

Implementation of a Strategic Maintenance Plan for a Telecommunications System and Its Relationship with the Operability of a Regional Hospital

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ABSTRACT

This study aimed to determine the relationship between the implementation of a strategic maintenance plan and the operability of the telecommunications system at Hospital Docente Clínico Quirúrgico Daniel Alcides Carrión in Huancayo. A total of 33 hospital managers were included in the study population. The research approach is mixed and was applied to specific problems, circumstances and characteristics. A non-experimental, intentional, cross-sectional and descriptive-correlational design was used. A correlation coefficient of .656 with a p value = $.000 < .01$ was obtained for variables "implementation of the Strategic Maintenance Plan" and "operability of a telecommunications system of Hospital Docente Clínico Quirúrgico Daniel Alcides Carrión". The results demonstrate that the implementation of a strategic maintenance plan guarantees the correct operation of a hospital's resources.

Keywords: strategic maintenance plan; operability; telecommunications system; maintenance budget.

INTRODUCTION

Since 2014, Hospital Regional Docente Clínico Quirúrgico Daniel Alcides Carrión (regional hospital) located in Huancayo has significantly increased the services it provides. For this purpose, a set of telecommunications systems was implemented, including: structured cabling, switching, servers, computer security, cable television, closed circuit television, access control, public address (PA) system, fire alarm, wireless internet, IP telephony, centralized storage and nurse call system. As each of these systems has its own specific features and complexity, their use and maintenance is challenging for those institutions that lack personnel trained in these technologies. It is therefore necessary to design a maintenance plan to ensure the operation of all these telecommunications systems.

Particularly in the case of regional hospitals, complexity is determined by the level on which they have been built, according to the Ministerio de Salud [Ministry of Health] (2011), in the Technical Health Standard NTS N° 021-MINSA / DGSP-V.02 in the section entitled Categorías de Establecimientos del Sector Salud [Categories of Health Establishments]; hospitals at each level must comply with certain characteristics in terms of care, which vary according to the problems and the geographical context. In this context, depending on the complexity of a hospital coupled with the services it must have to operate fully (health and administrative services), a high-capacity and complex telecommunications system that guarantees 100% of the execution of all activities is required (Gómez & Martínez, 2018).

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Several problems related to the lack of a maintenance plan have been identified at the Hospital Regional Docente Clínico Quirúrgico Daniel Alcides Carrión (hospital level III-1 and 7 of complexity). These included the following:

- The maintenance expenditure for telecommunications systems remains undetermined, leading to a deficient allocation of the budget for this item. Table 1 shows the allocated budget versus the actual cost for the maintenance costs of the systems mentioned above.
- Over the years reviewed, there have been several corrective maintenance expenses related to the telecommunications systems, and no maintenance policies have been established to mitigate them. This has led to a significant increase in unscheduled maintenance work, as shown in the horizontal analysis in Table 2, thus the maintenance costs incurred are higher than those budgeted.
- The lack of personnel trained in such systems has contributed to exceeding the budget allocated to maintenance tasks when they are not performed correctly, which results in rework, the allocation of a new budget and unplanned expenses.
- Eighty percent of maintenance services are outsourced because in-house personnel lack the skills required for maintenance tasks.

In view of this scenario, public managers are taking into account the importance of ensuring equipment operability to perform efficiently and avoid downtime in the production line to maintain a stable and continuous quality and production. Maintenance area activities serve this purpose, aiming to reduce the cost of its management as part of the added value of an industry (Herrera Galán, Duany Alfonso & Abreu-Duque, 2014).

Development of the strategic maintenance plan for the communications system of Hospital Regional Docente Clínico Quirúrgico Daniel Alcides Carrión began with the establishment of objectives, previous definitions, preventive maintenance periodicity, guidelines, manual of procedures for corrective maintenance, technical support, maintenance record, maintenance procedure for each communications system, among others. Subsequently, the schedule of activities was implemented, detailing the maintenance dates, communications subsystems to be maintained and maintenance percentage for each subsystem, documentation required for the control of all maintenance, technical reports, and certificate of compliance for each visit conducted during the maintenance period.

In this regard, Reyes (2018) conducted a study using a quantitative approach with a non-experimental correlational design, aimed at determining the relationship between strategic planning and maintenance management at Instituto Metropolitano Protransporte de Lima. Using Spearman's RHO correlation coefficient between the variables "strategic planning" and "maintenance management at the Instituto Metropolitano Protransporte", Reyes (2018) concludes that there is a strong correlation of .793 between both variables with a p value $< .05$.

Similarly, Acuña (2016) conducted research using an applied quantitative approach, aimed at developing a strategic preventive maintenance plan for the company Transportes Hagemsa SAC to reduce corrective maintenance costs in order to optimize and improve the reliability of all the company's systems. Acuña (2016) concluded that the lack of a strategic maintenance plan in the company leads to deficiencies in the management and control of operations in the Maintenance area, resulting in economic losses related to rework and machine downtime.

Rodríguez (2008), quoted by Zambrano, Prieto and Castillo (2015), states that maintenance management is a *conjunto de actividades de diseño, plan-*

Table 1. Allocated Budget vs. Actual Cost for Corrective Maintenance.

Year	Budgeted	Actual	Actual vs. Budget Variance	Horizontal Analysis
2016	S/ 85,400.00	S/ 118,300.00	S/ 32,900.00	27.81%
2017	S/ 79,768.00	S/ 107,650.00	S/ 27,882.00	25.90%
2018	S/ 84,356.00	S/ 98,300.00	S/ 13,944.00	14.19%

Source: Hospital Regional Docente Clínico Quirúrgico Daniel Alcides Carrión (2019).

ificación y control que tienen por objeto minimizar los costos asociados al mal funcionamiento de los equipos. Continúa el autor especificando que, además de las actividades típicas de mantenimiento, debe incluirse la formación del personal [set of design, planning and control activities aimed at minimizing the costs related to equipment malfunction. The author further specifies that, in addition to typical maintenance activities, personnel training should be included] (p. 497).

Service quality is directly influenced by maintenance and is an important strategy to achieve competitiveness; moreover, when maintenance activities are coordinated under a centralized management scheme and a managerial philosophy, maintenance management is achieved (Zambrano, Castillo & Prieto, 2013). Pardo and Mejías (2013) state that modern societies are characterized by the importance that they give to technical assistance and maintenance services. Therefore, the correlation between the Strategic Maintenance Plan and the operability of the communications system of Hospital Regional Docente Clínico Quirúrgico Daniel Alcides Carrión, located in Huancayo, was analyzed in this study.

In this context, maintenance objectives are *metas asignadas y aceptadas, las cuales requieren de actividades de mantenimiento, cada una de ellas perteneciente a uno de los diferentes niveles de control, desde el estratégico hasta el nivel operativo de mantenimiento [assigned and accepted goals, which require maintenance activities, each of them belonging to one of the several control levels, from the strategic to the operational level of maintenance] (Viveros et al. 2013, p. 127).*

As such, the direction of the maintenance unit must be *coherente con los objetivos de producción y las metas estratégicas generales de la compañía y, del mismo modo, debe existir coherencia en la definición de estrategias, políticas, procedimientos, estructura organizacional y decisiones en los diferentes niveles [consistent with the production objectives and overall strategic goals of the company and, likewise, the definition of strategies, policies, procedures, organizational structure and decisions at different levels must be consistent] (Viveros et al., 2013, p. 127).*

Regarding operational management, Martínez and Jerez (2018) state that

constituye la dimensión práctica de la gestión estratégica. Es de alguna manera, su brazo ejecutor. Llevar adelante una eficiente gestión operativa implica principalmente

garantizar la existencia efectiva de una organización consistente, con áreas de trabajo delimitadas y tareas específicas asignadas. En este sentido resulta importante tanto la consolidación de cada área o estructura laboral, como el reconocimiento [it constitutes the practical dimension of strategic management. It is, in a way, its executing arm. Efficient operational management mainly implies guaranteeing the effective existence of a consistent organization, with well-defined work areas and specific tasks assigned. In this sense, it is important to consolidate each work area or structure, as well as the general recognition of the main functions of each area]. (p.38)

According to Zavarce and Forero (2012), the purpose of operational management is *coordinar y llevar a cabo los subprocesos y actividades requeridas para entregar y gestionar los servicios, atendiendo los niveles de calidad acordados con los usuarios [to coordinate and perform the subprocesses and activities required to deliver and manage services, meeting the quality levels agreed upon with users] (p. 81). The objectives of service operation are *Asegurar la prestación diaria del servicio, coordinar y ejecutar las acciones operativas requeridas para gestionar los servicios en función de los niveles aceptados por los usuarios, facilitando a la organización cumplir con los objetivos del negocio [To ensure the daily delivery of the service, coordinate and execute the operational actions required to manage the services according to the levels accepted by the users, enabling the organization to meet the business objectives] (Zavarce & Forero, 2012, p. 82).**

METHODOLOGY

This study follows a mixed approach, which according to Hernández, Fernández, and Baptista (2014) encompasses a group of *procesos sistemáticos, empíricos y críticos de investigación [systematic, empirical and critical research processes] (p. 546)* that require the collection and analysis of quantitative and qualitative data. It also has a quantitative approach, with a descriptive level; non-experimental cross-sectional design and the instruments were applied in 2019.

Consistent with the objectives and problems, this research is applied to specific problems, situations and characteristics. The population is comprised of the 33 members of the management staff working in the hospital, as they are directly aware of the performance of the telecommunications systems. The

sample is considered a “census” since the entire population was included. Ramírez (1999) states that a “census sample” is defined as such when all the elements of the study are regarded as a sample, so the population under study becomes a census because it is the universe, the population and the sample at the same time. Information was obtained using the survey technique and the questionnaire as an instrument, which included a series of questions posed to the selected population, which were validated by experts and the Cronbach’s alpha internal consistency index was applied. SPSS version 25 and the Spearman Correlation Coefficient statistic were used for the analysis of the variables.

Five-point and three-point Likert scale techniques were used to quantify the factors in order to obtain effective statistical conclusions. Spearman correlation techniques and tests were used to verify the hypotheses. Responses were rated using 1-5 scale formats, ranging from (1) totally dissatisfied, (2) dissatisfied, (3) neither satisfied nor dissatisfied, (4) satisfied, to (5) totally satisfied. The perception of strategic planning is related to the managers’ assessment of the level of implementation and development of strategic planning in the hospital. In turn, the perception of operability is related to the managers’ appreciation of the level of efficiency of all services in the hospital.

RESULTS

According to the SPSS results, the reliability of the instruments is as follows:

- Implementation of the Strategic Maintenance Plan - Cronbach’s alpha: .789 (20 items) - Strong reliability

- Operability of the Regional Hospital’s telecommunications system - Cronbach’s alpha: .924 (20 items) - High reliability

Non-parametric statistical tests were used in the study as the data did not have a normal distribution given the results of the Shapiro Wilk test; likewise, the final results were ordinal in a range of poor, moderately efficient and efficient.

The interaction of the variables “implementation of the strategic maintenance plan” and “operability of the regional hospital’s telecommunications system” is shown in Table 1. It is observed that when managers report that a strategic maintenance plan has been implemented efficiently, the regional hospital’s telecommunications system operates efficiently; on the other hand, when managers report that a strategic maintenance plan has been implemented at a moderately deficient level, the hospital’s telecommunications system operates at a moderately deficient level.

Table 1 shows the correlation coefficient between the variables “Implementation of the Strategic Maintenance Plan” and “Operability of the Regional Hospital’s telecommunications system”, the level of 2-tailed significance and the number of respondents.

As shown in Table 2, there is a strong correlation between the implementation of the Strategic Maintenance Plan and the operability of a telecommunications system at the Hospital Regional Docente Clínico Quirúrgico Daniel Alcides Carrión, since a correlation coefficient of .656 was obtained, indicating that there is a moderate correlation between the variables with a *p*-value of .000 < .01, which indicates a reliability level of 99%. Therefore, the null hypothesis is rejected and the alternative hypothesis is accepted. Thus, a positive and significant relationship is found between the implementation of the Strategic Maintenance Plan and the operability of

Table 1. Cross Table of the Implementation of the Strategic Maintenance Plan*Operability of the Regional Hospital’s Telecommunications System.

		Count		
		Operability of the Regional Hospital’s Telecommunications System		Total
		Moderately Efficient	Efficient	
Implementation of the Strategic Maintenance Plan	Moderately Efficient	7	0	7
	Efficient	0	26	26
Total		7	26	33

Source: Database.

Table 2. Correlation between the implementation of the Strategic Maintenance Plan and the operability of the communications system of Hospital Regional Docente Clínico Quirúrgico Daniel Alcides Carrión.

Correlaciones				
			Implementation of the Strategic Maintenance Plan	Operability of the Communications System of the Regional Hospital
Spearman's Rho	Implementation of the Strategic Maintenance Plan	Correlation Coefficient	1.000	.656**
		Sig. (2-tailed)	.	.000
		N	33	33
	Operability of the Communications System of the Regional Hospital	Correlation Coefficient	.656**	1.000
		Sig. (2-tailed)	.000	.
		N	33	33

Source: Database.

** Correlation is significant at level .01 (2-tailed).

a telecommunications system of Hospital Regional Docente Clínico Quirúrgico Daniel Alcides Carrión located in Huancayo.

DISCUSSION

As evidenced by the results, a strong relationship exists between the implementation of the Strategic Maintenance Plan and the operability of the communications system of Hospital Regional Docente Clínico Quirúrgico Daniel Alcides Carrión with a Spearman correlation coefficient of .656. This result is consistent with that obtained by Reyes (2018), who applied Spearman's Rho correlation coefficient to determine the relationship between strategic planning and maintenance management at Instituto Metropolitano Protransporte de Lima, and concluded that there is a strong correlation of .793 with a *p*-value < .05 between both variables.

It is also similar to that stated by Alegría, Orellana and Zamora (2008), for whom the development of a strategic maintenance plan enables the optimization of the maintenance of medical and basic equipment, which guarantees the safe operation, maximum performance and cost-effectiveness of all equipment, while improving the equipment usage rate by health professionals.

These results reinforce the findings of Rodríguez (2008), quoted by Zambrano, Prieto and Castillo (2015), who stated that maintenance management is a *conjunto de actividades de diseño, planificación y control que tienen por objeto minimizar los costos asociados al mal funcionamiento de los equipos. Continúa el autor especificando que, además de las actividades típicas de mantenimiento, debe*

incluirse la formación del personal [set of design, planning and control activities aimed at minimizing the costs related to equipment malfunction. The author further specifies that, in addition to typical maintenance activities, personnel training should be included] (p. 497). Similarly, Acuña (2016) conducted a research aimed at developing a strategic preventive maintenance plan for the company Transportes Hagemsa SAC to reduce corrective maintenance costs in order to optimize and improve the reliability of all the company's systems, and concluded that the lack of a strategic maintenance plan in the company leads to deficiencies in the management and control of operations in the Maintenance area, resulting in economic losses related to rework and machine downtime. Noteworthy is the work of Barros (2015) from which he concluded that a strategic maintenance plan has an influence on maintaining and establishing the actual maintenance budget sustainable over time in addition to decreasing overall maintenance costs (labor, spare parts and work orders) by 30% and decreasing safety spending by 20% by applying corrective and preventive maintenance strategies. Service quality is directly influenced by maintenance and is an important strategy to achieve competitiveness; moreover, when maintenance tasks and activities are performed in a strategic environment under continuous planning and coordination, costs of unscheduled maintenance and rework are reduced (Zambrano et al., 2013).

CONCLUSIONS

The results of the study indicate a strong relationship between the implementation of the Strategic Maintenance Plan and the operability of a telecommunications system at the Hospital Docente Clínico

Quirúrgico Daniel Alcides Carrión in Huancayo, with a correlation coefficient of .656. It is possible to replicate the study at other hospitals interested in adopting a model to guarantee the correct operation of all their resources. Considering that there are currently 606 hospitals, 18 specialized health institutes, 2296 health centers and 8002 health posts^{4TN1} in Peru. Health care quality improvement is also related to the improvement of its facilities and equipment and, therefore, to their proper maintenance.

The implementation of a maintenance plan optimizes the use of the telecommunications systems and the entire infrastructure of the Daniel Alcides Carrión Surgical Clinical Teaching Hospital in Huancayo, thus prolonging the optimal life span of each system. In addition, the preventive nature of the maintenance plan represents major costs savings, as annual expenditures increase considerably each year.

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RECOMMENDATIONS

The strategic maintenance plan should be continuously reviewed, analyzed and updated according to the new requirements of Hospital Docente Clínico Quirúrgico Daniel Alcides Carrión de Huancayo. Also, management indicators should be established to comply with the objectives of the strategic maintenance plan.

All adverse events that may affect the continuity of service of the hospital's telecommunications system must be identified, classified and prioritized in order to update and improve the response action plan. It is also important to be proactive in searching for vulnerabilities in the system.

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^{4TN1} In Peru, a health post is defined by the Ministry of Health as a health station, found both rural and urban areas, staffed by general practitioners and/or specialists but where surgical intervention is not available.

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