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Measuring process performance within healthcare logistics
- a decision tool for selecting measuring technologies

Abstract:

90. Performance Management in Healthcare Organizations

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Measuring process performance within healthcare logistics

- a decision tool for selecting measuring technologies

Abstract

Performance measurement can support the organization in improving the efficiency and effectiveness of logistical healthcare processes. Selecting the most suitable technologies is important to ensure data validity. A case study of the hospital cleaning process at a public Danish hospital was conducted. Monitoring tasks and ascertaining quality of work is difficult in such a process. Based on principal-agent theory, a set of decision indicator has been developed, and a decision framework for assessing technologies to enable performance measurement has been proposed.

Keywords: Performance measurement, technology assessment, healthcare logistics

Introduction

Logistical processes are essential for a hospital to function and in providing services for the patients. Improving the efficiency and effectiveness of healthcare processes not only economizes on resources but also improves the quality of services. Performance measurement can support an organization to motivate employees and induce learning to improve processes (Neely et al., 2005). In a healthcare logistics context, employees will often perform tasks in various parts of a hospital and without close supervision. From a principal-agent point of view, there is a need to measure and monitor the process (Eisenhardt, 1989a; Melnyk et al., 2004). Technologies such as RFID, barcodes and portable job agents can capture data in a process and enable process measurement (Ferrer et al., 2010; Sarac et al., 2010). When measuring several performance indicators, one technology may not fit all, and a range of different technologies may be needed to enable performance measurement. Selecting the appropriate technologies for capturing data is important to ensure data validity and enable measurement of the most suitable performance indicators. Based on a hospital cleaning case study, a framework is developed that serves as a decision tool for assessing which technologies to implement to enable performance measurement in a healthcare logistics context.

Methodology

In this section, the research objectives, research design, collection of data, data analysis, and research quality are described for the study.

Objectives

A framework is developed by answering the following research questions (RQs):

- RQ1: How can performance indicators measure process performance of a logistical healthcare process?
- RQ2: How can technologies for measuring process performance be assessed for a logistical healthcare process?

The objective is to develop a decision support tool for logistics management within healthcare to decide on which technologies to implement for measuring process performance. *RQ1* is answered by developing a set of performance indicators that reflects the performance of the hospital cleaning process. These indicators are based on the strategic goals of the organization. To answer *RQ2*, the selected performance indicators are then used to develop a framework for assessing and selecting technologies to measure these performance indicators.

Research design and data collection

The research design chosen for this study is a single case study because it provides an in-depth understanding of a problem and is well suited for answering “how” questions (Eisenhardt, 1989b; Yin, 1994). A case study focusing on the hospital cleaning process was conducted at a public Danish hospital. Although cleaning at a hospital is not considered a traditional logistical process, the process contains some logistical elements. First, the service of cleaning is *distributed* across the hospital. Secondly, the technologies investigated are technologies commonly used within *supply chain management* and *logistics*, such as RFID and barcodes (Ramanathan et al., 2014).

Data for the hospital cleaning case was collected over a five month period from October 2014 to February 2015. During the case study, 20 interviews were carried out, the cleaning process was observed, and several documents were collected. Interviews were carried out with managers and supervisors of the logistics and cleaning departments as well as managers from the central IT department and the Strategy department. Case study results were presented to management for respondent validation (Bryman, 2012).

Analysis

A framework was developed by Jørgensen (Jørgensen, 2013) to serve as a decision support tool for assessing technologies in logistical healthcare processes. A modified version of the framework can be seen in Figure 1. The framework depicted in Figure 1 is valid for technologies performing logistical processes and will in this study be generalized for technologies capturing data to measure performance.

A principal-agent problem occurs when a) goals differ between the principal and agent and b) information and verification of behavior is difficult (Eisenhardt, 1989a). Cleaning personnel disperse into all parts of the hospital to clean their designated areas, and it is currently not possible to monitor and check the work of all employees. Providing information through performance measurement could create transparency about employee performance and the quality of their work (Neely et al., 2005). However, if data is not captured automatically, the employee may forget or deliberately neglect the registration of data. Thus, the technology used to capture data in a process affects data validity due to the particular process for capturing data. The principal-agent problem appears to be twofold: 1) getting employees to perform cleaning tasks and 2) ensuring that employees measure the cleaning process. Principal-agent theory was used to assess how the different technologies affect data validity. Based on an analysis of the hospital cleaning case using principal-agent theory, a decision process for selecting the technologies to measure performance was developed.

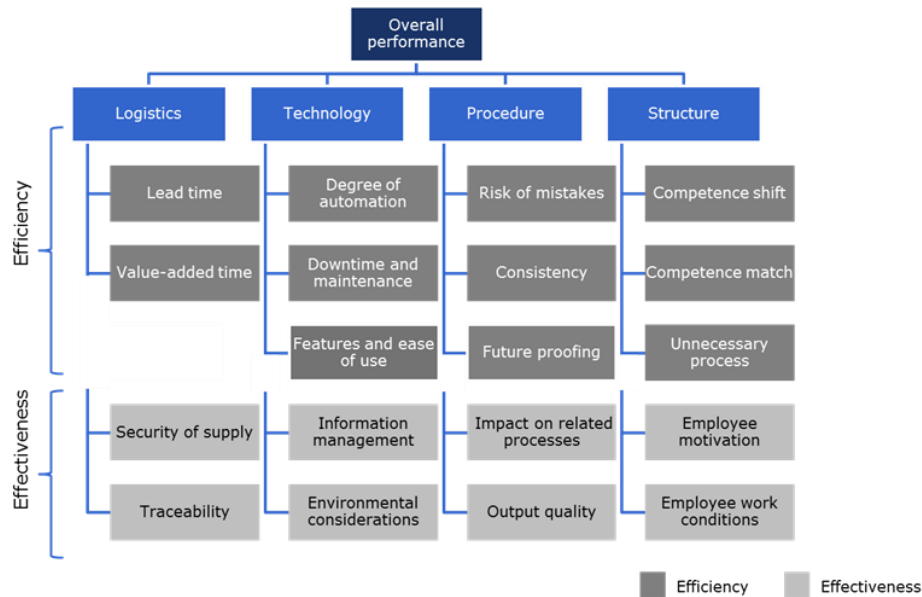


Figure 1 - Decision indicators for assessing technologies in healthcare logistics

Validity and reliability

Data from different sources were gathered and analyzed, and respondent validation was carried out to ensure construct validity (Bryman, 2012). Internal validity was ensured through pattern matching by comparing findings of this study with similar findings from a different context, in this case the framework in Figure 1 (Denzin and Lincoln, 1994; Eisenhardt, 1989b). External validity is limited to a logistical healthcare context within Denmark. This study is a generalization of an existing framework to include measuring technologies. Reliability was ensured through triangulation and colleague review.

Defining the performance indicators

Performance indicators should reflect the strategy of the organization and help achieve organizational goals (Brewer and Speh, 2000). To align organizational behavior with strategic goals, central management had in the case defined the following five performance aspects to be measured: 1) quality 2) resources, 3) productivity, 4) satisfaction, and 5) service delivery. Performance indicators were then defined for three management levels as seen in Figure 2. Investing in technologies would be necessary to enable data registration for measuring *productivity* and *delivery*. The following technologies were assessed: iBeacon, tablet, RFID, barcode and mobile job agents.

In measuring performance of the hospital cleaning process, it is only possible to check the quality of a random sample of rooms. To provide some reassurance of quality for the rooms not checked, supporting performance measures were developed. The productivity measures in Figure 2 aim to support the quality measures. Case study interviews showed that quality and time spent on cleaning are closely related. Demonstrating that a certain amount of time has been spent in a room could therefore provide supporting evidence of the level of quality provided. In line with principal-agent theory, this is an attempt to monitor the employee. It is important to note that measuring is also done to ensure that employees are allowed enough time for tasks.

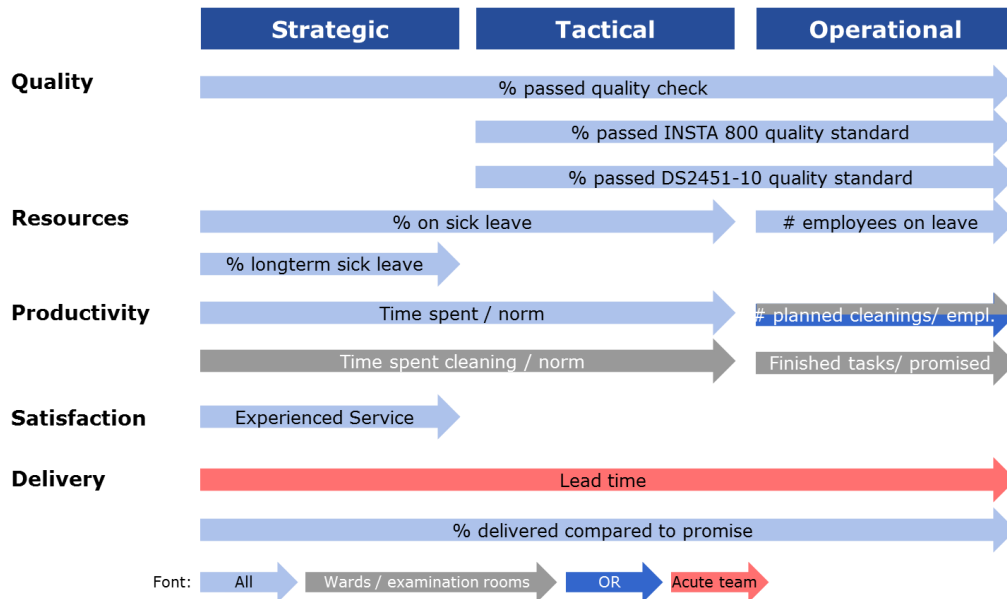


Figure 2 – Selected performance indicators across three managerial levels

Decision process for selecting measuring technologies

Some key steps were identified in the hospital cleaning process. First, a high number of data registrations, i.e. critical mass, is a precondition for a business case to justify an investment in technology. Secondly, when capturing data, some data points would be captured simultaneously in the cleaning process. E.g. the number of rooms cleaned/entered would be measured at the same point in time as starting time or end time of cleaning a room. Data points should therefore be bundled according to when data is captured in the process. Thirdly, technologies may provide the opportunity to potentially improve employee performance and the quality of cleaning; iBeacons and iPads allow for showing pictures and other types of instructions to cleaning personnel.

Data validity was assessed for every data point in combination with each of the five measuring technologies. The process of registering data was analyzed for each of the five technologies from a principal-agent and risk perspective. The following variables were found to affect data validity: 1) number of registrations, 2) level of automation for registering data, 3) employee motivation for performing registrations, and 4) traceability. Thus, the technology capturing a data point affects the validity of that data. The number of registrations and level of automation are closely related to employee motivation to perform the registration. The employee may not want to make personal performance transparent. Furthermore, the employee may forget to actively register e.g. start and end time of a task. The more registrations needed, the more the employee might forget or deliberately neglect to perform the registration. To increase validity of data, a high level of automation coupled with traceability is preferable. Number of registrations and employee motivation will not affect data validity if the data registration process is fully automated and traceable. Traceability is closely related to the principal-agent problem. Ascertaining the location of the employee will ensure that the employee was present at a given point in time. After assessing the validity of data points for each technology, it was clear that for some data points, only one technology could provide sufficiently valid data. Thus, the technologies were a given for these data points. Consequently, data points bundled with these data points were also a given. For the remaining data points to be measured, data validity should be compared to the cost of measuring data. There are several cost aspects of capturing data and measuring

performance. First, there is the investment in and maintenance of technologies. Secondly, there is a cost of processing and maintaining data. Thirdly, a cost occurs if the employee spends time registering data in the process. E.g. registering entry and exit from a room is automatic with RFID, but barcodes require the employee to actively scan the barcode. Lastly, economies of scale can reduce the marginal costs.

Technologies providing the most valid data may not be economically feasible solutions for the organization. The main part of Danish healthcare is public, and funds are limited. This means that funding for logistical investments is often scarce as clinical investments are prioritized. Financial considerations could have practical implications for the choice of performance indicators and measuring technologies. Although performance measures should be governed by the overall strategy of the organization (Brewer and Speh, 2000), the economically feasible technologies may not enable measurement of the preferred measures. Therefore, two additional steps in the decision process are added to accommodate any financial limitations. Based on the analysis presented in this section, a decision process is proposed in Table 1. Decision indicators from Figure 1 that are relevant to the proposed decision steps are included in the table. All decision indicators in Figure 1 were found to be relevant except *environmental considerations*.

Table 1 - proposed decision steps and relevant decision indicators to assess technologies

Decision step	Decision indicators affecting decision step
1. Select performance indicators	Lead time, value-added time, security of supply, traceability, output quality, consistency, information management, competence match, unnecessary process
2. Ascertain critical mass for data registration	
3. Bundle data points	
4. Assess data validity for data-technology combinations	Risk of mistakes, consistency, output quality, degree of automation, employee motivation, employee work conditions
5. Decide to include or reject any quality bonus option	Output quality
6. Determine given technologies	
7. Determine given technologies as a consequence of bundling	
8. Compare data validity with cost of measuring to select technologies for remaining data points	Future proofing, impact on related processes, downtime and maintenance, features and ease of use, unnecessary process
9. Determine feasible technological solutions from a financial perspective	Future proofing, impact on related processes, downtime and maintenance, features and ease of use, unnecessary process
10. Adjust performance indicators if necessary	

Discussion

Measuring performance is an incentive in itself to motivate desired agent behavior (Melnik et al., 2004). The proposed productivity measures do not ensure that the employees actually carry out the cleaning task sufficiently, but they do ensure that the person was there when the registration was made. Similarly, knowing how much time was spent in a room does not ensure that time was spent cleaning or even that it was done adequately. Thus, the principal-agent problem is still there, but it is reduced. The

other principal-agent problem addressed was that of measuring data. If the process of registering data is not automated, the lack of data will show if the employee did not register data, which could itself provide an incentive for data registration. However, automating and tracing data registration will eliminate the problem entirely.

Environmental considerations were not included in the suggested decision process, but it could be taken into consideration if possible and if of significance to the organization. However, it was not relevant in this case. The financial considerations included in the decision process are deliberately included towards the end of the process to prevent innovative ideas from being discarded early in the process.

The research questions are answered by analyzing how performance measures can be developed for a process where employees are not monitored and where the level of quality is difficult to ascertain. Furthermore, a decision tool consisting of 10 steps was proposed based on an analysis of the process for registering data.

Limitations and future research

Findings in this paper are limited to a healthcare logistics context and should be validated for other contexts and settings outside of Denmark. Financial considerations provided some practical implications for the choice of performance measures. Other practical implications for deciding on performance measures and measuring technologies should be investigated.

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