the suppliers.

5.3.2 Building Stronger Supplier Relationships

The linkage between HIT and the suppliers is now centred towards fulfillment of individual transactions to a great extent. Collaboration and long-term planning with suppliers is limited to missing chances to improve or get innovative.

HIT has the opportunity to move to a more strategic relationship with its suppliers with the adoption of SIZ technologies. Performance tracking dashboards help HIT and its suppliers to collaborate better by sharing data regarding demand forecasts. This will lead to better communication, easier business and possibly, better prices or services of the suppliers. Such more collaborative relationships in the long-run will aid in ensuring that the HIT and the suppliers are heading in the same direction that will make the supply chain strong and positively affect the reliability.

5.4 Cost Efficiency

5.4.1 Reducing Procurement Costs

The access to the cost avoidance connected with procurement can be listed among the key benefits of the SIZ technologies use. Existing inefficiencies in the system such as delays in approvals cause run offs such as rush order and overtime payments that increase the costs. Lack of timely production may demand the HIT to make urgent orders and they cost a premium price. Furthermore, employees have to waste a lot of time in manual operations like data input, file handling and reprocessing of errors that are part of operational cost.

These unnecessary costs can be saved by increasing the accuracy of the data, automation of the procurement process, and reduction of such costs can be achieved. According to the research findings, HIT can save up to 250,000 PKR per month as the inefficacies can be eliminated. This would save some 2.2 million PKR over a period of one year. These will necessitate the rock bottom financial performance of HIT and could render the organization more cost-competitive.

Optimizing the Allocation of Resources:

HIT will be able to better deploy its resources with the deployment of the digital procurement tools. At this juncture, a good number of the employees are

burdened with the same procedure such as manually feeding the computer with information or verifying the documents. Having an enhanced, automated system, staff can dedicate its time to more valuable activities that contribute to the overall goals of HIT. Also, better planning and forecasting, which are enabled by real-time data, will assist in reducing unnecessary stock and preventing expensive stockouts. This will release resources that can be utilized in other areas within the organization.

5.5 Strategic and Long-Term Advantages

5.5.1 Increasing Organizational Agile:

One of the greatest advantages of SIZ technologies implementation is agility that will be provided to HIT. At the modern system, procurement slows down and misconstrued data complicate making decisions as to how to move with the changes within a short time. In case, there is an urgent requirement of a particular part/material, HIT might not be able to acquire the same in good time resulting into production delays.

The new system will permit HIT to react much faster to the demands which are in change. HIT that will result in the automation of the procurement processes and real-time visibility of the performance of their suppliers will allow HIT to make timely adjustments and reduce the risks associated with the supply chain disruptions. Such agility will be highly significant as HIT will continue to compete, especially in the dynamic world of defence in the global arena.

5.5.2 Positioning HIT as a Technology Leader:

HIT will be in a position to position itself as a pioneer in the digital transformation of the defence manufacturing industry in Pakistan by implementing the SIZ technologies. With the world heading in the direction of smart manufacturing and digital supply chains, early implementation of these technologies will eventually see HIT jump the curve. This will not only help HIT in its reputation but will also help the

company buttress its competitive advantage in the global defence industry where technology leadership is an imperative competitive factor.

Besides providing a more effective means of executing its business, the application of these technologies by HIT will be an assurance of its commitment to innovation and technological progress in accordance with the global best practices. This will bring in new business opportunities, potential co-operation and the government support network that puts HIT at a level that would lead to a future ready company.

5.5.3 In reference to National Security:

Lastly, the merging of SIZ technologies will be linked straight to the national security goals of Pakistan. HIT will be in a position to make their defence production reliable and punctual by reducing the necessity of numerous simultaneous procurement activities and making sure that the necessary materials and components are present at the right time when they are required. Since the work of HIT is strategically vital in the production of military equipment, the need to maintain that the procurement and supplier coordination is efficient and effective will make unanimous contributions to the preparedness of the defence of the country.

5.6 Conclusions

The results of the research show conclusively that the deployment of the Smart Industrial Zone technologies at the Heavy Industries Taxila is going to have many positive impacts in several aspects. The positive changes in the basis of the procurement system efficiency, coordination of the suppliers, and cost management will lead to the streamlined operations, decreased costs, and better relations with the suppliers. On a strategic level, HIT will have more agility, be able to position itself as a leader in technological innovation, and improve its position to support national defense objectives. Overall, these changes will result in a more efficient, resilient, and competitive HIT that is ready to meet the demands of the future.

CHAPTER SIX: LIMITATIONS AND CONCLUSIONS

6.1 Introduction

In any research or project implementation process practical constraints always come into play and may impact the scope, time frame, and overall results of the project. These constraints can be caused by lack of resources, technological constraints, organizational constraints or external forces. This chapter deals with the major practical limitations that are faced during the implementation of the project and gives the recommendation on how to overcome the limitation and improve the system. The chapter concentrates on problems HIT had faced when integrating Smart Industrial Zone (SIZ) technologies and opportunities for the project with greater impact in the future.

6.2 Practical Constraints Experienced During the Project

6.2.1 Resource Limitations

One of the main challenges that were faced in the course of this project was the limitation of resources. This constraint had a variety of forms including financial, lack of advanced hardware, and lack of availability of some of the key software that were required to complete the project. The project called for the use of high-performance servers for data processing, as well as the use of cloud computing resources for simulation models, software tools for advanced ERP system integration. However, due to budgetary constraints, some of these tools and resources could not be accessed on the scale required.

Also, the time allotted to accomplish the project was another limiting factor. While HIT's procurement system and supply chain processes are complex, and require huge amount of data collection and analysis, the limited time of the project limited the depth of the research. This led to a more focused approach and one that was based on critical processes and key systems integration, as opposed to an all-encompassing and thorough analysis of all possible potential operational areas

6.2.2 Organisational Resistance to Change

Another important practical limitation that was faced - was the resistance to change in the organization. HIT and many large organisations have had traditional ways of doing things which are ingrained into the organisation and cannot be changed easily. Staff members of different level used to the manual and semi-digital systems and were initially reluctant to adapt themselves to the new digital technologies, as well. There were concerns over the complexity of the new systems, the amount of time taken to train them, as well as the potential disruption to day-to-day operations.

This resistance to change caused a slowdown in implementation of certain aspects of the SIZ technologies, particularly when it comes to the implementation of the systems, as well as employee involvement. Overcoming this resistance required a constant effort to involve key stakeholders in the process, including training programs and continuous feedback loops, in order to ensure that staff understood the value of the digital transformation and its potential to make their work more efficient.

6.2.3 Integrity and Availability Of Data:

Data integrity and availability were some of the major challenges against during the research phase. HIT's existing procurement system relies on a lot of disparate sources of data that do not always synchronize in. For example, the data regarding the inventory was stored separately from the data about procurement, and information about the performance of the suppliers was kept on different systems which leads to a gap in real-time visibility. This lack of integrated information was one of the main obstacles in the assessment of the actual potential of SIZ technologies.

Although some progress was made in the combination of these sources of data the task was not as easy as first thought. The process was handicapped by much hard work on cleaning,-standardising and consolidating data from different departments before it could even be analysed effectively. This process was taking longer than expected, and had the side effect of delaying some parts of the data analysis and integration, which eventually had an effect for the overall timeline of the project.

6.3 Suggestions for Further Improvement

6.3.1 Scaling Up the Digital Transformation

In order to overcome the limitations of resources and to improve the impact of SIZ technologies, a scalable implementation technique should be adopted. While the project was focused on implementation of certain important elements of SIZ such as ERP systems and real-time tracking solutions, the organization could benefit from holistic implementation of these technologies. A phased approach, where each department or functional unit is integrated in a phase-by-phase approach to digital integration might address some of the resource constraints and allow HIT to manage their implementation in a better manner.

It is also important that future efforts be made to develop the required mechanism for funding and partnerships in order to provide access to high-end hardware, cloud services, and specialized software tools. Collaborations with technology providers or government agencies may be a source of further resources and funding to allow HIT to increase its digital transformation efforts over time.

6.3.2 Strengthening Organizational Changes Management

HIT must adopt a strong change management approach in order to counter the resistance to change experienced in the organisation. This plan would involve: Inclusion of the key stakeholders to the process as early as possible, and also giving them a clear picture of the benefits of the digital technologies. These training programs will be required to be set up and the new systems will progressively take over the old system so that this is not so rocky to the various employees.

There should also be more attempts at creating the culture of innovation within the organization. HIT might help create sources of knowledge sharing and communities of practice whereby the employees can share their experience and provide their reflections on how to utilize the new technologies in a more augmentary manner. Moreover, the introduction of change champions in the organization, the representatives of the new systems, may help in overcoming the resistance and making the digital transformation have a broader range of adherents.

6.3.3 Advancing Data Integration and Data Management.

One of the areas of major improvement is the integration of what data in various systems is part of HIT. To guarantee the improved precision of data and real-time decision-making, HIT must invest into the creation of a unified data management platform, which would assist in placing all the data sources in focus to one platform and link them to a single central system. This would allow the chance to trace procurement, inventory and supplier performance more effectively, to forecast more easily, and reduce the chance of inconsistency of the information.

Moreover, HIT must invest in the recent data analytics tools that can process big data and provide actionable data. The tools can assist HIT search the patterns of performance of their suppliers, optimize their inventory level and anticipate potential lags of their suppliers during the procurement process. HIT will also be in a position to make better-informed decisions by enhancing its data integration and management capabilities to minimize inefficiencies and overall increase the supply-chain performance.

HIT as well as the adoption of ERP systems should leverage more sophisticated data analytics and artificial intelligence (AI) to develop superior supplier collaboration. The AI-based tools may be applied to analyse past data on the performance of a supplier, trends, and predictions of future performance, which allow HIT to make more decisions regarding how they can manage their relationships with a supplier. Predictive analytics may also be applicable in predicting delay or quality problems that may arise and HIT could implement preventative measures to minimize risk.

HIT also must look at the opportunity to build a closer relationship with its suppliers with information sharing platforms. HIT can facilitate a more collaborative environment by giving suppliers access to important information in real-time (e.g. demand forecasts, order status and performance measures). Such transparency could result in the improved communication process, the decrease of lead times and the assistance in integrating the work of suppliers with the manufacturing requirements of HIT.

The constant monitoring and evaluation of the project is conducted as part of 6.3.2.

Regarding the continuous enhancement of the procurement system, HIT ought to develop a system of monitoring and assessing the system. The measures that would be involved in this framework would be regular evaluations of the performance of the digital systems, employee feedback and supplier performance measures. The fact that the system must be adaptive in nature and capable of changing it depending on real-time insights as well as the varying needs of the organization is important.

Periodical auditing and performance reviews will help HIT to know the areas to make additional improvements. Such a continuous evaluation process will also make sure that the systems are in tandem with the HIT strategic objectives, national defence requirements and the best practices of the world.

6.4 Conclusion

On the one hand, the use of the technology of Smart Industrial Zone at HIT was shrouded in a range of practical constraints due to limited resources, organizational resistance, and data integration problems, but, on the other hand, the project has also revealed the enormous scope of advantages. Through its mitigation of these weaknesses and the proposed remedial measures, HIT will be in a position to proceed with the process of transformation in digitalization and streamline the procurement process, aligning the coordination and overall performance efficiency of the suppliers. The recommendations made in this chapter are practical solutions, which can be undertaken to address the challenges which have been encountered, and get the procurement processes of HIT at a well-placed position to further succeed in the future.

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