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ROLE OF TECHNOLOGICAL INTEGRATION IN SUPPLY CHAIN CORROBORATION ON PERFORMANCE OF MANUFACTURING FIRMS IN KENYA

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ABSTRACT: *The main purpose of the paper was to assess role of technological integration on performance of manufacturing firms. The target population of the study were managers or equivalent from Six (6) departments that is Procurement, finance, legal, stores, human resource and quality control because they are directly concerned with supply chain. The study adopted the use of a questionnaire and a document analysis as the main research instrument. The study adopted both quantitative and qualitative approaches, implying that both descriptive statistics and inferential statistics were employed. Quantitative data collected from the document analysis was analyzed statistically using the Statistical Package for Social Scientist (SPSS version 22). The study tested the significance hypothesis at 95% confidence level using regression techniques. The findings on the effect of technology integration revealed that technological integration has a positive and significant effect on firm performance, 0.731, p < 0.05. Thus, technology integration as concept of supply chain collocation is key determinants of performance of manufacturing firms. Firms are thus encouraged to invest in enhancing coordination efforts through utilization of cost-effective technologies. In addition, the investments should also be used to address the integration of technology.*

KEYWORDS: Performance, Manufacturing Firms, Technological Integration, Supply Chain Collaboration.

Introduction

Firm performance depends on whether or not a firm can create and commercialize knowledge in a timely and cost-efficient manner (Sampson, 2017). Performance of firms is of vital importance for stakeholders and economy at large. For investors the return on their investments is highly valuable, and a well performing business can bring high and long-term returns for their investors (Mirza and Javed, 2013). To garner performance benefits, firms need capability from overall operations (Flynn et al., 2010; Wu et al., 2010). The capabilities that enable firms to cope with uncertainty and gain performance through supply chain collaboration are imperative. Successful implementation of supply chain collaboration (SCC) by Wal-Mart has encouraged many manufacturing companies to initiate collaboration (Ramanathan, 2011). Subsequently, collaboration between suppliers and retailers has become a common practice in many recent supply chains. However, measuring the benefits of collaboration is still a big challenge. Based on supply chain literature and practice few studies have assessed role of technological integration in supply chain collaboration on performance of manufacturing firms in emerging economy such as Kenya.

As today's integrated supply chains require collaboration at many levels and from various functions, executives are increasingly looking for innovative ways to leverage existing and new supplier relationships for their expansionary pursuit. Kumar and Banerjee (2011) found that supply chain collaboration entails determining how company buyers interact with suppliers. It is a mirror image of customer relationship management. Just as a company needs to develop relationships with its

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customers, it needs to foster relationships with its suppliers to ensure quality goods and services, timely and assured deliveries and information flow to assist both organizations in planning (Spekman, 2016). Emiliani (2013) established that despite the various benefits of SRM, establishing strategic collaboration with key suppliers can be highly challenging. Thus, there is need to integrate technology in supply chain collaboration.

Information (and communication) technology plays a central role in supply chain management in the following aspects. First, IT allows firms to increase the volume and complexity of information which needs to be communicated with their trading partners. Second, IT allows firms to provide real-time supply chain information, including inventory level, delivery status, and production planning and scheduling which enables firms to manage and control its supply chain activities. Third, IT also facilitates the alignment of forecasting and scheduling of operations between firms and suppliers, allowing better inter-firms coordination. As such, the problems in coordinating supply chain activities which often are hindered by time and spatial distance can be reduced (Paulraj and Chen, 2017). The use of IT in supply chain has received considerable attention with various technologies being introduced for Business-To-Business (B2B) communication, including web internet, B2B private (Ethernet), and EPOS (Electronic Point of Sale). Studies have shown that effective IT connection improves the integration between supply chain partners in terms of material flows (Soliman and Youssef, 2011). However, Research on the use and benefits of IT in SCM without the focus on specific technology is fewer in number. The research on the benefits of the use of IT in SCM includes a number of surveys investigating the impact of IT on supply chain integration, customer integration and service (Closs and Savitskie, 2003), supply chain time performance (Jayaram et al., 2000), financial performance, or a combination of these (Vickery et al., 2003).

Problem formulation

Performance of the manufacturing firms is considered as a source of concern to both public and private sector clients. Manufacturing firm's performance remains a prominent issue in service delivery all over the world (Robinson *et al*. 2005). However, in manufacturing firm, Gwayo *et al.*, (2014) noted, there is a growing concern regarding the reasons why the requisite objectives are not achieved as per the public expectation. Muchung'u (2012) lamented that, some projects takes as many as 10 years before they are completed due to supplier related problems. The foregoing has resulted in evitable cost overruns, time overrun, idling resources, and also inconveniences to the targeted beneficiaries of such projects (Kikwasi, 2012). This is so due to the fact that, incomplete and/or unsuccessfully completed projects affect manufacturing performance. The challenge of demand for quality service and upcoming competitions for most of the firms has realized the need for quality service delivery and efficiency. Supply chain technology integration play a key role in ensuring that this is achieved (Chepng'etich *et al.,* 2015). Manufacturing firms are one of the most crucial sectors in Kenya's economy. They contribute a significant percentage of the Gross National Product (GNP) and employ tens of thousands of workers. However, a lot of concern has been raised by members of public and development partners on deteriorating performance of manufacturing firm. Major scandals in Kenya, like in other countries, revolve around ineffective performance, which could have been avoided by incorporating strategic alliances policies in the procurement cycle (Ayoyi and Odunga, 2015). If manufacturing firms can integrate technology in supply chain collaboration, they may improve their performance. However, previous studies did not address the integration of technology

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in supply chain collaboration on performance of manufacturing firms in Kenya. Thus, this study hypothesized that:

H_0: *There is no significant influence of technological integration on the performance of manufacturing firms in Kenya*

Theoretical Review

This study was anchored on E-Perspective Theory. Procurement performance lacks an overarching definition and encompasses a wide range of business activities. For example, (Choi and Rungtusanatham, 2001), state that procurement performance remains a first generation concept aimed at buyers, which should progress into e-sourcing and ultimately into e-collaboration. E-collaboration allows customers and suppliers to increase coordination through the internet in terms of inventory management, demand management and production planning (Lee, 2003). This facilitates the so-called frictionless procurement paradigm (Brousseau, 2000). This research recognizes the extensive nature of procurement performance and uses the definition provided by (Min and Galle 2001,) where procurement performance is a business-to-business (B2B) purchasing practice that utilizes electronic procurement to identify potential sources of supply, to purchase goods and service, to transfer payment, and to interact with suppliers. The authors believe that this definition provides the scope to investigate the basic level of procurement performance in the Irish ICT manufacturing sector.

The internet has been widely adopted by firms with the aim of improving performances both in internal processes and in processes going beyond their boundaries (Barratt and Rosdahl, 2002). Despite the fact that business-to-business (B2B) trade has enjoyed a quieter existence online than business-to-consumer (B2C) (Barratt & Rosdahl, 2002) the benefits of procurement performance in a B2B setting are significant (Min and Galle, 2001). Indeed it has been claimed that procurement performance has become the catalyst that allows firms to finally integrate their supply chains from end-to-end, from supplier to the end user, with shared pricing, availability and performance data that allows buyers and suppliers to work to optimum and mutually beneficial prices and schedules (Morris et al., 2000).

Usually firms adopt procurement performance systems to manage the purchase of low critical products and services (Min and Galle, 2001). In summation it is noted that the extent of procurement performance adoption remains in a formative stage, falling short of the type of e-sourcing and e-collaboration suggested by (Morris et al., 2000). Common procurement performance tools are online catalogues and direct auctions, where reverse auctions remain unpopular with sellers (Basheka & Bisangabasaija, 2010). Procurement performance implementation is characterized by the direct and indirect procurement divide, where firms tend to use online systems for uncritical items (Min and Galle, 2001). The transition to modern procurement performance calls for strategic adaptation. It is one strategy, though, that requires much organizational change (Macinnis and Jaworski, 2009). The above theory instigated the third research question: How does inventory optimization affect the procurement process in state corporations' performance.

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The use of information technology (IT) has facilitated the reduction of coordination costs, which has been extensively documented in the literature (Bakker et al., 2008). For example, electronic market places, facilitated through IT, reduce the cost of searching for obtaining information about product offerings and prices (Bakker et al., 2008). Also, collaboration facilitated by information sharing can lower transaction costs (in particular coordination costs) as firms can thereby reduce supply chain uncertainty and thus the cost of contracting. This can be explained with an example: If a supplier is unable to accurately predict the price of its product inputs, it will be reluctant to enter into a contract, which locks it into a fixed price for an extended period of time (Arrowsmith, 2002).

Uncertainty in the context of supply chains and more specifically in manufacturing is caused by supply uncertainty, demand uncertainty, new product development uncertainty, and technology uncertainty Adams et al. (2002). Supply uncertainty relates to unpredictable events that occur in the upstream part of the supply chain. Among the causes to supply uncertainty are shortages of materials and late deliveries. Clearly, supply uncertainty can disrupt manufacturing and have an adverse effect on sales, where distributors and retailers down the chain are also affected. Demand uncertainty can be defined as unpredictable events that occur in the downstream part of the supply chain (Koufteros, 1999). Demand uncertainty (or demand risk) can result from seasonality, volatility of fads, new product adoptions, or short product life cycles (PLCs) (Johnston, 2005). Furthermore, (Choi and Krause, 2005) identify three sources for the uncertainty of demand arising.

Another uncertainty related to manufacturing concerns new product development. New product development uncertainty can stem from unpredictable events during the process of market research, product design, and product prototyping. Finally, technology uncertainty refers to the fuzziness in the selection of a suitable technology platform (Koufteros, 1999). An example is the trade-off between a fool-proof manufacturing technology (perhaps dated), compared to a prospective technology offering better price to performance but whose viability is not certain (Klein, 2007). Furthermore, uncertainty can also arise from political (e.g. fuel crisis), natural (e.g. fire, earthquake), and social uncertainties (e.g. strikes) (Johnston, 2005). Thus, this theory is support of technology integration on performance of manufacturing firms.

LITERATURE REVIEW

Information Technology (IT), as part of a firm's resource portfolio provides a constant competitive advantage (Wu & et al, 2006). Sometimes the terms Information Systems and Information Technology are used, interchangeably, but these are two different concepts. Information System refers to all components and resources necessary to transmit and to process information. In contrast, information technology refers to all hardware, software, network and data management systems, which are essential to exploit system (O'brein & Marakas, 2010). In general, the primary objective of IT is to expedite and to facilitate access to information via the newest communication tools and techniques. IT categories have been studied by many authors, Ifinedo and Nahar (2009) mentioned IT asset, satisfaction with legacy IT system and employee's general IT skills as IT organization factors. Byrd and Davidson (2003) studied IT factors in three groups: 1-Top management support of

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IT 2- IT department technical quality 3- IT plan utilization. Wu et al. (2006) focused on IT advancement and IT alignment dimension of IT.

While the technological aspect of information integration is important, it is the frequency, the quantity and the quality of information that is shared that really matters. According to Fawcett et al. (2007), large investments in IT could fail to produce expected benefits if it is not supported by willingness to share needed information. Information sharing requires firms to exchange strategic supply chain information and not only transactional data, such as materials or product orders. The strategic supply chain information provides leverages to the supply chain partner for making strategic decision in their operations (Li et al., 2006).
The supplier positioning model is a way that businesses rank their sources of supplies based on the amount of money spent with the supplier and the level of vulnerability a business has if that supplier fails. According to Kraljic (2008), is a process of measuring spend or profit impact via volume purchased, percentage of total cost and impact on product quality or business growth by supply risk. Many large firms specify which suppliers are to be used by their first-tier category, mainly because particular critical components have to fit with other critical components (Johnsen. 2000). Because the purchasing and supply strategies have to support the overall business strategy that focuses on the demands and requirements of the major customers, firms are forced to enter into relationships (Johnsen. 2000).

The four types of relationships strategies are: Acquisition which means many suppliers, buyers dominates (Kraljic, 1983). Focus on supply chain Collaboration, efficient procurement processes, and receiving bids from many suppliers. Profit positioning requires Lots of suppliers, but big impact on company if supply is disrupted; so, consider target pricing strategies and umbrella contracts with preferred suppliers Guriting, and Ndubisi, (2006). Security: Few suppliers, but not a lot of financial risk from supplier failure; so, consider volume insurance contracts, maintaining buffer stock, and always be on lookout for alternative suppliers (CIPS 2009). Critical: The Company depends on the suppliers. The company will look for performance-based partnerships, with market and technology leaders, owning specific know-how. The position can result to strategic alliances, building close relationships, even vertical Collaboration (Steel and Court 1996).

Analytical studies provide evidence that between-firm IT integration reduces lead time. Cachon and Fisher (2000) find that sharing demand and inventory data can shorten the order processing lead time. Lee, So, and Tang (2000) study information. Although Brunn and Mefford (2004) provide a thorough conceptual discussion on the relationship between lean and IT as well as three detailed case studies, we are not aware of any empirical study that has tested the hypothesis, that is, lean/JIT practices mediate the influence of IT integration on lead-time performance. The difference between this study and Vickery et al. (2003) is that the earlier study tests the influence of

IT integration on supply chain integration while we examine the influence of IT integration on internal lean/JIT practices. Although proponents of IT integration and lean/JIT practices often appear to be at odds, there is no technical reason for such competition. The information systems in question are generally higher-level planning systems, while lean/JIT practices are primarily related to shop floor control and execution activities (Vollmann, Berry, Whybark, & Jacobs, 2005). Sharing in a two-level

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supply chain and show that sharing the current demand variation information leads to significant inventory reduction, which is generally associated with reduced lead times.
While IT and information sharing have been included in many empirical studies, the logistics integration of the material flow between supply chain partners has received less attention. Noticeable exceptions are Frohlich and Westbrook (2001), Sheu et al (2006), Zhou and Benton (2007), and Li et al. (2009). Frohlich and Westbrook (2001) modeled supply chain integration in terms of both information and material using eight items concerning IT, information sharing as well as logistics integration. They found that wider scope of integration had a positive association with performance improvement. However, since the items were combined into a single construct, they were unable to identify any relationship between information integration and logistics integration.

Based on a study of five pairs of suppliers and retailers in Taiwan, Sheu et al (2006) developed and proposed a relationship model, including long-term relationship, supply chain architecture (including e.g. information sharing and IT capabilities), supplier-retailer collaboration, and performance. They concluded that better IT capabilities as well as better communication contribute to a better platform for both parties to engage in supply chain coordination, participation and problem-solving activities. Zhou and Benton (2007), studied the effect of information sharing on supply chain practice; the latter captured as a construct including elements of planning, production, and delivery practice. They found that information sharing significantly impacts supply chain practice, and a significant effect of delivery practices on delivery performance. The study by Li et al. (2009) included IT implementation (both technology capabilities and information sharing), supply chain integration (of logistics systems) and performance. They found that IT implementation had a significant effect on supply chain integration, and indirectly on performance

MATERIAL AND METHODS

The study adopted both cross-sectional research design and explanatory research design. This study used a positivism research philosophy. The target population of this study were 213 registered manufacturing firms in Nairobi County (KAM, 2013). In this study, the sampling frame was a list of all 563 registered Manufacturing Companies in Kenya (KAMDirectory, 2016). The study used a confidence level of 95% hence a margin of error of 0.05. The Slovin formula is used where the researcher has no idea of the population behavior. It was developed by Slovin in 1960. The sample size was 138.The study adopted the use of a questionnaire and a document analysis as the main research instrument. Document analysis was carried out through desk research and involved a review of literature such as reports and books.

Data measurement, validity and reliability results

Factor analysis is a statistical method used to describe variability among observed, correlated variables in terms of a potentially lower number of unobserved variables called factors. For example, it is possible that variations in six observed variables mainly reflect the variations in two unobserved (underlying) variables. Factor analysis was carried out on the five factors including the dependent factor (firm performance). In general, the extraction method was principal component analysis and the rotation method was varimax with Kaiser Normalization.

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Table 1: Factor analysis for Technology integration

	1	2
Inter-organizational coordination is achieved using electronic links	0.904	
We use information technology-enabled transaction processing	0.878	
We use electronic transfer of purchase orders, invoices and/or funds	0.935	
We electronically purchase for our product and services	0.681	
We electronically order for receipt for payment of goods and services supplied	0.616	
There are direct computer-to-computer links with key suppliers for information exchange		0.723
We have electronic mailing capabilities with our key suppliers		0.937
We use advanced information systems to track and/or expedite shipments		0.808
We electronically process payment to our supplier electronically purchase approval are done		0.797
Total Variance Explained		
Eigenvalues	5.344	1.55
% of Variance	59.374	17.218
Cumulative %	59.374	76.592
KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.641
Bartlett's Test of Sphericity	χ^2	970.929
	df	36
	Sig.	0.000
Cronbach's Alpha		0.800

Regarding technology integration, the first five items (Inter-organizational coordination is achieved using electronic links, use of information technology-enabled transaction processing, use of electronic transfer of purchase orders, invoices and/or funds, electronically purchase for products and services and electronically order for receipt for payment of goods and services supplied) were loaded significantly on the first component and these can be summed up to relate to technology integration in purchasing and supply and use of information. This component accounts for 59.374% of the variance in technology integration. This means that the five items that define technology integration are grouped into 1. The next 4 items (There are direct computer-to-computer links with key suppliers for information exchange, we have electronic mailing capabilities with our key suppliers, we use advanced information systems to track and/or expedite shipments and we electronically process payment to our supplier electronically purchase approval are done) regarding technology integration loaded heavily onto the second component and can be summed up to relate to technology integration in supply chain process communication and contributes 17.218% of the variation in technology integration and cumulatively, both components account for 76.592% of the variation in technology integration. Sampling adequacy was tested using the Kaiser- Meyer- Olkin Measure (KMO measure) of sampling adequacy. As evidenced in Table 4.17, KMO was greater than 0.5 (0.641), and Bartlett's Test was significant, χ^2 (36) = 970.929, p-value < 0.000.

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Model specification

The regression coefficient indicates the relative significance of the independent variables in the forecast of the dependent variable while the coefficient of multiple determinations (R square) provides the measurement of how well a predictor of the equation of multiple linear regressions is likely to be. Moreover, if the p-value of multiple linear regressions is less than 0.05, then the relationship between the selected independent variables and dependent variable was significant. Thus, the alternative hypothesis should not be rejected. If not, vice versa.

FINDINGS

The study response rate was 87.65%, though; out of the 142 collected questionnaires only 112 were found to be useful for further analysis, because 30 questionnaires were excluded from the analysis due to missing data and outlier problems. This accounted for 70% valid response rate. According to Sekaran and Bougie (2010), response rate of 30% is acceptable for surveys. Hence forward, response rate of this study is adequate for further analysis.. As depicted in Levene test (see below), the results of independent- samples t-test showed that the equal variance significance values for all the variables and the dimensions were > 0.05 significance level of Levene's test for equality of variances (Field, 2009; Pallant, 2011)..Following this criterion, three multivariate outliers (respondent 8 = 105.0353, respondent 9 = 110.2931, respondent 7 = 111.1706) were identified and deleted from the dataset because they could distort the results of the data analysis. Henceforth, after removing three multivariate outliers, the final dataset in this study was 112. The findings in Table 4.5 regarding the amount of variation attributed to the age of the firm and the supply chain collaboration variables revealed that firm age has a significant contribution to the variation in technological integration, $F = 0.297$, $p < 0.05$ with the means for age 1 – 5 years (3.8889) and 6 – 10 years (3.9111) showing that younger firms are more inclined to technological integration in their supply chain processes. Furthermore, the findings revealed that firm age significantly contributes to the variation in order fulfillment, $F = 0.389$, $p < 0.05$. However, the findings revealed that firm age does not significantly contribute to the variation in organizational policy, $F = 0.832$, $p > 0.05$ regardless of the age of the age of the firm, organizational policy will be inclined in a given direction. Finally, the findings revealed that firm age significantly contributes to the variation in cost reduction, $F = 0.495$, $p < 0.05$. This means that cost reduction efforts in supply chain are not dependent significantly on the age of the firm.

Descriptive Statistics for Technology integration

From the findings, the overall mean response was for technological integration was 3.812 (std. dev. = 0.942). There were gaps identified within the firms in terms of technological integration in the communication between them and their suppliers, inter-organizational coordination, transaction processing, transfer of purchase orders, invoices and or funds, tracking of shipments as well as purchase of goods and services and payment to the suppliers. This confirms an earlier finding that 60% of the firms only integrate technology in e-procurement while not using other forms of technology in their supply chain processes. In general, while there is increase in sales when compared to expectations by majority of the firms, there is less growth when compared to competitors which in

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this case points to gaps especially in supply chain processes. However, majority of the firms performed better in terms of growth in profits in relation to their competitors compared to their expectations. In terms of market size, majority of the firms were not performing better compared to their competitors. There are also gaps identified in terms of improved efficiency, customer satisfaction and loyalty and ability to develop new products. The overall mean response was 3.58 (std. dev. = 0.541) that indicated overall agreement with the statements regarding firm performance.

Table 2: Technology integration

	Mean	Std. Deviation
Technological integration	3.812	0.749
Firm performance	3.58	0.541

Test of hypothesis

From the findings in Table 3, the relationship between technological integration and firm performance was found to be positive and significant, $\rho = 0.731$, p-value = 0.000 indicating that there is 73.1% probability that the firm's performance will increase with increased availability of various components of technological integration. Further, the results in Table 4 showed that all the predictors explain 53.4% of the variation in firm performance (R-squared = 0.534, Adjusted R-squared = 0.530). The study findings in Table 4.27 indicated that the above discussed coefficient of determination was significant as evidence of F value 123.922 ($p < 0.05$). The findings also revealed that technological integration has a positive and significant effect on firm performance, 0.731, $p = 0.003$ and indicating that with each unit increase in technological integration, firm performance increases by 0.731 units. These findings are in line with those of Mabert *et al.* (2010) who found that process automation of procurement function helps in reduction of cost to firms in various industries. In addition, the use of information technology (IT) has facilitated the reduction of coordination costs, which has been extensively documented in the literature (Bakker *et al.,* 2008). The findings in this study imply that the hypothesis stating that there is no significant influence of technological integration on the performance of manufacturing firms in Kenya is not accepted and the conclusion is that technological integration increases the performance of manufacturing firms in Kenya.

CONCLUSION AND RECOMMENDATIONS

The findings on the effect of technology integration revealed that technological integration has a positive and significant effect on firm performance. These findings imply that the hypothesis stating that there is no significant influence of technological integration on the performance of manufacturing firms in Kenya is rejected. However, despite these findings, there are challenges in manufacturing firms in terms of inter-organizational coordination using electronic links especially through technology integration. In addition, there are gaps in use of electronic mail communication between the firm and their suppliers.The findings have showed gaps in terms of inter-organizational coordination using electronic links. Firms are thus encouraged to invest in enhancing coordination efforts through utilization of cost-effective technologies such as electronic mail communication between the firm and their suppliers. In addition, the investments should also be used to address the

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integration of technology in the transfer of purchase orders, invoices and/ or funds thereby incurring costs in delays as well as errors in the purchase orders, integrated information systems to track and/ or expedite shipments, integration of technology in purchase of products and services electronically in order to reduce delays in purchase, errors in purchase and higher costs in manual purchasing of products and services and technology integration in the order for payment of goods and services supplied reducing delays in payment to suppliers and even delays in future delivery of goods and services to the firm.

However, the scope of this study was only concentrate on 200 manufacturing firms registered with KAM. However, there is need to increase the scope to cover other sectors so as to confirm the findings of this study and also to add more knowledge. Furthermore, because of the difference in operations between sectors, there is need to include the perspective of the top management for the purpose of establishing existing challenges in supply chain collaboration and find out means of mitigating them.

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