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The Relationship Between the Enterprise Resource Planning System and Maintenance Planning System: An Empirical Study

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Abstract: This study's objective is to investigate the interaction between an enterprise's ERP system and its maintenance planning system. The primary data were collected using a structured questionnaire in a descriptive and analytical cross-sectional survey. To accomplish the goal of this study, data collection was conducted by giving a questionnaire to a selected group of top managers, supervisors, and engineers at Lafarge Cement Jordan. The findings indicate that an ERP system's (workforce, information) component has a favorable and statistically significant link with equipment availability. The findings indicate that the (Spares Tools & Materials, Outsourcing,) component of an ERP system has insignificant effect on equipment availability. The outcome of the other model indicated that an ERP system's (Spares Tools & Materials, Outsourcing, and Workforce) components have a positive and substantial link with workforce utilization. The findings indicate that the (Information) component of an ERP system has a negligible effect on workforce utilization. A future research target for the characteristics is to expand on the present attributes by incorporating maintenance activities for vendor-supplied patches and designing and implementing a comprehensive set of paperless maintenance forms for managing and recording all maintenance operations.

Keywords: Maintenance Planning System, Enterprise Resource Planning System, Lafarge Cement Company

1. Introduction

ERP is a business management system that is used to manage, automate, and integrate all of an organization's business activities [1]. ERP systems are made up of a collection of interconnected software packages that include tools and applications for product planning, cost and development, manufacturing, inventory management, supply chain management, marketing and sales, shipping and payment, human resources, and customer information [2]. The ERP system makes use of a centralized database to provide a variety of functions used by multiple business divisions. This shared database is used by an ERP system to disseminate common data and provide access to essential data across the organization's numerous departments. ERP systems considerably help businesses by cutting information system running and maintenance expenses, lowering administrative costs, enhancing the efficiency of organizational business operations, and improving information quality for improved decision-making and organizational development [3]. It quickly became necessary to develop a more efficient method of carrying out the schedule maintenance as specified in the manuals. This prompted business to employ a variety of arrangements for planning maintenance within the constraints of available resources. Maintenance planning in conjunction with production is still irregular, despite the fact that the computer has enabled necessary rapid re planning as production requirements change in response to market needs [4]. Enterprise Resource Planning (ERP) can be thought of as solution software that satisfies the enterprise's process requirements while adhering to the organization's goals by tightly integrating all of the enterprise's functions. A well-integrated ERP system can both improve operational effectiveness and generate competitive advantages by assisting an organization's business operations [5]. (ERP)

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systems is now commonly acknowledged as a recommended practice, with several related business improvement potential for firms. Integrating these sorts of technologies into business processes successfully necessitates seeking as many end-user simplifications as possible, which may be done by optimizing important software features [6]. Significant advances in computer hardware and software development have had a significant influence on practically every organization and industry [7-10]. planning and management Computerized maintenance management systems, or CMMS, are no longer a luxury or a wasted business cost; in many cases, they are a must. Enterprises pursuing ISO or QS certification will discover that establishing a CMMS is a vital precondition for getting and retaining such certifications. There are several software programs available, and many have been around for years. Today, CMMSs are used to plan, monitor, and control all areas of maintenance. Because each business is regarded unique, the CMMS must be versatile and adaptive. In order to help justify the computer for Maintenance System Evaluation, a basic strategy has been developed that can be readily customized to particular cases (MSE). MSE has always required the manipulation of massive amounts of data, and the advent of more cost-effective processing, storage, and database systems has propelled computer use to the forefront in this sector [11]. (CMMS) is a software package developed to help with the planning, administration, and administrative tasks connected with successful maintenance and repair. These occupations were classified as those involving the creation, planning, and reporting of work orders, as well as those involving the execution of record keeping and transaction documentation [12]. According to [13], the CMMS is more than simply a tool for managing maintenance; it is also a way of maintaining high performance efficiency over time by implementing proper maintenance procedures. One of the most important advantages that CMMS can provide to the vehicle industry is the ability to concentrate on and analyze positive repair experiences. In general, the most modern CMMSs have been designed in a modular format to provide more stability and consistency across multiple production disciplines. The goal of the maintenance strategy is to lay out a plan for accomplishing maintenance goals like availability and dependability in an orderly manner. They also emphasize critical success factors such as the knowledge that maintenance personnel must have in order to prevent failures early on, management skills such as planning, human resource management, and task management, and the ability to capitalize on maintenance history trends and opportunities [14, 15]. As a result, this study attempts to answer a basic question: Can we improve the Maintenance Planning Performance system by using ERP? As a result, this study attempts to address the following key question: "How do an Effective Maintenance Planning System and an Enterprise Resource Planning System interact?" This is performed by reviewing the literature, providing a research model, and establishing a research methodology. Finally, the hypotheses are tested and the results are evaluated.

The Study Importance:

This study will emphasize the significance of establishing an ERP system for maintenance planning. Key Performance Indicator (KPI) outputs for the industrial sector will also monitor the impact of ERP system inputs on equipment availability, safety, and profit for Lafarge Cement Jordan Company. The findings of this study will have ramifications for maintenance management and will persuade them of the need of integrating an ERP system in their planning procedures.

2. Literature Review

According to research, ERP vendors are in charge of the bulk of their customers' ERP maintenance and upgrade operations. Vendors create two types of maintenance: legal change packs (LCPs) for the installed version and new ERP system versions for upgrading reasons. LCPs and new version upgrades are supplied by the vendor and applied by customers to solve problems, improve current functionality, and/or bring new capacity to the installed ERP systems [14]. In 1959, Penrose introduced the Resource Based View (RBV) or Resource Based Theory (RBT), which has since grown into a branch of management study focused on Maintenance Planning.

According to [16], as global competitiveness intensifies, factory planners are paying more attention to the integration of production scheduling and maintenance planning. Researchers have created a number of ways for maximizing integrated planning and scheduling choices, including mathematical modeling in a range of circumstances. In terms of late delivery costs and machine availability, the suggested integrated model revealed a high potential for significant performance benefits. This is shown with a hypothetical example of a 40% average savings.

[17] proposed that they evaluated the deployment of Computerized Maintenance Management System (CMMS) in revolution adjustment by investigating the functions of the IR4.0 in automation processes and assessing maintenance operations. The article focused only on this system's implementation characteristics to the system integration's ability to logically reflect the IR4.0 idea. Furthermore, this study examined the organizational and supplier readiness challenges involved with incorporating the IR4.0 concept into a CMMS. Furthermore, by implementing an IR4.0-enabled CMMS, considerable savings in work processes, forward analysis, operations, and maintenance expenses may be gained.

[18] used maintenance planning to shed light on the management of spare parts inventories for a range of maintenance institutions. Maintenance tasks, on the other hand, are taken into consideration when the case is the principal source of spare parts requests. Monitoring spare parts inventory is frequently complicated because an uneven distribution of continuous maintenance tasks is one of the

primary causes of interruptions in spare parts demand, and the study recommended using the maintenance plan, or planned maintenance tasks, as one source of pre-order information. The value of the most current time-series forecasting techniques was quantified using data from two large maintenance companies, and the findings showed that the plan resulted in cost savings ranging from 23 to 51 percent when compared to conventional approaches.

[19] performed another research to add to the existing body of information about the value of an ERP system after a company-wide adoption. Data was gathered via a questionnaire-based study from 217 Malaysian enterprises who successfully deployed the ERP system. We ran a data analysis. For multi-group least squares, partial least squares simulation equations and partial estimation techniques are used. According to the results, more ERP investment and the likelihood of post-implementation enhancements were related with higher efficiency benefits.

Additionally, [20] suggested ways to integrate ERP systems into production maintenance using a catalytic integration system with ERP functions in order to increase the maintenance department's activities. Apart from assessing maintenance operations and establishing a mechanism for implementing ERP systems in the field of production maintenance, we also propose an employee motivation system for the maintenance department based on successful employee motivation. The findings indicated that production maintenance is critical, particularly for automated industrial patterns, and that effective management of maintenance staff is challenging owing to the inability to plan for certain jobs such as breakdowns or repairs. Therefore, develop the flowing hypotheses by this study.

Research Hypotheses:

H01: There is no significant relationship between ERP system and maintenance planning system at a significant level (Sig. ≤ 0.050).

H02: There is no significant relationship between (Spares Tools & Materials, Out sourcing, workforce, Information) and Equipment availability at a significant level (Sig. ≤ 0.050).

H03: There is no significant relationship between (Spares Tools & Materials, Out sourcing, workforce, Information) and workforce utilization at a significant level (Sig. ≤ 0.050).

3. Methodology

The purpose of the research was to investigate the structural link between and among the latent variables. Based on the original research aims, the study selected the survey technique, which, according to prior studies, is one of the most appropriate methods of eliciting questions for our study. The simple random sampling method is used to choose a sample from a specified population: Jordanian industrial businesses. The present research has a response rate of 59 percent, which is much greater than the minimal response rate of 30 percent. The research used SPSS for data analysis since it is one of the most modern and robust data analysis techniques, particularly for structural challenges in social sciences. The data is gathered via a questionnaire that was created based on previous research.

Sample of Study:

The research's population comprises of all people who worked in the Maintenance, Operations, Safety, and Technical Resources (TR) Teams at the Lafarge Cement Jordan firm site, including senior managers, supervisors, and engineers. There are 88 workers working at the relevant levels, representing the study population. The questionnaire was issued to (88) workers of the Lafarge Cement Jordan firm. According to Sekaran's chart, a sample size of (88) workers is appropriate for statistical analysis [21]. As a result, the survey included all (88) workers. Only 52 valid surveys were received, representing 59% of the population.

Conceptual Framework:

In this study, the ERP system is the independent variable (IV) (Spares Tools & Materials, Out sourcing, workforce, Information). DV refers to maintenance planning in this study, which has two domains: (Equipment Availability, Workforce utilization). As illustrated in Figure 1:

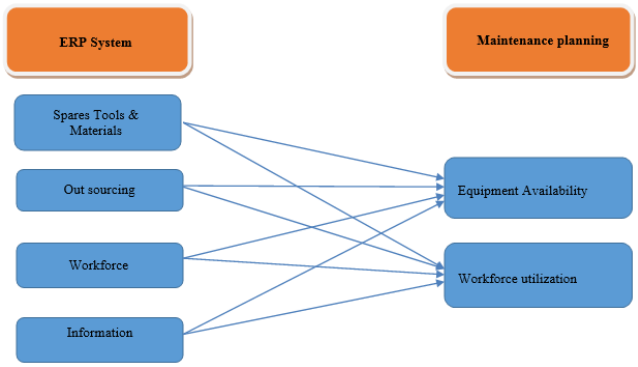

Figure 1: Research framework

4. Data Analysis

The factors used to distribute the investigation specimen were as follows: age, employment experience, educational qualification, and so on.

Table (1)

The Sample Demographic Characteristics

Variable	Category	Frequency	%
Job Location	Operations	19	36.55
	Maintenance	3	36.55
	Safety	6	5.8
	R&D	5	11.5
	Projects	5	9.6
Total		52	100

Position	Top Management Superintendent Engineer	6 13 33	11.5 25.0 63.5
Total		52	100
Experience	Less than 5 years	1	1.90
	From 5- 10	15	28.85
	From 10- 15	15	28.85
	15 and above	21	40.40
Total		52	100

Reliability Coefficients:

Reliability coefficient values for ERP System and Maintenance Planning tool dimensions are shown in Table 2, with values ranging from 0.845 to 0.934 and 0.855 to 0.865, respectively.

Table 2
Cronbach's alpha values

Variables	Level	Cronbach's Alpha	Number of Items
ERP System	Spares Tools & Materials	0.845	5
	Out sourcing	0.882	14
	workforce	0.869	6
	Information	0.934	10
Maintenance Planning	Equipment Availability	0.855	4
	Workforce utilization	0.865	7
Overall questionnaire reliability		0.972	46

As shown in Table 3, the arithmetic means and standard deviations (SD) were computed to represent the research sample's viewpoints on Independent and Dependent Variables.: When the level of respondents' opinions falls between 3.67 and 5.00, it suggests that the sample members strongly agree with the variables' items. When the level of respondents' opinions falls between 2.33 and 3.66, it indicates that the participants strongly agree with the variables' items. Otherwise, the level of opinion among responders is low.

Table (3) demonstrated that (Spares Tools & Materials, Outsourcing, workforce, Information) & (Equipment Availability, Workforce Utilization) had a high level of agreement among respondents. While resource availability, labor and outsourcing, received a moderate percentage of agreement from respondents.

Table 3
Descriptive Statistics of the Study Variables

Mean	Variables	STD	Degree
3.64	Spares Tools & Materials	0.857	Moderate
3.91	Out sourcing	1.046	High
3.32	workforce	1.237	Moderate
3.62	Information	1.212	Moderate
3.77	Equipment Availability	1.013	High
4.096	Workforce utilization	0.986	High

5. Result and Conclusion

Testing the Study Hypotheses:

Prior to using linear regression to assess the study hypotheses, a test and skewness coefficient were employed as pre-regression tests to confirm that there is no multicollinearity and no outliers in the study data. The correlation coefficients and the variance inflation factor were used in this research to identify the use of questionnaire survey data on maintenance planning (VIF). Low VIF values show weak correlation among variables under ideal circumstances VIF3; VIF is the reciprocal of tolerance. If it is fewer than ten, though, it is fine. The tolerance value should be high, suggesting that there is little ambiguity (i.e., the other independent variables do not collectively have any substantial amount of shared variance). A typical cutoff level is 0.10 tolerance, which corresponds to a VIF value of 10. [21]. To put it another way, in a regression model, there is no significant association between the independent variables. The skewness of the data was assessed to confirm that there was no outlier and that the data was distributed normally. A severely skewed distribution is indicated by skewness values outside of the range of -1 to +1. Typically, statisticians suggest that a sample size of 30 is adequate for most distributions; Table (4) demonstrates this. This study's independent variables met the linear regression assumptions:

Table (4) Multicollinearity and Normality Test

Independent Variable	VIF	Tolerance	Skewness
Spares	1.841	0.543	-1.289-
Tool & Material	2.827	0.354	-1.289-
Out sourcing	2.318	0.431	-.400-
Workforce	3.939	0.254	-.689-
Information	2.192	0.456	-1.451-

The next phase in the study is to test the hypotheses after analyzing the quality of the study instrument and the applicability of the study variables for statistical tests.

The First Hypothesis: H01: There is no significant relationship between ERP system and maintenance planning system at a significant level (Sig. ≤ 0.050).

To test the first hypothesis, simple linear regression/ enter method adopted. Table (5) shows the corresponding results.

Table (5) Model Summary

Model	R	R2	Durbin-Watson	F	Sig.
ERP-MP	0.874	0.763	2.273	161.361	*0.000

Table (5) shows that the two variables have a highly significant association, with R equal to 0.874. The ERP system's input is highly predictive of maintenance planning, with R2 equal to 0.763 and a substantial F equal to 161. 361. This model can predict 76.3 percent of the variance in maintenance planning (dependent variable), with the remainder ascribed to external factors. As a result, precise ERP system input has a considerable positive impact on maintenance planning. This finding supports the first hypothesis and provides an answer to the study's first question. According to Table (6), the value of Beta is 0.874, indicating that the ERP system input (t= 12.703) is statistically significant at the significance level (P0.05). These findings lead us to develop the following interpretation equation:

Maintenance Planning = 0.341+ 0.874*(Accurate ERP system inputs)

Table (6)

The ERP-MP Model Coefficients

	Unstandardizd				Standardized Coefficients
	B	**Std. Error**	Beta	**T**	Sig.
(Constant)	0.341	0.289		1.179	.244
ERP system inputs	0.974	0.077	0.874	12.703	0.000

H02: There is no significant relationship between (Spares Tools & Materials, Out sourcing, workforce, Information) and Equipment availability at a significant level (Sig. ≤ 0.050).

Multiple regression analysis was conducted to examine if there is a statistically significant influence of the recourse availability aspects (Spares Tools & Materials, Out sourcing, workforce, Information) on the Equipment availability at a statistically significant level (0.05). Data for multiple linear regression analysis assumptions were already confirmed in Table (6) above. The correlation coefficients of the research variables in this model are shown in Table (7). The findings show a large strong positive relationship between labor, tools and materials, and equipment availability (dependent variable), as well as a significant moderate relationship between spares and outsourcing. The coefficients were 0.818, 0.717, 0.647, and 0.585, respectively. These relationships have a greater correlation coefficient than the other correlation coefficients intersected in the table. Labor has a strong beneficial relationship with tools and materials, as well as outsourcing.

Table (7)

Correlation of Equipment Availability Model*

Eq. Av.	1.000				
Spare	0.647	1.000			
Out sourcing	0.717	0.558	1.000		
workforce	0.585	0.572	0.661	1.000	
Information	0.818	0.664	0.796	0.737	1.000

*Dependent variable: Equipment Availability

The second hypothesis was tested using multiple linear regression. The model summary is shown in Table (8). R2 = 0.682, suggesting that the regression model explains 66.3 percent of the data variance, according to the study's results. Durbin-Watson d = 1.857, a number that is between 1.5 d 2.5 and the other critical values. First order linear autocorrelation was found to be absent from this study's linear regression data. The F value is 34.384 with sig.= 0.000, indicating that the model can interpret 66.3 percent of changes in the dependent variable (equipment availability), with the remainder attributable to external variables.

Table (8)

Model Summary of Equipment Availability**

Model	R	R2	Durbin-Watson	F	Sig.
Res. Av-Eq. Av	0.826	0.682	1.857	34.384	0.000

The following table summarizes the model parameters, including the intercept, the t value, and their relevance. Table (9) demonstrates that the independent variables

(Tools & Materials, and outsource) have no statistically significant impact at the 0.05 level, based on their insignificant values of 1.423 and -(0.570), respectively, whereas the variable Workforce and Information has a statistically significant impact at the 0.05 level, with t equal to 4.707 and 2.403, respectively. These findings led us to construct the following interpretation equation:

Table (9)
The Resource Availability-Equipment Availability Model Coefficients

Unstandardizd Coefficients				**Standardized**	
	B	**Std. Error**	Beta	**T**	Sig.
(Constant)	1.46	0.311		4.689	0.000
Spares Tools	0.183	0.129	0.195	1.423	0.161
Out sourcing	-0.056	0.098	-0.070	-0.570	0.572
Workforce	0.581	0.123	0.714	4.707	0.000
Information	0.123	0.126	0.052	2.403	0.018

The Third Hypothesis: H03: There is no significant relationship between (Spares Tools & Materials, Out sourcing, workforce, Information) and workforce utilization at a significant level (Sig. ≤ 0.050).

The correlation coefficient for the workforce utilization model, which includes the resource availability dimensions (IV) and the workforce utilization, is shown in Table (10). (DV). The data reveal that whereas (Spares Tools & Materials, Outsourcing, Workforce, and Information) have a large strong positive relationship with workforce utilization, spares have a major moderate relationship with workforce utilization. The coefficients were 0.818, 0.585, 0.717, and 0.647, respectively. These correlation coefficients are greater than the others intersected in the table.

Table (10)
Correlation of Equipment Availability Model*

	Eq. Av.	**Spare**	**Out sourcing**	**Workforce**	**info**
Eq. Av.	1.000				
Spare	0.647	1.000			
Out sourcing	0.717	0.558	1.000		
Workforce	0.585	0.572	0.661	1.000	
Information	0.818	0.664	0.796	0.737	1.000

*Dependent variable: Equipment Availability

The purpose of multiple linear regression analysis is to investigate and analyze the influence of several independent factors on a dependent variable. This research will examine the influence of resource availability on workforce utilization (Spares, Tools & Materials, Outsourcing, workforce, and Information). The corrected R square = 0.811 and the R2 equals 0.822, showing that the independent variable (resource availability) accounted for 81.1 percent of the variation in the dependent variable (workforce utilization), with the rest attributable to other variables. d = 2.182, which is in the middle of the two critical values of 1.5 d 2.5. As a consequence, the linear regression data in this study show no first order linear autocorrelation.

Table (11)
Workforce Utilization Model Summary**

Model	**R**	**R2**	**Durbin-Watson**	**F**	**Sig.**
Workforce Utilization	0.907	0.822	2.182	73.986	0.000

As indicated in Table 11, the value equals 73.986 is statistically significant at the 0.05 level of significance (sig.=0.000). Thus, a multiple regression model is appropriate for estimating the link between the availability of resources (Spares, Tools & Materials, Outsourcing, labor, and Information) and workforce utilization.

The following Table (12) summarizes the results of multiple linear regression, including the intercept and significance values. The findings indicate that Outsourcing, workforce, and information all have a statistically significant influence on workforce utilization, as measured by the t value and its significance level of 0.05. Which means that for every unit increase in major outsourcing, workforce, or information about resource availability, workforce utilization increases by 0.466, 0.191, 0.152, or 0.000.

Table (12)
The Resource Availability-workforce Utilization Model Coefficients

Unstandardizd Coefficients				**Standardized**	
	B	**Std. Error**	Beta	**T**	Sig.
(Constant)	.044	.230		4.538	0.000
Spares Tools	.466	.091	.580	5.105	0.000

Out sourcing	.191	.095	.206	1.423	0.050
Workforce	.152	.072	.193	2.011	0.040
Information	.000	.109	.000	2.107	0.999

After establishing the significance of the ERP system and maintenance planning aspects, the following paragraphs will examine the findings of the study hypotheses:

First, the findings indicated that there is a correlation between ERP systems and maintenance planning. However, the independent variable (ERP system) could account for 75.9% of the variance in the dependent variable (maintenance planning), and the remainder to unobserved variables.

As a consequence, the ERP system may significantly reduce information technology expenditures, as well as the time necessary to perform work operations and tasks. Additionally, to offering a commercial process platform for standardizing operations, it serves as an incentive for business innovation by making the organization more adaptable to labor market changes via the standardization and simplification of work stages. Other ERP inputs facilitate the process of evaluating data, forming conclusions, making better choices, adjusting swiftly to changes, and reacting to them.

These findings corroborate [16],which demonstrated that the suggested methodology, which combines preventive maintenance planning and work scheduling, has the potential to greatly enhance performance in terms of cost of delay in delivery and machine availability. It is close to 40%.

Secondly, the findings suggested that the ERP system has an effect on equipment availability. Nevertheless, the independent variable (ERP) was able to account for 66.3 percent of the variation in the dependent variable (Equipment availability). Additionally, the data indicate that although Spares, Tools & Materials, and Outsourcing have no significant effect on equipment availability, workforce has a substantial effect.

This result is attributed to the institution's knowledge of its resources, such as its workforce, equipment, tools, and materials, which serves as a starting point for identifying aspects of prior shortages and surpluses and thus working to strengthen them and provide the institution with what it needs to carry out its activities and operations.

These findings corroborate the findings of a previous research [20], which suggested that working capital was lowered via increased integration of corporate operations, intra-organization communication, and greater collaboration. On the other hand, waste was eliminated in the form of unused material, stock, energy, defects, or energy, and product cycle times were reduced by reducing preparation and delay, optimizing space, and aligning machine maintenance with production processes, with the goal of optimizing worker, equipment, and workstation utilization.

Thirdly, the findings indicate that there is an influence of recourse availability on labor force utilization, with the independent variable (resource availability) explaining 81.1 percent of the variations in the dependent variable (workforce utilization). This result is attributed to the fact that knowing the available resources will improve human resource management processes; because determining the number of tools and materials, as well as determining the number of human resources required to carry out the required work, will aid in determining the activities that the institution must undertake, and then determining the number of workforce required. Furthermore, the data demonstrate that spares have no significant influence on workforce utilization, but labor, tools and materials, and outsourcing have a considerable impact on workforce utilization.

These findings are consistent with the findings of a previous research [22], which found that ERP had a considerable influence on staff productivity, service quality, and creativity.

6 CONCLUSION

In this research, we investigate the interaction between an enterprise's ERP system and its maintenance planning system. The findings indicate that an ERP system's (workforce, information) has a favorable and substantial link with equipment availability. The findings demonstrate that an ERP system's (Spares Tools & Materials, Outsourcing,) has a negligible link with Equipment availability. These findings are consistent with the findings of a previous research [20], which found that working capital was lowered via the integration of corporate operations, intra-organization communication, and greater collaboration. The outcome of the other model revealed that an ERP system's (Spares Tools & Materials, Outsourcing, Workforce) has a positive and substantial link with workforce utilization. The findings indicate that the (, Information) of an ERP system has a negligible link with worker utilization.

Additionally, the ERP system improves the performance metrics for the Lafarge Cement Jordan company's maintenance planning. The proposed

framework may be used as a reference for ERP managers to explain the cost and benefit of implementing decision-alternatives, also known as crucial success factors (CSFs), in order to reduce total ERP software costs. Maintenance of production equipment is vital, even more so in increasingly automated industrial sectors. It is difficult to manage maintenance personnel effectively since some of the jobs that are completed cannot be scheduled (time of breakdowns or overhauls). The suggested ERP system deployment approach in the field of production maintenance blends monitoring of maintenance job performance with a motivating system for maintenance workers. Because the user's needs are gathered in an orderly and systematic way, ERP maintainers can service the modification request more effectively. The suggested maintenance data-model makes all maintenance data conveniently accessible. This may boost maintenance efficiency since no time is spent searching for or gathering the necessary information. As a result, more maintenance requests may be fulfilled in the same amount of time.

7. LIMITATIONS AND FUTURE RESEARCH:

There are several limits that must be addressed. Because the sample was limited to the Lavarg business, it's probable that it didn't reflect all of Jordan's industries. A future study might delve at private and public organizations. Because self-report questionnaires may introduce response bias into the results, the use of surveys to collect data may be seen as a restraint on the study. Future research may seek to obtain data from both sides in order to eliminate such possible bias. A future research target for the characteristics is to expand on the present attributes by include maintenance activities for vendor-supplied patches and creating and implementing a full set of paperless maintenance forms for managing and recording all maintenance operations.

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