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THE EFFECT OF OUTPUT MONITORING ON SUPPLIER LOGISTICS PERFORMANCE AND FLEXIBILITY: THE MEDIATING EFFECTS OF BUYER-SUPPLIER INTEGRATION IN THE CONTEXT OF ESSENTIAL MEDICINES SUPPLY

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ABSTRACT

This paper examines the relationship between output monitoring and supplier performance. It focuses specifically focuses on buyer-supplier exchange relationships in delivering essential medicines in Tanzania, and examines the mediation effects of buyer-supplier integration on supplier's flexibility and supplier logistics performance. The resource-based view of the firm was used to frame the relationships by considering output monitoring efforts and the buyer-supplier integration as resources aimed to improve performance. A survey data of 111 public-owned health facilities selected randomly after stratifying them into hospitals, health centres and dispensaries was used for final analysis. Structural equation modelling using Smart PLS3 was employed to ascertain the relationship between output monitoring, buyer-supplier integration and supplier logistics performance and flexibility. The research hypotheses focused on both direct and indirect effects. The results revealed that the buyer-supplier integration partially mediates the effects of output monitoring on supplier logistics performance while fully mediating the effects of output monitoring on supplier flexibility. The results of the study imply that buyer-supplier integration is critical for multiple dimensions of performance improvement.

Key words: *Buyer-supplier integration; output monitoring; supplier logistics performance; supplier flexibility*

INTRODUCTION

Despite the relevance of flexibility and logistics performance, this area has not been comprehensively examined from the resource-based view (RBV), and even studies on supply flexibility/logistics performance in essential medicine supply are still missing. Moreover, the theoretical underpinnings of the concept of supplier performance in terms of logistics performance and flexibility have yet to be well-developed, as it has been typical for the theory to address performance as a one-dimensional and ignore the differences based on the exchange environment. Noticeably, limited evidence exists from the healthcare supply chain research (Polater and Demirdogen, 2018) as most of the existing studies have used a manufacturing industry setting (Droge *et al*., 2004; Jayaram and Tan, 2010; Paiva, 2010**).**

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Well-functioning supply chains for delivering health commodities such as medicines, vaccines and other health products are critical to the provision of health services (Yadav, 2015). A guaranteed consistent availability of such commodities is a characteristic of a good health system. Thus, the availability of health commodities of high-quality at the health facility level is necessary for any health system designed to ensure access and delivery of quality services. Moreover, supply chains do not only deliver medicines and health products to the population, but also return critical information on the needs, demand, and consumption to health system planners (Yadav, 2015). Therefore, supply chains are critical for strengthening health systems, which is crucial in the achievement of the health-related Millennium Development Goals (MDGs) (WHO, 2010).

Recently, the importance of supply chains has been emphasised with a focus on health systems strengthening, employing the WHO-framework of action on health systems (WHO, 2009), which describes six clearly-defined Health systems building blocks: (i) service delivery; (ii) health workforce; (iii) information; (iv) medical products (medicines), vaccines and technologies; (v) financing and (vi) leadership/governance. It is expected that there are multiple relations and interactions among the blocks which together influence the observed health care outcomes (e.g. access, efficiency). Based on the systems thinking, essential medicines supply chains are critical in the provision of medical services, of which the availability/shortage of medical supplies (e.g. essential medicines) will influence the other five building blocks of the health system and eventually the healthcare provision outcomes.

Despite the importance of medicines, the availability of such inputs poses a big challenge in the world, as indicated by the WHO (2011) assessment that availability of medicines is still less than 60% of the required capacity in developing countries (the Western Pacific, South East Asia and Africa Regions). This is also evident in developing countries because they have not been able to utilise the supply chain management field to improve their public health supply chains (Yadav, 2015).

Generally, in many low and middle income countries the public distribution network of medicines is largely ineffective and inefficient contributing to inadequate availability of medicines (Yadav, 2015). Several contributory factors were identified, including long procurement cycles the government follows, long re-supply schedules, demand uncertainty and amplification, unnecessary level of complexity as the supply chain follows the administrative structure and long lead times (Yadav, 2015). These challenges suggest a need for proper mechanisms to mitigate them and establish factors which could improve logistics performance as well as delivery flexibility in the essential medicines supply chain

Yet, very few studies have been able to demonstrate what works could improve supply chain performance within health systems. For instance, Schneller and Smeltzer (2006) suggested that e-procurement systems can help to reduce significantly the purchasing costs through the consolidation of supplier networks and creation of supplier partnerships. Burns (2002) discussed the aggregation of suppliers and their products through electronic catalogues, visibility of orders and materials, and efficiency in procurement. Acharyulu (2007) looked at the role of radio frequency identification data (RFID) in improving visibility in the healthcare supply chain. However, supply chains are context-specific and, hence, reliance on previous studies which were

mainly from the developed world may not be feasible due to contextual differences. Therefore, this paper examines supplier logistics performance and supplier flexibility in the context of essential medicines supply chain in Tanzania.
Supplier logistics performance and flexibility are critical performance dimensions from the health system strengthening perspectives (Alliance for health policy and systems research, 2004; WHO, 2007). If the supply system has a problem, then the whole health system will suffer, on the other hand, stronger systems will ensure the availability of essential medicines which can lead to increased quality and quantity of healthcare services.

According to the resource based view **(**Barney, 1991; Hartmann and Grahl, 2011**),** *supplier flexibility* is a distinct capability which is essential as health facilities continue to rely on the suppliers' to meet their medicines need and, eventually, satisfy their customers. In operations management, flexibility refers to "the ability to change or react to environmental uncertainty with little penalty in time, effort, cost, or performance" (Upton, 1994). It has both an adaptive mechanism for coping with internal and external uncertainties based on supply chain relationships (Johnsen, 2011; Kortmann *et al*., 2014). In healthcare, it involves the ability of the supplier to respond to changes in patients' demands successfully and reduce the effects of fatal events (Polater and Demirdogen, 2018).

Supplier logistics performance entails the ability of the supplier to deliver the right amount of the right product at the right place, at the right time, in the right condition, at the right price and with the right information (Coyle *et al*., 1992). It also includes product availability, order accuracy, order condition, order quality, order discrepancy handling and timeliness (Mentzer *et al*., (2001). As such, supplier logistics performance and supplier flexibility are critical performance dimensions to support the achievement of healthcare outcomes.

In the buyer-supplier relationship literature (Heide, 1994; Wathne and Heide, 2004), supplier performance was influenced by the existence of governance mechanisms (e.g. alliances, partnerships, collaborations, bilateral information exchange, output monitoring, and behaviour monitoring, specific asset investment) which enforce the supplier commitment to develop capabilities aimed to meet the buyer's objectives. Despite its importance, such governance mechanisms have mainly been associated with, safeguarding the exchange relationship from hazards such as opportunism (Heide, 1994; Wathne and Heide, 2004); impact on transaction specific investment (Yu *et al*., 2006) with limited research addressing the direct link to the supplier's operational performance in the context of essential medicines supply chain.

Extant literature treats "buyer-supplier integration[2]", which involves information sharing and joint problem-solving between the buyer and the supplier; and buyer's efforts to monitor supplier's output as vital governance mechanisms aimed to ensure supplier performance. Despite the existing evidence showing that the two improve performance, it is not yet clear how they behave in the presence of multiple performance dimensions.

Therefore, this paper attempts to link buyer-supplier integration and supplier output monitoring (as governance mechanisms) to supplier logistics performance and supplier flexibility in a buyer-

[2] In this study buyer-supplier integration implies health facility-supplier integration

supplier exchange relationship in an essential medicine supply chain in Tanzania. It specifically addresses the following three research questions:

- *Does health facility-supplier integration improve supplier logistics performance and supplier flexibility?*
- *Does output monitoring improve supplier logistics performance and supplier flexibility?*
- *Does health facility-supplier integration mediate the effects of output monitoring on supplier logistics performance and supplier flexibility?*

The paper is expected to inform health systems strengthening initiatives, policy makers, health workers and purchasing managers on the role of output monitoring and health facility-supplier integration in improving supplier logistics performance and supplier flexibility in the essential medicines supply chain.

THEORETICAL FRAMEWORK, RESEARCH MODEL AND HYPOTHESES

Theoretical framework

In the healthcare context, essential medicines are complex products. For example they exist in several brands and are associated with variations in service providers' preferences, experience high demand uncertainty. In addition, procurement is based heavily on the clinical preferences of physicians instead of standard treatment guidelines (Burns *et al*., 2002; Lauer, 2004; Mustaffa and Potter, 2009). This complexity impairs the ability of health facilities (e.g. hospitals, health centres and dispensaries) to make accurate predictions of the patients' mix and their demand.

It is also noted that, today most public health facilities in developing countries have adapted a centralised procurement model where they buy their essential medicines from central medical stores/agencies (which have mandate to procure, store and distribute medicines to health facilities). These system features support the need for health facilities and their suppliers to invest in effective governance mechanisms to ensure supplier‘s commitments. In this regard, Kohtamäki (2010) suggests that effective relationship governance requires several mechanisms to govern a single supplier relationship. According to the RBV, such governance mechanisms in buyer-supplier exchange relationships are considered organisational resources/capabilities.

In logistics and supply chain management, there is a growing amount of empirical literature that supports the usage of the Resource-Based View (RBV) (Chung-Shan and Taih-Cherng (2017); Huu and Gilles (2015); Olavarrieta and Ellinger (2004). The RBV theory examines the impact of organisational resources and capabilities on competitive advantage that leads to overall organisational performance (Barney 1991; Barney and Arikan, 2001). For example ability of buyer (health facility) to monitor the supplier's delivery output (output monitoring) as well as both parties investing in bilateral information exchange and joint action (health facility-supplier integration) in order to achieve supplier performance improvements.

According to Wathne and Heide (2000), governance can be formal or informal. Ju *et al.* (2010) have considered buyer- supplier integration a relational governance mechanism due to its information sharing (interaction) dimension; and monitoring as a "*formal governance mechanism*".

Moreover, some of the existing literature has established that formal and informal governance mechanisms may function as substitutes (Luo, 2007), yet others treat them as compliments. However, it remains unclear if they can also cultivate one another. Therefore, this paper attempts to establish the cultivation-relationship between output monitoring "as a formal mechanism" and buyer-supplier integration "as an informal mechanism" and their effect on the supplier logistics performance and supplier flexibility.

In the supply chain integration literature, the link buyer-supplier integration and performance has been evidenced with conflicting opinions, as some scholars support that it improves performance (Boon-itt and Wong (2011) while others do not (Flynn *et al*., 2010; Stank *et al*., 2001). In the healthcare supply chain literature, the role of integration in influencing performance has also been examined; Yap *et al* (2012) looked at the strategic network alliances integration in healthcare as clusters of the organisation, and proposed that an alliance integrated network can mediate the effects of the supply chain management practices on performance. Yet, there is lack of evidence in the context of a buyer-supplier relationship in the medicines supply chain.

In the buyer-supplier relationship literature, output monitoring is informed by the principal-agent theory as governance mechanism aimed to mitigate information asymmetry between buyers and suppliers (Douma and Schreuder, 2002). As an organisation resource, monitoring improves the availability of information on supplier performance, critical for supplier development in long-term buyer-supplier relationships. However, the literature reviewed indicates that, the link between output monitoring, supplier logistics performance and supplier flexibility is not clear. In fact, most of the existing studies have associated monitoring with exchange hazards while ignoring the fact that monitoring activities are organisational resources which may have so many other paths to influencing the supplier. Therefore, this paper posits that, output monitoring supports the development of problem-solving activities as the performance feedback from monitoring activities will assist suppliers in taking remedial actions to improve their performance and meet the demands of the buyer (Talluri and Sarkis, 2002).

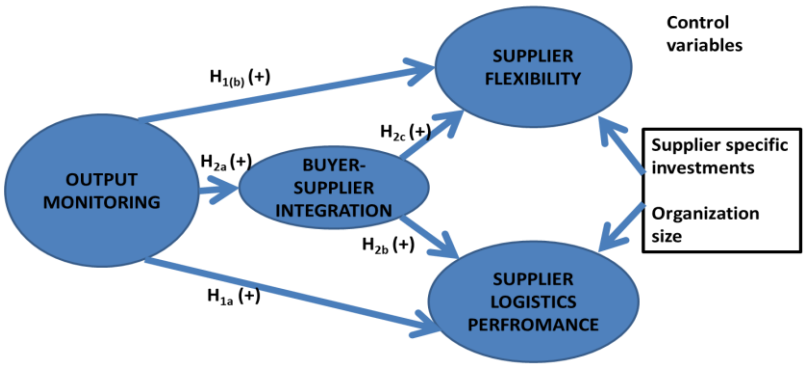
However, the link between output monitoring and buyer-supplier integration (which includes joint actions in solving problems) and their effects on supplier logistics performance and supplier flexibility has not been clearly examined. Moreover, most of the evidence on the role of buyer-supplier integration and output monitoring in buyer-supplier relationships come from the manufacturing industry setting (Rokkan and Buvik, 2003; Stump and Heide, 1996), with limited empirical evidence from the healthcare environment.

Research model and hypotheses

The research model (Figure 1) estimates the direct and indirect effects of the supplier output monitoring and buyer-supplier integration on supplier logistics performance and supplier flexibility, while controlling for supplier specific investments and organisation size[3].

[3] In this paper, organisation size was measured by the approximate amount of annual purchasing volume in Tanzanian shillings (TZS) from the focal supplier (MSD).

Figure 1: Research model



The relationship between supplier output monitoring, supplier flexibility and supplier logistics performance

Output monitoring measures the extent of monitoring efforts through inspection and recording of the supplier's delivery outputs by the buyer. According to Douma and Schreuder (2002), output monitoring mitigates information asymmetry between buyers and suppliers. When the buyers increase their ability to detect the supplier's performance, it creates social pressure, which enforces the suppliers to comply with the existing supply agreements (Eisenhardt, 1989). Ju *et al.* (2011) believes that, measuring supplier outcomes ensures that a supplier focuses on achieving meaningful outcomes, and reduces goal conflicts as it brings the preferences of a buyer and its focal supplier in alignment by focusing on results of concern to both parties (ibid.). Output monitoring also reduces the suppliers' free riding behaviours (Atuahene-Gama and Li, 2002), which hold them responsible for their outcomes and for improving their productivity to meet customer expectations.

Based on the above arguments, it was hypothesised that,

> *$H_{1a.b}$ Output monitoring is positively associated with (a) supplier logistics performance (b) supplier flexibility*

Buyer-supplier integration as a mediator

According to Paulraj and colleagues (2008), buyer-supplier integration is a relational competency which involves inter-organisational communication and joint action between exchange partners.

The expectation is that, output monitoring will positively influence buyer-supplier integration in a number of ways: First, monitoring of the supplier output is a mechanism for the buyer to generate information on supplier performance, hence supporting the ability of the buyer to share the right information on supplier performance which strengthens the feedback loop. In addition, the availability of information on supplier performance enhances the interaction between a buyer

and a supplier by strengthening the ability to communicate more frequently, clearly, and with less effort (Galvin and Morkel, 2001).

Output monitoring also encourages buyer-supplier integration through focused collaboration. The expectation is that joint-actions in solving problems demands performance feedback. In this regard, output monitoring provides a more focused and easily understood feedback. The supplier may use this feedback to improve internal and external performance and improve resource capacity to meet customer needs. These arguments support previous scholars who contend that firms with access to information tend to develop positive bilateral expectations of their partner, which makes them inclined to adapt accordingly as circumstances change (Wathne and Heide, 2004). The changes may be in response to, for instance, market fluctuations or the buyer's shifting demands (ibid.).

Several studies provide evidence on the positive relationship between integration and performance (Lin *et al*., 2010; Paiva, 2010). For example, upstream integration (with supplier) improves performance in the product development context (Petersen *et al*., 2005); similarly evidence exist in the manufacturing setting where information integration and relationship building were associated with improved delivery and firm performance (Jayaram and Tan, 2010). Other studies found supplier partnering to have a positive effect on the firm's performance (Carr and Pearson, 1999). Notably, companies employ supplier integration strategies to improve performance. For example, Motorola's supply cost reductions were twice that of its competitors; Marks and Spencer increased innovation and experienced decreased cost and cycle time (Lewis, 1995; Ragatz and Sandor, 2009). Buyer-supplier integration through information exchange and collaboration (joint action) can cultivate trust between exchange partners which, ultimately, can have a direct impact on the supplier's performance.

Moreover, the buyer-supplier integration also develops a shared vision between a buyer and a supplier which influences the supplier's mix and delivery flexibility. Flexibility is an expected behavioural norm, which establishes a positive attitude towards adopting requests for adjustments (Macneil, 1981). For instance, a firm's ties with its customers can help it learn of new consumer wishes, which may support flexibility (Claro and Claro, 2010). The Evidence further suggests that, interaction and collaboration between a public health facility and its supplier of essential medicines is a pivotal issue to attaining supplier flexibility to respond to rapidly changing patients' demands for essential medicines (Simatupang and Sridharan, 2002; Gosling *et al*., 2010). With regard to supplier logistics performance, suppliers of essential medicines may experience longer delivery times and low customer service in the absence of integration (Lee *et al*., 1997).

Thus, the literature reviewed suggests that monitoring of supplier output influences buyer-supplier integration which, in turn, impacts on supplier logistics performance and flexibility.

The following hypotheses were proposed:

> *H_{2a} Output monitoring is positively associated with buyer-supplier integration*
> *$H_{2b,\,c}$ Buyer-supplier integration will mediate the relationship between (b) output monitoring and supplier logistics performance, (c) output monitoring and supplier flexibility*

METHODOLOGY

Empirical setting

The public health system in Tanzania follows a referral structure, whereby the provision of medical services starts from the dispensaries, health centres, district hospitals, regional hospitals and subsequently to the national hospital, hence making a total of more than 6,000 public health facilities (MoHSW *et al*., 2015). The country has adopted a centralised purchasing organisational structure, with the Medical Stores Department (MSD) being the sole supplier mandated with the procurement, storage and distribution of medical essentials including medicines. All the public health facilities are restricted to buying from the MSD; and they are allowed to source from other supplies only when the MSD runs out of stock. Recently, the prime vendor model has been introduced and health facilities are allowed to buy from them when the MSD runs out of stock.

Data collection

The unit of analysis was a dyadic exchange relationship between a public health facility and its focal supplier (Medical Supplies Department, MSD). A survey of 216 public health facilities (categorised as hospitals, health centres and dispensaries) was carried out using a semi-structured questionnaire. Samples were selected using stratified random sampling whereby the health facilities were grouped into three strata of hospitals, health centres, and dispensaries from which random selections were made. However due to unforeseen limited access to some of the facilities, replacements—where necessary—were made conveniently. A seven-point Likert scale was applied to measure all the adapted measurement items for each construct. Key informants at the health facility level (purchasing managers for hospitals; and medical in-charges for health centres and dispensaries) were asked to fill out the questionnaires. The average work experience of the key informants was six years, which indicates that they had sufficient experience pertaining to purchasing practices and supplier evaluations. Out of the 216 questionnaires, 183 were returned, after data cleaning only 111 questionnaires qualified for the final analysis.

Measure development

This paper used reflective reconstructs as presented in Figure 1 (the Research Model), which were measured using a seven-point Likert scale. All measures (see Table 1) were adapted from previous studies.

Table 1: Scales and Reliability Measures

Scales:	Sample of items. *Response format*: 7-point Likert-type scale
SASPEC Supplier specific investments[4] 4 items	• The MSD has made extensive investments in information technology to process our order information. • The MSD has made significant adaptation through extra expansion of their zonal warehousing storage capacity in order to meet our needs. • The MSD has tailored its zonal warehouse routine workflows to the specific needs of our ordering routines. • The MSD has made specific investments in picking and packaging systems to handle our orders.
SUPINTEG	• Our purchasing unit and the MSD always work together as a team to solve essential drug

[4] This construct measures the extent of specific investments made by the supplier in its logistics activities such as storage capacity, storage facilities, logistics procedures and information technology tailored to their relationship with the public health facility.

Buyer-supplier integration[5] 5 items	supply-related problems. • Our purchasing unit and the MSD always work together in following up of our essential drug orders sent. • Our purchasing unit always collaborates closely with the MSD on quality control of delivered essential drugs. • Our purchasing unit and the MSD have closely integrated the supply of essential drugs and other drugs in vertical programs. • Our purchasing unit and the MSD always hold periodic meetings to plan for our drug supply.
Supplier flexibility[6] 6 items	• MSD has a high ability to accept late mix changes in orders • MSD is flexible enough to handle unforeseen problems • MSD responds quickly to order changes • MSD can readily adjust its inventories to meet changes in our needs • MSD rapidly handles order changes without excessive cost or penalties • MSD has a high ability to respond to our demand when emergencies occur
Output Monitoring[7] 3 items	• We frequently monitor the MSD delivery timeliness • We always monitor the MSD delivery accuracy (conformity to order) • We frequently monitor the MSD's lead time (time between ordering and delivery)
Supplier logistics performance[8] 6 items	• We regularly experience timely delivery of essential drugs from the MSD • We always experience consistency on the MSD order fill capacity • We always experience satisfactory lead time on the back order delivery • We regularly experience satisfactory lead time from the MSD • We always experience high accuracy on order delivery from the MSD • We always experience complete order delivery from the MSD

Data analysis

The research model was predicted using a partial least square method (PLS-SEM) from Smart PLS 3 software. This method was opted because this is a prediction model, and the method has high degree of statistical power compared to CB-SEM (Reinartz *et al*., 2009; Hair *et al*., 2017). It is also useful for non-normality of the data (Hair *et al*., 2011), and that the method use an iterative procedure which maximises the strength of the relationship between independent and dependent variables (Schade *et al*., 2016). Moreover, it is easy to estimate the measurement model.

[5] This construct measures the extent of inter-firm co-ordination/information exchange and collaboration/joint action between a public health facility and its focal supplier of essential medicines

[6] This construct measures the ability of the supplier (MSD) to adapt to the changing environment in the exchange relationship with public health facilities

[7] This construct measures the extent of monitoring efforts through inspection and recording of the MSD's delivery outputs by the public health facility.

[8] The construct measures the ability of the supplier to deliver essential medicines faster and more reliably, which implies better quality, more accurate quantities, and improved goods availability.

Reflective measurement model evaluation

Reliability **(***Internal consistency)*: The results (Table 2) show that all the Cronbach alpha (α) and composite reliability values for all the reflective constructs were above the critical threshold of 0.7 as recommended by Hair *et al*. (2017). Therefore, all the constructs have high levels of reliability. In addition, the examination of outer loadings shows that all the indicators for each construct scored loadings of above the threshold of 0.7 (ibid.), which shows that all the indicators were highly reliable.

Table 2: Constructs and measurement reliability assessment

		Loadings	**Indicator reliability**	**AVE**	**Composite Reliability**	**Cronbach's Alpha**	**HTMT confidence interval does not include 1**
		>0.7	>0.5	> 0.5	0.6-0.9	0.6-0.9	
ORGSIZE		1.000		1.0			
	LP2	0.762	0.58				
	LP3	0.902	0.81				
	LP4	0.805	0.65				
	LP5	0.753	0.57				
	LP7	0.845	0.71				
SUPLOG	LP8	0.830	0.69	0.67	0.81	0.9	Yes
	SAP1	0.785	0.62				
	SAP2	0.815	0.66	0.66	0.89	0.83	Yes
	SAP5	0.869	0.76				
SASPEC	SAP6	0.785	0.62				
	SFFLE5	0.787	0.62				
	SFLE1	0.816	0.67				
	SFLE2	0.866	0.75				
	SFLE3	0.842	0.71				
	SFLE4	0.830	0.69				
SUPFLEX	SFLE6	0.810	0.66	0.68	0.92	0.91	Yes
	SI1	0.845	0.71				
	SI2	0.781	0.61				
	SI4	0.709	0.50	0.58	0.88	0.82	Yes
	SI8	0.715	0.51				
SUPINTEG	SI9	0.763	0.58				
	SM1	0.907	0.82				
	SM2	0.903	0.82				
SUPMON	SM3	0.895	0.80	0.8	0.92	0.89	Yes

Constructs validity

Convergent validity: The results (Table 2) show that all the measured constructs scored AVE values, which are above the recommended critical value of 0.5 (Hair *et al.* 2017). This means that each construct explains more than 50% of the variance of its indicators. Therefore, all the constructs have high levels of convergent validity.

Discriminant validity: To test for *discriminant validity*, this paper employed the Fornell-Lacker criterion which compares the square-root of the AVE values with the latent variables correlations (Hair *et al*. 2017). The results (Table 3) show that discriminant validity was achieved as the square-root of each construct's AVE was greater than its highest correlations with any other construct. However, this approach has limitations to detect reliably discriminant validity issues.

Table 3: Validity assessment

CONSTRUCTS	**Bivariate correlations**	**Square root of AVE**	**HMTM ratio**	**HTMT ratio confidence intervals**	
				2.5%	97.5%
SASPEC -> ORGSIZE	0.099	SUPINTEG= 0.76 ; SUPLOG = 0.82; SASPEC =0.81; SUPMON = 0.9 ; SUPFLEX =0.83;	0.113	0.042	0.179
SUPFLEX -> ORGSIZE	0.194		0.203	0.041	0.320
SUPFLEX -> SASPEC	0.476		0.537	0.391	0.660
SUPINTEG ->ORGSIZE	0.339		0.359	0.281	0.420
SUPINTEG -> SASPEC	0.453		0.526	0.385	0.662
SUPINTEG ->SUPFLEX	0.506		0.565	0.431	0.689
SUPLOG -> ORGSIZE	0.314		0.323	0.198	0.429
SUPLOG -> SASPEC	0.410		0.470	0.300	0.625
SUPLOG -> SUPFLEX	0.645		0.717	0.614	0.798
SUPLOG -> SUPINTEG	0.533		0.597	0.477	0.702
SUPMON -> ORGSIZE	0.288		0.306	0.224	0.373
SUPMON -> SASPEC	0.195		0.223	0.108	0.324
SUPMON -> SUPFLEX	0.338		0.376	0.207	0.528
SUPMON -> SUPINTEG	0.475		0.536	0.367	0.683
SUPMON -> SUPLOG	0.416		0.462	0.296	0.591

Another test was run using the HTMT ratio which is more reliable (Hair *et al.*, 2017). The results for HTMT ratio values for all the pairs of constructs were below the relevant threshold level of 0.85 (Table 3). The bootstrapping procedure was further used to determine whether the HTMT ratio values observed were significant (different from 1). At 95% confidence interval (2.5% to 97.5%) the results shows that neither of the confidence intervals included 1. Therefore discriminant validity was further established.

Evaluation of the structural model

- *Assessment of collinearity problems* using VIF scores suggests that collinearity is not a problem as all the constructs scored VIF values above 5 (Hair *et al*., 2017).
- *Assessment of the mediation model explanatory power* also provides satisfactory R^2 results. The model had three endogenous constructs, SUPINTEG, SUPLOG and

SUPFLEX, which had R^2 values of 0.23, 0.37 and 0.35, respectively. The variance explained was considered to be satisfactory as in the logistics and supply chain literature. Other scholars also used $R^{2\ values}$ ranging from 0.3 to 0.4 (Stank *et al*., 2000)

- *Assessment of model predictive relevance* employed a blindfolding technique to establish the model's predictive power. Based on the 111 observations, an omission distance of 7 was chosen. The results show that all the endogenous latent variables "SUPINTEG, SUPFLEX and SUPLOG" had Q^2 values of above zero, that is, 0.12, 0.22 and 0.23, respectively. Therefore, the model results support the model's predictive relevance regarding endogenous latent variables.

Analysis of the direct and indirect effects

The primary purpose of this paper was to examine the role of output monitoring and buyer-supplier integration on supplier performance dimensions i.e. logistics performance and flexibility. To test the mediation effects of buyer supplier integration, the theoretical framework illustrated in Figure 1 was subjected to an analysis using Smart PLS 3.

Based on PLS bootstrapping results (Table 4), the indirect relationship of SUPMON on SUPFLEX and SUPLOG was significant at $p < 0.05$.

Table 4: Standardized direct and indirect effects for public health facilities

Direct effects						**Indirect effects**	
Target construct-SUPFLEX	**ORGSIZE -> SUPFLEX**	**SUPINTEG -> SUPFLEX**	**SASPEC -> SUPFLEX**	**SUPMON -> SUPFLEX**	**SUPMON -> SUPINTEG**	**SUPMON -> SUPFLEX**	**SUPMON -> SUPLOG**
b	0.03	0.29	0.32	0.13	0.47	0.138	0.139
95% Confidence Interval	(-0.168; 0.142)	(0.124; 0.449)	(0.175; 0.447)	(-0.035; 0.298)	(0.318; 0.593)	(0.06, 0.231)	(0.063, 0.233)
T values	0.336	3.533	4.577	1.549	7.033	3.209	3.146
significance (p<0.05)?	No	Yes	Yes	No	Yes	Yes	Yes
Target construct-SUPLOG	**ORGSIZE -> SUPLOG**	**SUPINTEG -> SUPLOG**	**SASPEC -> SUPLOG**	**SUPMON -> SUPLOG**	**SUPMON -> SUPINTEG**		
b	0.14	0.29	0.23	0.19	0.47		
95% Confidence Interval	(0.023, 0.237)	(0.126;0.456)	(0.046;0.385)	(0.041; 0.34)	(0.318; 0.593)		
T values	2.538	3.457	2.647	2.565	7.033		
significance (p<0.05)?	Yes	Yes	Yes	Yes	Yes		

- *Mediation analysis* on the direct effects suggest that the direct effects of SUPMON on SUPFLEX was weak (b =0.13) and statistically non-significant (t =1.549; $p > 0.05$), whereas the direct effects on SUPLOG was significant at $p < 0.05$. Therefore it was concluded that SUPINTEG completely mediates the effects of SUPMON on SUPFLEX

(b = 0.32; t = 3.822). In addition, the effects of SUPMON on SUPLOG lessened but was still significant. Therefore, SUPINTEG partially mediates the effects on SUPLOG (Baron and Kenny 1986). Partial mediation was further examined to establish its type. Given that the products of the coefficients of SUPMON (b = 0.19) and SUPINTEG (b = 0.29) are positive, the partial mediation is considered a complementary one (Hair *et al*., 2017).

Further assessment was carried on the SUPMON effect size. The rule of thumb defines f^2 values higher than 0.02, 0.15, and 0.35 depict small, medium, and large effect sizes (Cohen, 1988). The results indicate SUPMON has an insignificant effect on SUPFLEX (f^2 value = 0.02); on the link SUPMON-SUPLOG (f^2 value = 0.05); and on SUPMON-SUPINTEG (f^2 value = 0.29). Therefore, this paper provides further evidence that SUPINTEG fully mediates the effects of output monitoring on supplier flexibility but partially mediates the effects on supplier logistics performance.

Table 5: Summary of results

Hypotheses	***Result***
Output monitoring and supplier performance	
H_{1a} Output monitoring will have a positive effect on supplier logistics performance	***Supported***
H_{1b} Output monitoring will have a positive effect on supplier flexibility	***Not supported***
Direct/indirect effects of buyer supplier integration	
H_{2a} Output monitoring is positively associated with buyer- supplier integration	***Supported***
H_{2b} Buyer-supplier integration will mediate the relationship between output monitoring and supplier logistics performance	***Supported***
H_{2c} Buyer-supplier integration will mediate the relationship between output monitoring and supplier flexibility	***Supported***

DISCUSSION AND IMPLICATIONS

Meijboom *et al*. (2011) considered traditional supply-driven systems to be insufficient because of their autonomous nature. On the other hand, they considered co-operation as indispensable variable in accomplishing a smooth healthcare operation (Meijboom *et al*., 2011). In consequence, recent business operations management methods have received more attention in the healthcare sector (Young *et al*., 2004). The intention is to find effective ways to ensure health facilities meet their patients' needs (Fredendall *et al*., 2009). According to the operations management concepts, the application of the supply chain management tools and techniques provide benefits to hospitals, to their suppliers, and finally to the patients (McKone-Sweet *et al*., 2005).

This paper has focused on two supplier performance constructs "*logistics performance and flexibility".* The results show that, *buyer-supplier integration* is critical for the enhancement of supplier performance, as the two links were positive and significant: (i) *buyer-supplier integration and supplier logistics performance*; (ii) *buyer-supplier integration and supplier flexibility*. This finding is similar to previous results, for example, Polater and Demirdogen (2018) who established that the supply chain integration has a direct and positive effect on

supply chain flexibility. Based on these results, it is evident that health facilities should integrate externally with their suppliers to improve essential medicines' availability at the facility level.

Moreover, *buyer-supplier integration partially mediates the effect of output monitoring on supplier logistics performance*. This implies that, output monitoring has both direct and indirect effects: Direct effect on supplier logistics performance and indirect effect through the buyer-supplier integration. Therefore, it is possible to receive benefits from output monitoring in the absence of buyer-supplier integration. The implication is that health facilities should invest more in monitoring their suppliers' deliveries to enhance delivery performance.

In contrast, *buyer-supplier integration completely mediates the relationship between output monitoring and supplier flexibility*. This means that, output monitoring operates indirectly through the buyer-suppler integration. Thus, in the absence of integration, output monitoring will have no impact on supplier flexibility. It can be concluded that, in the presence of output monitoring, buyer-supplier integration is more important for supplier flexibility than supplier logistics performance. This outcome supports those of others such as Lee *et al*. (2015) who found a positive correlation relationship between integration and flexibility. It also implies that, output monitoring facilitates boundary spanning initiatives such as buyer-supplier integration in line with the findings of previous scholars such as Talluri and Sarkis (2002).

Regarding the effect of output monitoring, the lack of support for a direct effect on supplier flexibility implies that, output monitoring has differential role on supplier performance improvement. This result contradicts those of previous scholars (see, for example, Bergen *et al*., 1992; Rokkan and Buvik, 2003) who argued that output monitoring may influence performance due to the social pressure it creates on the supplier. This effect is likely to occur because output monitoring involves assessment and collection of information on delivery performance; therefore, a direct effect on logistics performance is likely to occur. As supplier flexibility is considered an internal capability of a supplier, output monitoring may not have a direct influence on the development of such capabilities.

Subsequently, this paper positions buyer-supplier integration as a central component of logistics firm performance improvement, which consistent with previous scholars such as Narasimhan and Jayaram (1998) who found a positive relationship between SC integration and customer responsiveness; Stank *et al*. (1999) and Frohlich and Westbrook (2001), who also established that companies with high levels of logistics integration are more effective in meeting key customers' needs, accommodating special service requests.

Although both relationships (output monitoring—supplier logistics performance and output monitoring—supplier flexibility) were examined, both partial and complete mediation effects were detected. This is contrary to our expectation, thus showing that health facility-supplier integration plays an important role in the transformation of output monitoring effects on different supplier performance dimensions for essential medicines.

Managerial implications

This paper also provides some insights into the role of different governance mechanisms "output monitoring and buyer-supplier integration" in ensuring suppliers of essential medicines improve their logistics performance and flexibility. The results further inform healthcare providers/

purchasing managers on the mechanisms/strategies they should choose to manage their supplier based on the intended performance objective. Thus, when they invest/make efforts in monitoring delivery of essential medicines they should also couple those efforts with efforts/investments in interaction and joining actions with their supplier (hence buyer-supplier integration). This collaboration should involve information sharing on the status of the availability of essential medicines from each partner. This is particularly important in improving supplier flexibility, as buyer-supplier integration completely mediates the relationship between output monitoring and supplier flexibility. Therefore, managers should treat it as a requisite component in the context of output monitoring. However, that is not the case with supplier logistics performance, as efforts in buyer-supplier integration can bring about lesser benefits due to the existing direct effects from output monitoring. Nevertheless, purchasing managers should consider it as a requisite component.

Overall, if healthcare providers and their purchasing managers pay enough attention to output monitoring and integration with their suppliers of essential medicines they can experience improved supplier flexibility in meeting the unexpected medicines demand in addition to improving delivery performance in terms of quality, quality, time and place.

Theoretical implications

In terms of theoretical implications, the paper, first, provides empirical evidence on the strong role of output monitoring in stimulating buyer-supplier integration. It also provides empirical support to previous contributions from other researchers who provided evidence that supply chain integration has a positive effect on performance (Droge *et al*., 2004; Frohlich and Westbrook, 2001; Iyer *et al*., 2004; Jacobs *et al*., 2007; Vickery *et al*., 2003). More significantly, this paper has added to the body of literature on the mediation role of the buyer-supplier integration in improving supplier performance, whereby two different types of performance "supplier logistics performance and supplier flexibility" were included. As a result of mediation effects, this paper has established the differential role of the buyer-supplier integration, which as a mediator, completely intercedes the effects of output monitoring on supplier flexibility while partially interposes some effects on supplier logistics performance. Therefore, it further contributes to the logistics and supply chain management literature on factors for improving the logistics performance and flexibility in the context of the buyer-supplier relationship. In addition, it also provides a validation of formal and informal buyer-supplier relationship governance mechanisms in the healthcare context. Thus, it can be concluded that relational governance mechanisms such as the "*integration of the supplier of essential medicines and health facilities*" can be extended to the health sector. On the whole, the sector can benefit from lessons learned in the industrial sector.

CONCLUSION, LIMITATIONS AND FUTURE RESEARCH

Despite making some important contributions to the body of knowledge on the relationship between output monitoring and supplier performance in the healthcare context of Tanzania, this paper has some limitations. Financial constraints and lack of communication led to the exclusion of some public health facilities. However, the selection was done randomly. Hence, it is expected that the sample was adequately representative. Moreover, private health facilities were also excluded. As such, future studies may include them. The health sector in Tanzania is still undergoing reforms aimed to improve further the availability of essential medicines at the

facility level. For example, the prime vendor model has recently been adopted coupled with the adoption of several logistics information systems. Future research may include these variables in the model, and establish how they moderate the established relationships. As data was collected from a single industry (the healthcare sector), confounding results due to industry differences is reduced, which may also reduce generalizability of the findings. Therefore, future research may include other industries and compare the results. Furthermore, the research setting was the public sector, which is more highly regulated than the private sector. As such, the generalizability of the results to the private sector may also present a challenge. In addition, as the data was collected from one side of the dyad (buyer), it is imperative in future perspectives to capture such data from both sides.

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