

The Role of Maintenance and Facility Management in Logistics: A Literature Review

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Abstract

Purpose - The purpose of this paper is to provide a literature review on the different ways of carrying out Facility Management and related topics in order to uncover that there is limited research regarding the impact of Facility Management on the logistics and operational performance of warehouses.

Design/methodology/approach – Four different focus areas have been identified and for each one different methodologies and streams of research have been studied.

Findings – The study underlines the importance of Facility Management for the logistics operations; therefore it supports the notion that investments aiming at preserving the status of the building and service components of warehouses are crucial.

Originality/value – This paper aims to suggest to Facility Management managers that they can contribute to enhance business performance by designing effective Facility Management strategies.

Keywords Facility Management, Logistics, Maintenance, Warehouses

Introduction

In the last decades, Facility Management (FM) has established itself as a key business service factor (Scupola, 2012). FM involves supporting services and coordinating functions necessary for maintaining, operating and managing physical assets and workplaces. As a result, the needs of an organization and its employees can be met and successful business activities are enabled (Lavy *et al.*, 2010). FM can be defined as the integration and alignment of the non-core services required to operate and maintain a business to fully support the core objectives of an organization (Tucker and Pitt, 2009).

FM has been gaining increasing credit for the crucial role it can play to generate efficiency and cost savings in business operations.

FM has also been being successfully applied to maintaining and operating diverse types of constructed facilities for logistics and warehousing. In this context, maintenance plays a significant role. In fact, it assures the full service of the warehousing system, which includes both, building, utilities, and material handling equipment. Despite increasing recognized importance of FM as an integrated component of business operations, most companies still complain about the rising cost of maintenance of industrial and logistic facilities. Managers often seek to cut FM spending by reducing repair interventions to a minimum and by delaying preventive maintenance actions, leading to a cascade of extra costs in the medium and long term (De Marco *et al.*, 2010).

Accordingly, the study of the FM function in the fields of logistics and warehousing is becoming an interesting issue for many scholars and practitioners. However, limited literature is available in this area and previous contributions are mainly focused on FM actions, performance indicators in logistics, operations and maintenance, and FM contracts for warehouses and logistic buildings. Also, no framework literature review is at hand to set the importance of FM within the context of warehouse operations, and, in particular, very little analysis has been carried out to understand the importance of FM to create the conditions for improved performance of logistic businesses.

To fill this research gap, the present paper provides a comprehensive literature review of the FM function in the logistics and warehousing arena in order to disclose the interesting fields of available research, and identify the weakest areas so that future research directions can be addressed.

The paper is structured as follow. First, pertinent literature review is presented as decomposed into four main domains, namely: Performance Measurement in FM; Performance Measurement in Logistics Operations; Maintenance of Warehouses; and Outsourced FM Contracts. Then, an analysis of the given

literature review is developed. Finally, implications and conclusions are drawn together with future research directions.

Performance Measurement in Facility Management

The FM discipline emerged out of practice because of a clear need to focus on elaborate facilities, which crucially support the activities of most of today's organizations. FM services were first provided in the 1960s in the USA, and they were fully developed in 1970s; but it was only in the 1980s that such FM market developed in Europe (Salaris, 2002). The FM function is mainly associated with building facilities and auxiliary services; it includes activities such as building maintenance, utilities management, gardening, surveillance, cleaning, etc. (Ancarani and Capaldo, 2005). The growing competitiveness in the FM service sector has raised the need for FM providers to differentiate the services they offer from their competitors. This differentiation can be achieved by giving attention to the specific requirements of the clients. To gauge effectiveness of FM and reach desired performance, it is necessary to get an understanding of the current conditions of a facility. Performance measurement has been receiving an increasing attention over the past 20 years because of the changing nature of work and growing business competition. The importance of measuring the performance of the FM function becomes evident because costs associated with maintenance represent the largest ones for an organization after the cost of personnel and the cost of the production assets (Brandt, 1994). This proves further the need for FM to be part of the business model. FM should aim not only at simply reducing the operating expenses of a constructed facility, but also at enhancing the efficiency of the facility (Lavy *et al.*, 2010). Basically, the idea is that FM should include quantitative performance indicators. Thus, performance metrics is an important step in the process of performance evaluation for it includes relevant indicators expressing the performance of the facility. Through an effective measurement system it is possible to support decision makers with regard to the allocation of resources within an organization. Therefore, it is of crucial importance to identify a set of key performance

indicators (KPIs), to establish effective performance evaluation metrics for the facility under consideration (Cable and Davis, 2004). KPIs are general indicators of performance that focus on critical aspects of outputs. The vast majority of FM practitioners have realized the importance of performance measurement for the success of the business. In particular, four main business areas have been identified: value for money, client focus, high standard of service delivery, and tender selection based on performance (Meng, 2011).

In recent years we have observed the introduction of KPIs in the FM discipline, such as loss of business due to failure in service, provision of project to customer satisfaction, provision of safe environment, effective utilization of space, effectiveness of communication, service reliability, professional approach of staff, and responsiveness of problems. Moreover, Meng (2011) underlines how, according to the results of his survey, FM organizations benefit from effective performance measurement and the proper choice of KPIs is considered crucial for the improvement of the performance. KPIs in FM are associated with cost of operations, maintaining and running a facility, revenue generated space usage and management, environmental, health and safety issues (Enoma and Allen, 2007). The ten most important KPIs selected by respondent are: client satisfaction, cost effectiveness, response time, service reliability, health safety, environmental compliance, staff commitment, client-service provider relationship, and Information and Technology application. Moss *et al.*, (2007) suggest adopting the Quality Managed Facility (QMF) (Alexander, 1992) as a KPI for performance measurement; it is a process to guide an organization through a quality journey to excellence, utilizing continuous improvement of service quality and customer satisfaction. The drivers of this process can be “hard”, such as: performance, productivity, viability- or soft, such as flexibility, innovation, reputation. Hinks and McNay (1999), carry out a survey on the most important KPIs that should be taken into account in the different performance dimensions, namely: equipment provided to meet business needs, correction of faults, management of maintenance, reliability, effectiveness of helpdesk services, and standard of

cleaning. Lavy *et al.* (2010) propose a list of KPIs classified under the following categories: financial, physical, functional, and survey based. They state that a strong FM approach provides needed support to the organization's mission, the realization of future facility requirements, greater cost efficiency, and the ability to anticipate results of current management decisions. On the contrary, poor FM could result in inadequate facilities to support functioning, not contributing to the organization's mission, cost inefficiencies, and unavailability of the facility for future needs.

Performance Measurement of Logistics Operations

Over the last decade, the role of logistics in most businesses has increased in both scope and strategic importance. The Council of Supply Chain Management Professionals (2007) defines logistics management as "that part of Supply Chain Management that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services and related information between the point of origin and the point of consumption in order to meet customers' requirements". Initiatives such as supply chain integration, quick response and just in time, inventory control have revolutionized not only the way companies manage their logistics activities, but also how they run their entire business. Logistics strategies have influenced customer selection, product design, partnership building and many other core business processes (Caplice and Sheffi, 1995). Logistics services have become a critical issue for companies' performance. The highly competitive environment along with customers' demand has forced companies to continuously evaluate, improve and reengineer their logistics operations (Gotzamani *et al.*, 2010). More and more companies have started to consider supply chain and logistics performance important elements for the achievement of competitive advantages (Harrison and New, 2002). Logistics performance measurement is the term for a set of metrics and processes related to assessing and evaluating how accurate the planning is and how well the execution is carried out (Chae, 2009). Gunasekaran and Kobu (2007) state that measures in logistics are essential for an effective management of the operations inside a company. Logistics performance

encompasses multiple service metrics, such as lead time and on-time delivery, which are related to each other. The purpose is to monitor, control and direct logistics operations. Logistics performance is positively impacted by supply chain management strategy and directly impacts marketing performance which in turn, influences financial performance (Green *et al.*, 2008). Logistics performance is often related to delivery service, logistics cost and tied up capital. Delivery service can be split up and measured as lead-time and on time delivery (Forsuld, 2011). The framework developed by Andersson *et al.* (1989) classified the measures into two main groups: financial measurement methods that encompass budgeting techniques, cost estimating, mission costing, and engineered physical measures such as productivity, lead times, quality, and customer service. Chae (2009) proposes key metrics for the different processes of a supply chain: Plan, Source, Make, and Delivery. Each process is associated with a panel of KPIs. The Plan process is measured via forecast accuracy and planning cycle time; the Source process is measured by supplier fill rate; the Make process by order fill rate and on time production; and the Deliver process is measured through on time departure. Ip *et al.* (2011), split KPIs in measurement objectives: effectiveness, efficiency, productivity, quality, innovation and profitability. The associated KPIs are: cost, dependability, speed/time, flexibility, and quality. These KPIs can interact with and contribute to each other to ultimately achieve a cost advantage. Gunasekaran *et al.* (2004) include six KPIs in their study: supplier delivery performance, lead time, supplier pricing against market, efficiency of purchaser order cycle time, efficiency of cash flow method, and supply booking procedures.

Logistic Service Providers (LSPs) should measure their performance based on five strategic resources (physical, human, information, knowledge and relational resources) in order to achieve competitive advantage (Wong and Karia, 2010). Physical resources include tangible assets required to perform logistic tasks. They are logistic centers, hubs, vehicles and aircraft. Human resources are referred to as workforces who are skillful and experienced in performing logistics tasks and building up and

maintaining customer relationship. Knowledge resources are the abilities to gaining access to rare resources and relational resources are meant as the abilities to build up long-term working relationship with key suppliers and customers.

The pressure on LSPs in operating business is getting heavy due to the continuous increase in demand of clients. LSPs need to monitor and improve their performance at four different levels, namely: operational, management, customer service and operation cost level (Chow *et al.*, 2005). Therefore, it is crucial for LSPs to formulate business strategies in order to keep distinctive competitiveness advantage in such a changing market environment (Davenport *et al.*, 1996). Furthermore it is always a challenge for logistics strategy planners to develop a series of strategies integrating the facilities. These actions encompass material handling and facility design, distribution and service facility, and facility layout. In this way it is easier to align the clients' logistics strategies.

Maintenance of Warehouses

Today's successful warehouse operations view maintenance as a top priority to ensure maximum utilization of both facility and equipment assets, thus having a strong influence on logistic operations (Campbell, 1995). Effective warehouse maintenance practices must become part of the warehouse strategic master planning process. The scope of warehouse operations in terms of location, size, and type of equipment addresses whether the maintenance plan has its own in-house maintenance, or it depends more on contract services.

Regardless of the source of repair, two responsibilities of warehouse maintenance must be achieved: safe and reliable operations of material handling equipment and maintenance of facilities, grounds, utilities, plumbing, heating, air conditioning, security system, fire protection, etc. (Smith and Tomkins, 1998). Salonen and Bengtsson (2011) show that manufacturing companies can achieve substantial improvement on their productivity via development of strategic maintenance. Maintenance of built assets is often considered as a cost burden (Sherwin, 2000) and organizations are reluctant to spend,

aiming at preserving the condition of their assets (Chew *et al*, 2004). Maintenance should be considered not only as a mere source of cost, but rather as a way for potential gain (Taillander *et al.*, 2011). Therefore, facility managers should consider the business implications of their actions before large maintenance program are designed and carried out. Moreover, it is possible to monitor the impact of any action against key business drivers through feedback mechanisms (Jones and Sharp, 2007). By identifying the true strategic goals of maintenance and by implementing a well-formulated strategy, companies can optimize the return on investment of their maintenance expenditure (Salonen, and Bengtsson, 2011). The measurement of maintenance performance appears to be very important and tracking the performance of maintenance operations should be a key management issue. This is a complex task because multiple inputs and outputs are involved in the process (Tsang *et al*, 1999). Arts and Mann (1995) use the time horizon to classify maintenance decision into three categories, namely strategic, tactical, and operational. Strategic maintenance decisions are made in the selection of design options, tactical ones relate to the formulation of policies for effective and efficient use of resources, and operational decision are more to achieve a high level of effectiveness and efficiency in maintenance activities.

Maintenance can be divided into two main groups (Lind and Muyingo, 2012), namely corrective and preventive maintenance. Corrective maintenance, also known as breakdown, failure-based, or run-to-failure maintenance, is the simplest type of classical maintenance policy. It is based on the idea that an item is used until it breaks, with the only activity centering on repair and servicing of the parts. Preventive maintenance refers to cases where repairs or replacements take place without the occurrence of any specific fault. It can be subdivided into condition-based maintenance and time-based maintenance. Condition-based maintenance is a preventive maintenance approach where the object is inspected on a regular basis and the object serviced or replaced when a certain condition is observed.

Time-based maintenance, is similar to preventive maintenance, but tasks are performed at a frequency dictated by the course of time.

The approaches to measure maintenance and FM performance can be classified into three types, namely: system audit, value-based assessment, and balance scorecards. System audits give an approach to predict future performance focusing on interactions between the social system in the organization and its operating environment (Dwight, 1994). Value-based assessment seeks to evaluate the impact of maintenance activities on the future value of the associated asset. This methodology is laborious and it gives only financial information related to future cash flow without considering the associated risks (Dwight, 1999). Balanced scorecards are based on the idea that no single measure is sufficient to indicate the total performance of a system. They consist of a panel of indicators, such as response time, service commitments, and customer satisfaction (Eccles, 1995). Through the adoption of a set of KPIs it is possible to evaluate the objective of a strategy. Similarly, data collection methods and contractual responsibilities should be defined in a strategy implementation. In this way organizations are able to identify what factors may potentially influence the gap between current and desired level of performance.

Outsourced Facility Management Contracts

Organizations have been increasingly turning to outsourcing in an attempt to enhance their competitiveness, increase profitability, and refocus on their core business (Burdon and Bhalla, 2005). Outsourcing is often seen as a critical business capability that enhances company's overall profitability. It allows managers to leverage resources and capability by concentrating on core competences that create value for the company's customers (Yoon and Naadimuthu, 1994). As a matter of fact manufacturing and logistics companies usually perform a mix of in-house repair and contract maintenance on their physical assets. Some maintenance activities are carried out by the factory floor staff, others are serviced by a supplier, especially in case of actions requiring equipment or skills that

the plant personnel does not have. The way maintenance contracts are managed often depends on customary practice, corporate culture, and available human resources of the management team (Lai and Yik, 2007). While outsourcing has great potential for significant benefits, it also includes some potential risks such as loss of critical skills, loss of cross-functional communications and loss of control over a supplier. Another problem related to maintenance activities is the result of the supplier extensive knowledge of the technical system and the customer's lacking information about the technical aspects of the system. The supplier can use its own information, so-called hidden information, for its own benefits and take actions, hidden actions, which could be not necessary in the interest of the customer. This is referred to as the moral hazard problem, wherein the customer can observe the outcome of the supplier's actions, but he cannot verify supplier's actions (Jong and Smit, 2012). To reduce the risks, the contract and the contracting process should be dealt with in delicate manner. Specialists in the maintenance technical requirements and specialists in technology and business needs, as well as specialists in contract management should be involved in the process. The contract itself should have a conflict resolution and problem solution mechanism for uncertainties and inevitable changes in the requirements and technology changes. Other measures for reducing risks include splitting maintenance requirements into more than one supplier (Al-Turki, 2011).

However, many organizations, both in the public and private sectors, are increasingly outsourcing their asset maintenance jobs. Contractual management represents one of the greatest challenges facing the FM discipline in the modern business world. The outsourcing strategy and the contractual arrangement is of crucial importance to reduce the risk of disputes between the contract parties that could escalate costs, increase risk, and jeopardize the performance and level of satisfaction (Lai, *et al.*, 2004). Contracting practice is influenced by several cultures and tasks-related factors. FM services are usually long term and involve frequent contacts between supplier front-line staff and client end-user. Thus, we might expect FM relations to be collaborative and trust-based (Kadefors, 2008). The irregularities or

inadequacies in maintenance contracts have often led to disagreements that reduce contract performance (Pearson, 2002). This is especially applicable to long life equipment maintenance contracts (Datta and Roy, 2010). It is important that the risks of not achieving the agreed targets are identified and written down. As targets are achieved, new targets will replace them, and this situation is updated with respect to the financial performance of the contract for all parties (Akhlaghi, 1996). Moreover, when lacking a long term maintenance service partnership, the supplier will be hesitant to invest in staff development, equipment and new technologies to perform the service (Martin, 1997).

Contract design in FM varies considerably depending on the contracting parties' scope of the contract and type of relationship. A complete FM contract comprises numerous documents that specify responsibilities, KPIs and compensation principles (Kadefors, 2008). Cotts (2003) states that FM has not truly developed innovative contracts and contracts forms, to manage outsourcing better. Salonen (2004) points out the importance of trust that appears to be very important, especially during the contracting phase. This is because it is very difficult to build up a control mechanism.

Burdon and Bhalla (2005) propose two different kinds of contract for engineering and FM activities. On the one hand, schedule of rates contracts tend to be used as a starting point for outsourcing experience and less understanding contracts by organizations with less outsourcing experience. On the other hand, alliance contracts for either services, with profits based on performance. Jong and Smit (2012) argue that collaborative contracts might facilitate the exchange of information and shared investments in inter-organizational processes and enable continuous improvements at the mutual benefit of the operator and maintenance organization.

Two of the most common kinds of contract in operations and maintenance are work package contract and fixed price contract. In work package (time, material and labour) type of contract, the initiative for innovations was with the operator companies, unless some motivations (such as incentives, improving market position, improving relationship) existed for the service provider to take such initiatives. Fixed

price contracts for well- defined maintenance activities are considered better respect to the innovation, even if the risk is transferred completely to the service providers (Panesar and Markeset, 2008).

At-Turki (2011) underlines the potential benefits of outsourcing maintenance activities such as reduced total system costs, better and faster work done, exposure to outside specialists, greater flexibility to adopt new technologies, and more focus on strategic asset management issues. Moreover, he states that the service should not be outsourced if the company does not have the capability to assess or monitor the provided service and when it lacks the expertise in negotiating contracts.

Critical Analysis and Future Research Directions

The analysis of the presented literature shows that FM has been traditionally considered as a way of managing cost efficiency rather than a method to achieve multidimensional enhancement of business competitiveness. FM can bring value towards organizational effectiveness, through management and the improvement of services (Noor and Pitt, 2009). Effectively planned FM services can create significant business returns. As competition intensifies, and as change accelerates, many leading organizations are re-valuating the contribution that FM makes to business success (Goyal and Pitt, 2007).

Firms are realizing that there is a critical need for proper maintenance of facilities and assets (Meulen *et al.*, 2008). Industrial plants and equipment are becoming technologically more advanced, and at the same time more complex and difficult to control. In addition, just in time, lean and agile manufacturing and logistics, and the use of automated storage and retrieval systems have made logistics assets increasingly vulnerable to risks and susceptible to diverse consequential effects due to breakdown (Holberg, 2001). In this context, logistic KPIs have not been widely adopted, and companies find that there is a lack of practical guidelines on how to develop them (Chae, 2009). Similarly, Bai *et al.* (2010) underlines that formal models based on analytical tools for KPI determination are missing with special regard to supply chain related KPIs. Therefore FM actions can be summarized as creating an

environment that is conducive to carrying out the organization's primary operations, taking an integrated view of the services infrastructure, and using this to deliver the enhancement of the core business (Atkin and Brooks, 2002). Moreover, with the growing dependence on technologies for most of business operations, it is important to develop appropriate maintainability and reliability strategies to ensure that these organizations are able to deliver high quality and dependable services to their customers (Madu, 2000). FM should be included and positioned as a strategic support function and FM strategies have to be aligned with the core activities of an organization. Goyal and Pitt (2007) argue that the relationship between organizational strategic (core business) and operational (non-core business) activities is vital in FM. FM needs to be recognized at the boardroom level. Hence, to be effective maintenance actions should be consistent with business strategy; in this way it can be more proactive in contributing to the competitive advantage of a company (Pintelon *et al.*, 2006). Alsayouf (2006) states that at least 14% of potential improvements on the return on investment (ROI) are directly related to the contribution of the maintenance function to lost profits. Similarly, Salonen and Bengtsson (2011) show that the awareness of maintenance as a driver of the company's profitability has increased. At the same time, maintenance managers have worked hard to sell change initiatives. In particular, many companies have decreased the downtime due to corrective maintenance, which is more expensive than the time used for preventive maintenance. In this context, Blanchard (2004) demonstrates that a large percentage (e.g. 70% for some systems) of the total life cycle cost for a given system is due to operating and maintenance activities. Tucker and Pitt (2009) prove that strategic use of customer performance measurement processes can enhance the provided FM services. Olanrewju *et al.* (2011), show a survey on university buildings in Malaysia indicating that maintenance issues are considered as tactical rather than strategic. Alsayouf (2009) carries out a survey involving 185 Swedish companies and results show that 28% of firms have no maintenance strategy, 48% have a written strategy, and 24% have an oral one. Also, it was found that about 39% of the respondents have a maintenance department

that is independent from the production department, while about 56% of the sample companies maintenance is part of the production department. More than half of the time is spent on planned maintenance, 37% on unplanned tasks, and only 13% is allocated to design and planning of maintenance actions. Finally, most of the firms do not use a specific methodology in the selection of the maintenance policy, but the decision is based on the knowledge and experience.

The Tesem Research Group (2012) has conducted a survey among Italian firms. The portion of time dedicated to preventive maintenance is 47% of the total time devoted to maintenance activity for process companies, 41% for manufacturing and 68% for network ones. 47% of companies carry out maintenance with in-house staff, even if they do not have an internal maintenance department. 37% manage internally maintenance with the coordination of a structured department. 8% outsource maintenance, but the activities are managed by an internal dedicated department. 8% rely on an external supplier and they do not have a maintenance department. This research shows that maintenance is still not completely integrated with the processes, but more and more companies are involved on Information and Communication Technology (ICT) processes in order to improve the efficiency and generate savings. Therefore, good maintenance management may reflect well on various sectors of a company and even boost companies to extent that, through planned maintenance, they will obtain a competitive advantage (Reis *et al*, 2009).

De Marco and Mangano (2011) prove that a few factors associated with the operational characteristics of the logistics business have a significant impact in improving the logistics service level. In addition, maintenance cost has an influence on the logistics service level performance. Thus, it is crucial to maintain both building components and logistics equipment in order to avoid expensive and ineffective managerial practices. These first results underline the importance of maintenance for the logistics service level performance. In particular, they support the notion that increased investment to preserve maintenance status of the building and service components of warehouses is very likely to lead to

improved performances of the logistics service level. Therefore, the linkage between FM actions and the efficiency of the logistic service level should be deeply studied in the future not only in a qualitative way, but also from a quantitative perspective. As a matter of fact, through the adoption of statistical techniques it is likely to prevail upon the practitioners that the FM arena can significantly improve the logistic business.

It can be also argued that the FM is continually changing and in the last years FM providers are expected to be a part of delivering on environmental commitments. Price *et al.* (2011) underline that sustainable business practice is not yet embedded into the FM industry. However, sustainability is playing a crucial role and what is needed now is an understanding of the driving forces for sustainability in the FM industry, especially in a period of bad economy when it is very important to implement efficiency and effectiveness. As a matter of fact, FM heavily impacts on the environmental aspects of a warehouse that, in turn, influence maintenance and operational costs. Therefore, future research directions are addressed to the investigation of the relationship between FM strategies, environmental actions, and associated costs that appear to be crucial for long term sustainability.

Future works should also orient towards the development of a standard FM strategy for the warehouses of the future, which are likely to be characterized for their lean processes and energy efficiency. In fact, a developed view of FM as an integrated approach aiming at operating, maintaining and improving infrastructures is necessary to enable the primary objectives of an organization (Nutt, 2004).

Implication and Conclusion

This paper presents a review of literature available on the main research areas related to the FM discipline applied to logistics and warehousing. The aim of FM is the improvement of the effectiveness and efficiency of physical assets and workplace to contribute to enhancing operational business performance. In this context, improved logistics performance via FM and maintenance services is a significant factor to achieve continued competitive advantage.

The logistics industry is aware of the role of maintenance in improving the reliability of systems and improving performance of the organizations. Nevertheless, there is a need to spend and invest more in maintenance, since the status and the role of maintenance are not highly recognized.

However, in the last years the awareness that appropriate strategies for FM can generate profits and can be an important source of competitive advantage is growing (Sherwin, 2000). Therefore maintenance is playing a role on the strategic operational planning process: it is not only responsible for the reliability and the safety of the assets, but it can also fulfill environmental requirements. The top management should provide leadership and support toward this strategic direction and they should make greater efforts to link the maintenance strategy to the overall corporate strategy.

This literature review underlines the importance of FM for logistics performance and addresses the need to carry out research to better explore the relationship of the FM function with logistics performance and, in turn, with the business strategy of an organization.

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