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ORIGINAL PAPER

IMPACT OF REVERSE LOGISTICS BARRIERS ON SUSTAINABLE FIRM PERFORMANCE VIA REVERSE LOGISTICS PRACTICES

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ABSTRACT. **Background:** Due to the industrial revolution, extensive production, more raw materials are consumed, which are enough for landfills and disturbing environmental integrity. RL is an established concept in developed countries in comparison to developing countries. RL implementation is in its infancy due to some barriers. Therefore, the purpose of this study is to identify the RL barriers through literature review and to check their effect on the adoption of RL practices and to explain either they influence the firm performance or not.
Method: Data were collected from the employees of manufacturing companies and relevant government institutes and later were analyzed by using the structural equation modelling technique. A novel structural model connecting all study variables was developed to verify the impact of RL barriers on sustainable firm performance.
Results: Study results show that Infrastructure & technology, Financial & economic, Knowledge & experience-based barriers are critical and negatively affect the adoption of RL practices. The adoption of RL practices has a positive effect on the company's economic and environmental performance both. Further, the mediating role of adoption of RL practices between RL barriers and firm performance was also found.
Conclusion: The results of this research help to extend literature presenting that the ecological modernization and new environmental laws and regulation should be integrated with enterprises to mitigate infrastructure & technology, financial & economic and knowledge & experience related barriers by conducting proper training programs and promoting sustainability among company's top management.

Key words: sustainability, reverse logistics adoption, barriers, manufacturing companies, Pakistan.

INTRODUCTION

The reverse logistics (RL) started to get attention from the mid-1980s. The primary focus of these studies was to promote sustainability through internal, external and practical integration of RL processes and procedures. Since customers have become more sensitive in their buying and using, the demand for innovative and environmentally friendly products has been increased. In the current era, competitiveness is becoming more powerful tool in manufacturing sectors that directs to produce innovative products and services and bringing significant improvement in firms. However, world's concern about climate changes is becoming an indispensable issue. More recently, the impact of manufacturing industry has significantly increased on soil, water, and air pollution, to cope with this situation, RL is considered as an effective tool to recover these aspects [Waqas, Dong et al. 2018].

Reverse flow of different used products, recycling and reusing it as a raw material by manufacturing industry has been getting attention from past few decades. Developing the reverse flow of used products is not only

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the responsibility of manufacturing industry, but consumers may also have the responsibility as being the integral part of industrial manufacturing and recycling process. Recently, RL is start attracting both scholars and manufacturers in whole world but unfortunately it is at early stages in developing economies especially in Pakistan due to various constraints.

Rapid urban population, development in technology, the production, and utilization of shortening lifecycle products and services have increased worldwide. Massive production required massive raw material consumption in production process, which is enough for landfills and are filling up. However, the cost of used product reprocessing is higher than the cost of landfilling in Europe. Therefore, manufacturing firms in developing world preffered to dumped it in open environment without any proper treatment [Abdulrahman, Gunasekaran et al. 2014] . "Reverse logistics (RL) is a process of dealing with products and services that have been retuned by customers to the company with the objective of worth creation, cost reduction and environmental protection" [Govindan and Bouzon 2018]. Implementation of RL practices can assist the manufacturers how to reduce their impact on world ecological system by lessening the effect of end-of-life goods on the atmosphere. Furthermore, the companies have been influenced by various constraints to implementing the RL practices. However, it's not easy to overcome these barriers [Abdulrahman, Gunasekaran et al. 2014].

Commonly, barriers and issues related to RL tend to be a forward step to bring sustainability within the industry [Govindan and Bouzon 2018] and all those manufacturing companies that protect and meet the environmental standard may confront various challenges in their operations. Though, in literature, very few studies identify the barriers to adoption of RL practices.

Practices of RL includes many activities e.g. waste management, recycling, reusing, reprocess, material recovery and design for RL which can help any organizations to convert their opportunities into profit [Wang, Jiang et al. 2019]. Therefore, adoption of RL practices have more potential for increasing the performance of RL and also add a greater impact on firms' economic performance (ECP) and environmental performance (ENP) in manufacturing industry. RL practices are the main drivers for application of sustainable development in manufacturing firms. Moreover, the research articles that provide the discussion of RL practices and barriers and drivers, focus on reverse logistics performance, product transformation and innovation [Cordano, Marshall et al. 2010]. Therefore, the direct link among RL barriers and RL practices is still ambiguous. The direct and indirect impact of RL barriers and RL practices on manufacturing firm's performance indicators also needs better understanding in literature, because till present the majority of scholars evaluated the RL barriers and RL practices from the economic viewpoint [Waqas, Dong et al. 2018]. Unfortunately, after searching the comprehensive literature review a few research articles were found on adoption of RL practices and manufacturing industry performance in perspectives of ECP and ENP indicators.

On the behalf of above-mentioned studies and in association with Subramanian and Abdulrahman [2017], who has developed a framework to understand the role of RL barriers in application of RL activities and to enhance the manufacturing industry performance in perspective of ECP and ENP. The key determination of current paper is to evaluate the barriers and issues to RL and to check their impact on adoption of RL practices and to explain either they influence the firm performance or not. Barriers to reverse logistics may differ from context to context and as well as may differ from company to company and country to country [Govindan and Bouzon 2018]. The major contribution of the article is as follow:

According to authors best knowledge and literature, the current study gathered various significant concepts in one conceptual framework including, till present that were treated individually in the previous researches. Theoretical and hypothetical implications are applied on environmental modernization, ECP

and ENP with the glance of manufacturing firms of Pakistan. This study develops a complete understanding of barriers to RL that can be related to improving RL practices helping concern authorities to implement reverse logistics and to attain a better fit among RL practices and firm performance.

This study is conducted on manufacturing industry of Pakistan, a most populous country at the face of earth with 211 million inhabitants and positioned at number 6th in world population. In South Asia, Pakistan is the second largest economy with 988.2 billion GDP with 4.7 growth rate [US.CIA 2016]. Identifying the barriers affecting adoption of RL practices and its role in improving firm performance is necessary because Pakistan is standing at number 7th in the world which is most affected by global warming. On the other hand, due to environmental threats to Pakistan, Pakistan environmental protection agency (PAK-EPA) has introduced the new policy environment which is national policy on solid waste of Pakistan (NPSWP) under the section 13 & 14 of Pakistan environmental protection Act, Hazardous Substance Rule (2003) and its new contracts with European Union (EU) at Generalised Scheme of preferences (GPS+) to "promote sustainable development and good governance" in beneficiary nations. Furthermore, recent research in other developing countries evaluated barriers to RL in China, Indian [Chaudhary, Mathiyazhagan et al. 2017] and Brazil [Govindan and Bouzon 2018], but unfortunately there is no such kind of empirical research exist in Pakistan. As, Pakistani managerial style is different from other developing countries in term of cultural attitude toward adopting new environmentally friendly practices. Pakistani manufacturing companies may face more obstacles at the time of adopting new managerial practices as their directors are reluctant to adopt change and green management practices [Waqas, Dong et al. 2018]. Unique cultural characteristics of country and reluctance to adopt new managerial practices is developing a strong foundation of empirical study.

Further, structure of paper is arranged in given sections: literature review and hypothesis development are located section 2. Research methodology is presented in section 3. Section 4 describes results and data analysis and discussions are shown in section 5. Section 6 and section 7 presents conclusions and practical implication and future research direction respectively.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Barriers to RL adoption and RL practices

Due to environmental degradation, Pakistan is developing new environmental laws and regulation such as national policy on the solid waste of Pakistan (NPSWP), and struggling to protect the environment to reduce pollution and promote RL practices between public and manufacturing firm's. This situation could be improved with the help of environmental modernization and formulation of new environmental laws and regulations that can enforce manufacturing firms to bring green innovations in their production processes. In developing countries, ecological modernization can be utilized to understand a greener and sustainable context. Manufacturing firms must adopt green practices to bring sustainability, that can be done using their capabilities and resources to attain competitiveness on the base of environmental management and improve firm performance. Investing on green product development, waste reduction and controlling carbon emission and may help to maintain the manufacturers competitive andvantages among competitors, while the firm performance might also be improve by better dealing with green issues. Therefore, according to the resource-based view, the manufacturing firms should look inside of their resources to mitigate barriers to achieve the competitive advantage rather finding for a competitive environment. Integrating sustainability and ecological modernization into green reverse logistics practices to gain competitive advantage is difficult, still facing multiple barriers and require more research Giunipero, Hooker et al. [2012].

Table 1A. Study categories and variables

Construct	Barriers	References
Infrastructure & technology (ITB)		Abdulrahman, Gunasekaran et al. [2014]; Govindan and Bouzon [2018]; Waqas, Dong et al. [2018]; Rameezdeen, Chileshe et al. [2016]; Satapathy [2017]
B1	Lack of modern technology and information system	
B2	Lack of logistics infrastructure facilities	
B3	Lack of modern technology for waste management and recycling	
B4	Poor service quality of local 3PL provider	
B5	Lack of a system to monitor return	
B6	Lack of enough in-house facilities	
B7	Deficiency of road conditions	
Financial & economic (FEB)		
B8	Lack of initial capital	
B9	Higher costs of adopting RL	
B10	Lack of bank loans to encourage green products/ processes	
B11	Uncertainty related to economic issues	
B12	Lack of funds for products return monitoring systems	
B13	Higher investments and less return-on-Investments	
B14	Lack of funds for training	
B15	Financial burden of tax	
Laws & regulations (LRB)		
B16	Lack of government supportive policies for RL	
B17	Changing regulations due to changing political climate	
B18	Lack of regulatory restrictions	
B19	Lack of enforceable laws on products return of end-of-life	
B20	Lack of environmental laws awareness	
B21	Lack of effective environmental measure	
B22	Difficulty in identifying environmental opportunities	
B23	Lack of international or U.S environmental standards	
B24	No specific environmental goals	
B25	Lack of community pressure	
Knowledge & experience (KEB)		
B26	Lack of skilled professionals in RL	
B27	Lack of awareness about RL practices	
B28	Immaturity and low investment in knowledge management	
B29	Lack of responsiveness about RL	
B30	Wrong forecasting	
B31	Lack of taxation knowledge on returned products	
B32	Lack of information about RL channels	
B33	Lack of waste management practices	
Policy (PB)		
B34	Lack of corporate social responsibility and ethical standards	
B35	Companies policies against RL	
B36	Lack of clarity regarding sustainability	
B37	Limited forecasting and planning in RL	
B38	Lack of motivational laws and regulations	
B39	Lack of government supportive polices	
B40	Misuse of environmental laws	
B41	Lack customers awareness about environmental protection	
Reverse logistics practices (RLP)		Lai, Wu et al. [2013]; Graham, Graham et al. [2018]; Anne, Nicholas et al. [2016]
RLP1	Waste management	
RLP2	Design for RL	
RLP3	Recycle	
RLP4	Reprocess	
RLP5	Reuse	
RLP6	Material recovery	
Firm performance (FP)		Ye, Zhao et al. [2013]; Agrawal, Singh et al. [2016]; Huang, Jim Wu et al. [2012]
FP1	Economic performance	
FP2	Environmental performance	

According to [Kaviani, Tavana et al. 2020] RL barriers have significant positive impact on green product innovation and environmental performance, also influences the depletion of resources with tight environmental laws. [Abdullah, Zailani et al. 2016] found that internal and external barriers to reverse logistics and supply chain management has negatively influence on green system innovation and green product innovation while technical and knowledge barriers to logistics and supply chain management have no impact on adoption green product innovation and green system innovation. Moreover, according to [Jabbour, de Sousa Jabbour et al. 2016] internal barriers have more significant positive effect on adoption of green operational practices than external barriers and also

indirectly influenced the firms performance while green operational practices have direct association with firm performance in Brazilian manufacturing industry context. [Phochanikorn, Tan et al. 2020] empirically deducted top five barriers in his study to RL implementation in Thailand palm oil industry to reduced this industry impact on environment. [Waqas, Qianli et al. 2020] examined contextual relationship among 25 barriers of Pakistani manufacturing industry by applying MICMAC and interpretive structural modeling (ISM). On one hand, the barriers associated with RL practices can be recognized most related approach when developing sustainability within the firm [Prakash and Barua 2015]. Moreover, it seems difficult to understand the barriers restraining the implementation of RL practices in manufacturing companies of developing countries like Pakistan [Govindan and Bouzon 2018]. Although, the researchers have been discussing barriers, drivers, and motivational factors, opportunities are still available to develop the understanding with problems and issues to adoption of reverse logistics practices in manufacturing industry of developing countries specially in Pakistan.

In order to ensure the comprehensive literature evaluation barriers and drivers to reverse logistics, these research papers presented as few as 2 as many as 38 barriers and drivers [Prakash and Barua 2015]. In this study, barriers are divided into five main categories that avoid the adoption of RL practices, environmental protection, and sustainability within and outside manufacturing firms such as infrastructure & technology, financial & economic, laws & regulations, knowledge & experience and policy-related barriers constructs. Table 1A shows the main factors related to RL practices concentrate production process at manufacturing organizations.

Based on above-mentioned categories, following hypotheses are proposed:

H1- infrastructure & technology barriers construct negatively effect of adoption of RL practices

H2- financial & economic barriers construct negatively effect of adoption of RL practices

H3- laws & regulations barriers construct negatively effect of adoption of RL practices

H4- knowledge & experience barriers construct negatively effect of adoption of RL practices

H5- policy barriers construct negatively effect of adoption of RL practices

Reverse logistics practices and firm performance

Reverse logistics practices promote the system within organizations to decrease the environmental problems by introducing policies and procedures to improve existing infrastructure and to align it with the sustainability. Table 1A demonstrates the notions, factors, and references utilized in current study to describe RL practices and measure the firm performance.

The RL practices motivate the sustainable development and green practices in organizations. In literature, some recent researchers discovered a significant relationship between RL practices and firm ECP and ENP [Ye, Zhao et al. 2013]. Agrawal, Singh et al. [2016] uncovered the issues inducing the implementation of RL activities considering organizational, environmental and technical dimensions. It is important to invest in RL practices and envir onmental practices for improving sustainable policies and procedures for developing business competitive advantages, it would also be substantial for manufacturing firms to bulit distinctive position through linking environmental and quality investment. Therefore, the integration of green issues in firm operations are essential to advance the firm performance. Though, the literature review has yet to achieve consensus on this issue. Ye, Zhao et al. [2013] described that, ecological system management can expand the firm performance, however, some environmental practices negatively effect on it. Huang, Jim Wu et al. [2012] perceived the adoption of RL practices have a strong positive

impact on manufacturing firm performance and could have some influence from contextual and external factors. Therefore,

H6- RL practices positively affect ECP.

H7- RL practices positively affect ENP.

Barriers to RL adoption and firm performance

The association between RL practices and firm performance is still important and blinking research area [Satapathy 2017]. If barriers and drivers to RL negatively influence the RL practices as confirmed by literature, it also can be considered that barriers and drivers to RL may have an indirect influence on manufacturing firm performance. [Jabbour, de Sousa Jabbour et al. 2016] used green operational practices as mediator in barriers performance link in Brazilian manufacturing companies, however, RL practices adoption has not been considered as mediator in the literature of barriers performance link. For instance, lack of awareness about RL practices is treated as barrier and driver, it can be avoided by the exact adoption of RL practice in advance and accordingly can negatively effect on RL practices.

Therefore based on above discussion and literature evidence, we hypothesized that:

H8- *infrastructure & technology barriers construct negatively mediate the ECP through adoption of RL practices.*

H9- financial & economic barriers construct negatively mediate the ECP through adoption of RL practices.

H10-laws & regulations barriers construct negatively mediate the ECP through adoption of RL practices.

H11- knowledge & experience barriers construct negatively mediate the ECP through adoption of RL practices.

H12- policy barriers construct negatively mediate the ECP through adoption of RL practices.

Mediating role of RL practices

Abdulrahman, Gunasekaran et al. [2014], Bouzon, Govindan et al. [2018] studies are related to barriers and drivers to RL practices adoption and performance. A very few researchers have examined the link among issues to reverse logistics and firm performance and more research is needed. Developing the clear association among RL barriers and performance could help to concern authorities choose exact practice to avoid specific barrier and to increase firm performance [Bouzon, Govindan et al. 2016].

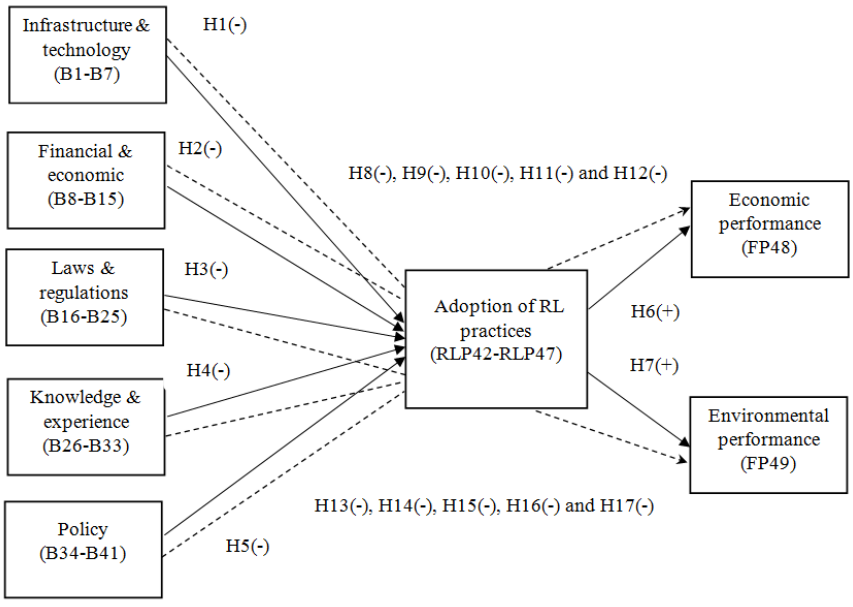

Fig. 1. Conceptual model presented in this study with direct and indirect effect

In developing countries especially in Pakistan, more research on sustainability and barriers evaluation are required [Abdulrahman, Gunasekaran et al. 2014].

Therefore, we hypothesized that:

H13- infrastructure & technology barriers construct negatively mediate ENP through adoption of RL practices.

H14- financial & economic barriers construct negatively mediate ENP through adoption of RL practices.

H15- laws & regulations barriers construct negatively mediate ENP through adoption of RL practices.

H16- knowledge & experience barriers construct negatively mediate ENP through adoption of RL practices.

H17- policy barriers construct negatively mediate ENP through adoption of RL practices.

Direct hypothesis based on literature are (H1, H2, H3, H4, H5, H6, and H7) and indirect hypothesis are (H8, H9, H10, H11, H12, H13, H14, H15, H16, H17), as mention in section 2 and Figure 1 empirically tested the conceptual framework of current research.

RESEARCH METHODOLOGY

Definition of constructs measurement

The key determination of current paper is to test a new conceptual model based on quantitative research base survey strategy presented in figure 1. Barriers to RL are measured into five categories such as:

- Infrastructure & technology barriers construct; this barriers construct contains the information about barriers related infrastructure & technology for example lack of modern technology for waste management, poor logistics infrastructure, deficiencies of roads, lack of monitoring systems for return and poor infrastructure & technology for development of RL practices within the country.
- Financial & economic barriers construct; this group of barriers has the information about barriers and drivers related to financial & economic obstacles such as a loan, investment, and adoption cost and return funding etc.
- Laws & regulation barriers construct; this category including the information about barriers related to laws & regulations.
- Knowledge & experience barriers construct; this construct refers to the barriers and drivers related to knowledge & experience to reverse logistics.
- Policy barriers construct; this barriers construct includes the information about issues that are related to policy.

41 barriers and drivers are included above mention five categories presented in Table 1A. The five-point Likert scale was utilized to estimate each barrier and driver, ranging from 1 (strongly disagree) to 5 (strongly agree).

- RL practices; variables related to RL practices are offered in Table 1A. The five-point Likert scale was utilized to estimate each of the item, ranging from 1(not applied) to 5 (fully applied).
- Firm performance; variables related to firm performance are presented in Table 1A. Again five-point Likert scale was utilized to estimate the firm performance variables, ranging from 1 (much poorer) to 5 (much improved).

In the end, company size is treated as a controled variable. Big companies more actively participate in sustainable practices, comparatively, they face more pressure from stakeholder to participate in environmental activities because big companies are considered as a trendsetter in their sectors. Adoption of RL practices has more concern with bigger companies rather than smaller. Normally, in four categories the firm size is measured; micro, small, medium, and large size firms which based on a number of firm employees. Micro size firms have 19 workers, small size firms have 20 to 99 workers, medium size firms have 100 to 499 and big companies have 500 or more workers. According to [Darnall, Henriques et al. 2010] firm size undeniable fact when discussing ecological system management and corporate social responsibility. Therefore, it is considered as a key variable when discussing

organizational problems and barriers, as many variables were not measured because of irrelevant to firm size.

Sample size and data collection

Research in the field of SCM can avail the more authentic results through survey because the advantage of the survey is to collect empirical research evidence related to real world including the perception of knowledge experts in particular research field. A comprehensive questionnaire was developed on behalf of section 3.1. Companies listed with the securities & exchange commission of Pakistan (SECP) were preferred from the manufacturing sector for data collection including automobile, textile, electronics, apparel, fertilizer, plastics, and food manufacturing companies etc. The facilitator arranged the meetings with potential respondents like (supply chain expert, business owner, directors, and managers) to deliver them the questionnaires and calls were made for a higher response rate. In total, 1000 questionnaires were distributed among respondents of relevant companies in Pakistan during Decembers to May 2018. From the government side, the data was gathered from the employees of PAK-EPA and sustainable development policy institute (SDPI). These institutes are focal institutes in Pakistan for successful implementation of NPSW within the country. Finally, 485 questionnaires were received back, 19 questionnaires were eliminated due to missing values, therefore, 466 questionnaires responses were considered as usable.

DATA ANALYSIS

Structural Equation Modelling (SEM) was applied to verify the hypothesis of conceptual model on the behalf of empirical data [Kaufmann and Gaeckler 2015] and AMOS 22.0 (trial version) was used to test indirect effect because AMOS is very useful to calculate the multicollinearity problems as well as some statistical indices.

Delphi method (DM) was used to evaluate all measures by the group of professionals. Initially, a meeting was arranged with professionals on DM procedure [Linstone and Turoff 1975] to evaluate the weight of measures to RL. Moreover, the board of experts including RL professionals, supply chain supervisors, financial experts, ecological experts, managerial specialists, social experts, and supply chain managers from different manufacturing industry of Pakistan was requested to participate in decision-making process. Initially, the pre-defined survey was filled by professionals independently according to their best knowledge about measures in Table 1A. After the completion of this first iteration, the response was gathered by the facilitator. According to their first iteration response, the anonymous summary of results prepared and again distributed among professionals for the objective of further amendment in selected measures list. After completion of three iteration consensus was developed among all professional experts, selecting the final set of barriers to become quite easy affecting the adoption of RL practices in Pakistani manufacturing industry.

Table 2. Details of respondents

Demographic	Count	Percentage%
Gender		
Male	356	76
Female	93	24
Age group		
20-35 years	108	23
36-50 years	273	59
>50 years	85	18
Education		
Bachelor	246	53
Master	199	43
Ph.D.	21	4
Industry category		
Automobile industry	45	10
Electronic products manufacturing	30	6
Textile mills	55	12
Plastic bags manufacturing	25	5
Apparel mills	34	7
Cement manufacturing	20	4
Fertilizer companies	38	8
Beverage companies	49	11
Paper manufacturing	20	4
Rubber and plastics mills	23	5
Food industry	74	16
Lubricants companies	22	5
Government Employees (PEPA, SDPI)	31	7
Work status		
Top level	53	11
Middle level	280	60
Low level	133	29
Total	**466**	**100**

Finally, the board of expert suggested deleting following 10 barriers from given five barriers categories (B4, B7, B10, B12, B17, B23, B28, B33, B37, and B39) due repetition and ambiguity. In the end, 39 variables were considered under eight constructs for defining the model of study. Initially, Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) was applied to analyse reliability and validity instruments. Internal consistency was measured with Cronbach's Alpha outcomes, the findings of Cronbach's Alpha were fluctuate between 0.731-0.868 that verified the inner consistency of each constructs, and meets the standard criteria. Reliability of developed scale is supported by the values of Cronbach's Alpha.

EFA was implemented to eight constructs having 39 variables to expose the latent variables. The keen objective of EFA to check relationship among observed and latent factors whether the factors are unknown or uncertain. In this research, the principle component analysis (PCA) with varimax rotation was utilized to apply EFA on 39 variables. EFA starts with examining the suitability of data, Bartlett test and Kaiser-Meyer-Olkin (KMO) checks sample adequacy. To perform the factor analysis the value of KMO should be 0.60 or more. The value of KMO was 0.835 that fulfil the stated standards and finding of Bartlett test was X2=3365.453 and P>0.000 which is showing substantial and satisfactory inter-correlation. Factor loading of all variables should be 0.40 or more, commonalities and cross-factor loading values should be 0.40 or more criteria. Eigenvalues should be 1 or more, as finding of EFA showing that all seven constructs eigenvalues are more than 1 with 73.34% total variance and factor loading values were ranging between 0.567-0.865 that meet the given criteria. EFA findings are shown in Table 3A.

Barriers are arranged according to their highest factor loading for each category presented in (Table 3A), infrastructure & technology construct the barriers with highest factor loadings are B6>B1>B3>B2>B5. According to the finding of study lack of enough in-house facilities (B6), lack of new technology and information system (B1) and lack of modern technology for waste management and recycling are dominant barriers of the category.

In Financial & economic construct the barriers with highest factor loadings are B8>B15>B14>B13>B9>B11 respectively. Study findings reveal that lack of initial capital (B8), the financial burden of tax (B15) and lack of funds for training (B14) are main barriers of the category.

In law & regulation construct the barriers B22>B24>B19>B25>B21>B20>B18>18 are with highest factor loadings. Following three barriers, difficulty in identifying environmental opportunities (B22), no specific environmental goals (B24) and lack of enforceable laws on products return of EOL (B19) are identified as most critical barriers of the category.

Knowledge & experience construct the barriers with biggest factor loading are B29>B26>B27>B30>B31>B32 respectively. Lack of responsiveness about RL (B29), lack of trained professionals in RL (B26) and Lack of awareness about RL practices (B27) are the dominant issues of the construct.

In policy construct the barriers are B38>B36>B34>B41>B35>B40 with their highest factor loadings. According to results, Lack of motivational laws and regulations (B38), lack of clarity regarding sustainability (B36) and Lack of corporate social responsibility and ethical standards (B34) have strong factor loadings.

In the adoption of RL, practices construct the barriers with highest factor loadings are RLP44>RLP47>RLP45>RLP42>RLP46>RLP 43 respectively. Results show that recycle (RLP44), material recovery (RLP47) and reprocess (RLP45) are the main variables of the category.

Finally, firm performance variables with their factor loading are FP48>FP49, economic performance, and environmental performance.

Table 3A. Results of Exploratory Factor Analysis

Constructs	Variables	Reliability	AVE	Composite Reliability	1	2	3	4	5	6	7
Infrastructure & technology	B1	0.850	0.532	0.890	0.832						
	B2				0.751						
	B3				0.820						
	B5				0.735						
	B6				0.855						
Financial & economic	B8	0.822	0.575	0.923		0.865					
	B9					0.705					
	B11					0.667					
	B13					0.764					
	B14					0.832					
	B15					0.855					
Laws & regulations	B16	0.731	0.602	0.856			0.679				
	B18						0.767				
	B19						0.803				
	B20						0.756				
	B21						0.790				
	B22						0.854				
	B24						0.810				
	B25						0.798				
Knowledge & experience	B26	0.785	0.566	0.876				0.843			
	B27							0.820			
	B29							0.862			
	B30							0.770			
	B31							0.746			
	B32							0.699			
Policy	B34	0.868	0.643	0.887					0.805		
	B35								0.730		
	B36								0.832		
	B38								0.840		
	B40								0.680		
	B41								0.769		
RL practices	RLP1	0.815	0.510	0.901						0.751	
	RLP2									0.567	
	RLP3									0.830	
	RLP4									0.815	
	RLP5									0.732	
	RLP6									0.823	
Firm performance	FP1	0.798	0.530	0.897							0.865
	FP2										0.817

Table 4. Correlation and discriminant validity

Latent variables	Mean	S. D	ITB	FEB	LRB	KEB	PB	RLP	FP
ITB	3.43	1.854	1						
FEB	4.17	1.516	0.534**	1					
LRB	2.78	1.095	0.335**	0.476**	1				
KEB	3.80	1.475	0.498**	0.567**	0.365**	1			
PB	2.25	0.902	0.278**	0.326**	0.565**	0.235**	1		
RLP	4.68	1.690	0.576**	0.287**	0.271**	0.426**	0.525**	1	
FP	2.66	1.076	0.389**	0.384**	0.178**	0.501**	0.213**	0.374**	1

The values of convergent and discriminant validity are enough good. Convergent validity proved that the most barriers have better loadings in the origin of the construct are presented in Table 3A and table 4 respectively.

Constructs validity was checked by CFA applying on 39 variables under eight constructs. CFA is one of significant research methods of SEM that is largely applied in supply chain management and RL field to

calculate covariance structure and linear structural relationship models. When scholars have limited or inadequate information toward latent variables, they prefer to utilize this kind of multivariate research technique to discover the significant association among variables. Eight model constructs scrutinized with 39 variables using different model fitness indices. According to the model findings the values of squared multiple correlations (SMCs) ranged between 0.468-0.759 which meets the recommended criteria. The final findings of CFA, correlation among variables and model fitness of the research paper is presented in tables 5.

Table 5. Model fitness results

Fit indices	Statistics	Recommended Criteria
NFI	0.93	>0.90
NNFI	0.92	>0.90
CFI	0.95	>0.90
GFI	0.91	>0.80
AGFI	0.96	>0.80
RMSEA	0.053	>0.08

Source: Hair, Black et al. 2010

Adoption of RL practices, in turn, affect the firm's performance (economic and environmental performance). Moreover, Economic performance is more focused, than environmental performance based on factor loadings values. In term of mediation relations, Law & regulation and policy barriers constructs are not tending to be associated significantly to firm performance.

Path diagram model is presented in figure 1 and table 6 presenting relationships among variables. Direct and mediated significant relationships are presented in Tables 6, considering P-value <0.05 as the standard for defining the level of significance. On the behalf of table 6 results, from seventeen proposed hypotheses, six has been rejected and eleven has accepted findings are presented in table 7. Next section explains the results of hypotheses in details and also discusses.

Table 6. Hypothesis testing

Hypothesis	**Standard error**	**P-value**	**Acceptance Yes/No**
Infrastructure & technology → adoption of RL practices	0.085	0.000	Yes
Financial & economic → adoption of RL practices	0.047	0.000	Yes
Law & regulation→ adoption of RL practices	0.126	0.235	No
Knowledge & experience → adoption of RL practices	0.034	0.000	Yes
Policy → adoption of RL practices	0.099	0.219	No
Adoption of RL practices → economic performance	0.087	0.000	Yes
Adoption of RL practices → environmental performance	0.053	0.000	Yes
Infrastructure & technology → adoption of RL practices → Economic performance	0.087	0.000	Yes
Financial & economic → adoption of RL practices → Economic performance	0.065	0.000	Yes
Law & regulation → adoption of RL practices → Economic performance	0.115	0.236	No
Knowledge & experience → adoption of RL practices → Economic performance	0.043	0.000	Yes
Policy → adoption of RL practices → economic performance	0.131	0.237	No
Infrastructure & technology → adoption of RL practices → Environmental performance	0.072	0.000	Yes
Financial & economic → adoption of RL practices → environmental performance	0.036	0.000	Yes
Law & regulation → adoption of RL practices → environmental performance	0.153	0.275	No
Knowledge & experience → adoption of RL practices → environmental performance	0.045	0.000	Yes
Policy → adoption of RL practices → environmental performance	0.132	0.238	No

Table 7. Test of hypotheses results

Hypotheses	Results	Reasons
H1- infrastructure & technology barriers construct negatively effect of adoption of RL practices (when barriers and drivers will be more than the adoption of RL practices will be less).	Accepted	Beta 0.51; P-value<0.001
H2- financial & economic barriers construct negatively effect of adoption of RL practices (when barriers and drivers will be more than the adoption of RL practices will be less).	Accepted	Beta 0.57; P-value<0.000
H3- laws & regulations barriers construct negatively effect of adoption of RL practices (when barriers and drivers will be more than the adoption of RL practices will be less).	Rejected	Beta 0.057; P-value<0.235
H4- knowledge & experience barriers construct negatively effect of adoption of RL practices (when barriers and drivers will be more than the adoption of RL practices will be less).	Accepted	Beta 0.51; P-value<0.000
H5- policy barriers construct negatively effect of adoption of RL practices (when barriers and drivers will be more than the adoption of RL practices will be less).	Rejected	Beta 0.68; P-value<0.219
H6- RL practices positively affect economic performance.	Accepted	Beta 0.83; P-value<0.001
H7- RL practices positively affect environmental performance.	Accepted	Beta 0.55; P-value<0.001
H8- infrastructure & technology barriers construct negatively mediate economic performance.	Accepted	Beta 0.51; P-value<0.000
H9- financial & economic barriers construct negatively mediate economic performance.	Accepted	Beta 0.55; p-value<0.001
H10-laws & regulations barriers construct negatively mediate economic performance.	Rejected	Beta 0.042; P-value<0.236
H11- knowledge & experience barriers construct negatively mediate economic performance.	Accepted	Beta 0.85; P-value<0.000
H12- policy barriers construct negatively mediate economic performance.	Rejected	Beta 0.058; P-value<0.237
H13- infrastructure & technology barriers construct negatively mediate environmental performance.	Accepted	Beta 0.68; P-value<0.000
H14- financial & economic barriers construct negatively mediate environmental performance.	Accepted	Beta 0.75; P-value<0.001
H15- laws & regulations barriers construct negatively mediate environmental performance.	Rejected	Beta 0.044; P-value<0.275
H16- knowledge & experience barriers construct negatively mediate environmental performance.	Accepted	Beta 0.85; P-value0.001
H17- policy barriers construct negatively mediate environmental performance.	Rejected	Beta 0.074; P-value<0.238

RESULTS AND DISCUSSION

According to the finding of study infrastructure & technology, financial & economic and knowledge & experience barriers constructs are more relevant to adoption RL practices than law & regulation and policy barriers constructs. Finding proves that if firms need to achieve distinctive advantages as recommended by the resource-based view of firms, they need to deal with above mention three barriers constructs concentrate on growing level of green awareness among top management by introducing enough green training program. Our study suggests that simple publications on NPSW are not enough to encourage sustainability in the manufacturing industry of Pakistan. It is the duty of government proposing, assigning and producing sustainable knowledge among all size of companies. Therefore, the organizations must develop the connection between environmental modernization problems and natural resource-based view to overcoming above-mentioned barriers constructs to upgrade the performance of firms.

The finding of the study framework proved that the firm size has no important effect on ECP and ENP. Therefore, companies of different sizes have confronted different barriers in the same way, because of the presence of barriers in the similar scenario, i.e. Pakistan. Current study adds to addressing existing literature and confirm that bigger companies have good resources to manage their sustainability and ecological management as compared to smaller companies. This study confirmed that higher performance does not depend on company size, thus, small companies also can adopt RL practices for developing sustainability.

When verifying hypotheses of study, out of seventeen hypotheses, eleven were accepted and six were rejected. H1-infrastructure & technology barriers construct negatively affect the adoption of RL practices. In simple words, stronger the barriers to infrastructure & technology construct resulted in a lower tendency for adopting RL practices. Because

Pakistan under developing country, therefore, there is a lack of new technology and logistics infrastructure facilities to managing the solid waste and the monitor return. H2-financial & economic barriers construct negatively affected the adoption of RL practices. Presence of financial & economic barriers also resulted in a lower tendency for the adoption of RL practices. A very few companies in manufacturing industry of Pakistan have operational RL department and they allocate budget for it. Therefore, Pakistani manufacturing firms need financial assistance to establish reverse logistics infrastructure and to overcome major impeding barriers. H3-law & regulation barriers construct negatively affect the adoption of RL practices but don't have a significant association to the adoption of RL practices. Because Pakistan is independent in the field of laws and regulation, every kind of laws are available in the constitution of Pakistan related to every field but unfortunately, there has no proper implementation. H4-knowledge & experience construct barriers are also negatively correlated with the adoption of RL practices. More the knowledge and experience barriers lead, the adoption of RL practices is less. Education institutes in the country are failed to cope with the expectations of industry in the field of reverse logistics. However, Pakistani companies are struggling to spend on recruiting experienced and foreign technical experts in the related field. In some cities of Pakistan, foreigner skilled professional demand security for providing their services, sometimes companies face difficulties to arrange proper security for them. H5-policy barriers construct is negatively affecting the adoption of RL practices but had no significant association to the adoption of RL practices

H6 and H7 proposed a significant positive association among adoption of RL practices and ECP and ENP of Pakistani manufacturing firm's. implementation of RL practices in manufacturing industry create an important role in environmental degradation and improving environmental quality. Along with environmental sustainability, RL is packed with multiple economic benefits as it develops an infrastructure for products recycling and solid waste management which improves an organisation's productivity and ECP performance.

This research also contributes to analyzing the mediating effect of RL practices adoption. Results found that (H8, H9, and H11) infrastructure & technology, financial & economic and knowledge & experience barriers construct respectively to reverse logistics adoption have an indirect negative effect on firm's economic performance through RL practices adoption. Thus, firms tending to improve economic performance should not only consider RL practices adoption but should also deal with above mentioned three barriers constructs to RL. (H10 and H12) law & regulation and policy barriers construct respectively to RL adoption also have a negative indirect impact on firm's ECP through adoption of RL practices, as results found, these two hypotheses do not have a significant effect on ECP.

The mediation analysis also found that (H13, H14, and H16) infrastructure & technology, financial & economic and knowledge & experience barriers construct respectively to reverse logistics adoption have an indirect negative impact on firm's ENP through RL practices adoption. Therefore, results found that the existence of above-mentioned three categories barriers is impeding the firm's environmental performance. Companies should take remediation actions to eradicates these barriers during their operations. (H15 and H17) law & regulation and policy barriers construct respectively to RL adoption also have a negative indirect impact on firm's ENP through adoption of RL practices, as results found, these two hypotheses do not have a significant effect on ENP. Supporting mediating relationships provide more insights into the implementation of RL in Pakistan. It is one of the key theoretical contributions of the current article is to check the mediating role of RL practices in the barriers-implementation relationship.

Study findings proved that infrastructure & technology, financial & economic and knowledge & experience barriers constructs are more significant to manage the

sustainability at the time of adoption RL practices and their implications for firm's economic and environmental performance. As previous studies in literature indicate that infrastructure & technology, financial & economic and knowledge & experience barriers categories are more significant to sustainable development and adoption of RL practices as compared to law & regulation and policy barriers constructs is confirmed by [Abdulrahman, Gunasekaran et al. 2014, Bouzon, Govindan et al. 2016]. Therefore, organization top management, when willing to adopt RL practices for the enhancement of firm's ECP and ENP, firstly should deal with infrastructure & technology, financial & economic and knowledge & experience barriers constructs because these three barriers constructs should be eradicated at the initial level for effective implementation of RL practices [Govindan, Kaliyan et al. 2014]. Managers and directors should develop the solid understanding of barriers to prioritize them according to their rank for the purpose of better utilization of the firm's resources.

Lastly, evaluating each barriers category, law & regulation and policy barriers categories containing the barriers related to environmental legislation and environmental modernization initiative will work only when infrastructure & technology, financial & economic and knowledge & experience related barriers should be mitigated first and the attention should be paid by upper management to create awareness on sustainability problems and conduct proper training system within organizations as expressed through literature [Rameezdeen, Chileshe et al. 2016]; [Satapathy 2017]. RL practices, the focus should be paid toward the production process and the selection of environmental friendly suppliers [Wong, Lai et al. 2012]. Selection of green supplier the results has been emphasized by literature [Genovese, Lenny Koh et al. 2013]. In term of firm's performance, it is compulsory to reduce the waste generation and hazardous/toxic materials because of environmental modernization in Pakistan is enforcing eradication of waste due to NPSW.

CONCLUSIONS

This research advances the knowledge of environmental and sustainability management in RL practices to enhance the manufacturing industry performance. The key purpose of current research is to validate the direct and indirect association among different barriers constructs (infrastructure &technology, financial & economic, laws & regulations, knowledge & experience and policy) and explore the adoption of RL practices and firm's performance (economic and environmental) on the behalf of data collected from Pakistani manufacturing industry. Following are the key conclusions based on study findings and implications:

Infrastructure & technology, financial & economic and knowledge & experience related barriers are more significant than laws & regulations and policy related barriers during the adoption of RL practices and these practices help to increase firm's ECP and ENP.

The results of this research help to extend literature review presenting that the ecological modernization and new environmental laws and regulation should be integrated with enterprises to mitigate infrastructure & technology, financial & economic and knowledge & experience related barriers by conducting proper training programs and promoting sustainability and environmental protection among company's top management. Universities and different Pakistani manufacturing associations (PMA) can create the partnership to consider and promote this process. Companies looking forward to creating company competitive advantages can upgrade the firm's ECP and ENP through the adoption of RL practices in promoting the greening manufacturing processes. Without considering the firm's size, a strong understanding should develop with barriers to RL will important to move forward the Pakistani manufacturing industry toward greening production in a timely manner.

PRACTICAL IMPLICATIONS AND FUTURE RESEARCH DIRECTION

This research has a substantial contribution to the adoption of RL practices in the manufacturing industry of developing republics, as it has included the barriers to RL from an international context. Furthermore, current research also contains the managerial implications, particularly for Pakistani manufacturing context, as the selection of main barriers by the team of professionals from the manufacturing industry and scholars in Pakistan. However, the finding of this research might be beneficial for manufacturing industries situated in the rest of developing economies. The findings might be beneficial for the adoption of RL practices in India, China and Iran, which are the most emerging economies of the region.

Internationally, there are a lot of issues related to waste management that is alarming the ecological system of the world and now, these issues must be considered by scholars. A considerable portion of EOL products are incinerated or untreated that is polluting the environment. To reduce the impact of used products, the companies must activate the RL operations in their manufacturing system to put used products at the proper destination. For this, the companies must highlight the barriers to RL and deal with them at priority basis. Better knowledge on barriers to RL make easy the adoption of RL practices that encourage the product return and product recycling management help to realize the manufacturers to realize their corporate social responsibility toward environmental protection. Moreover, the identification of critical barriers, as well as having the information about factors affecting them or being affected by them, might be helpful for concern authorities and decision makers.

This research is related to manufacturing industry interested in adoption of RL practices for Pakistani context and prioritize the barriers to RL in different categories in way of adoption of RL practices. It might useful for industrial managers to eliminate the most critical barriers to RL at priority basis at the time of the adoption of RL practices. It can also guide the policy makers to enhance the usage of resources by the adoption of RL practices.

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WPŁYW OGRANICZEŃ LOGISTYKI ZWROTNEJ NA ROZWÓJ ZRÓWNOWAŻONY PRZEDSIĘBIORSTWA

STRESZCZENIE. **Wstęp:** Wskutek wzrastającego rozwoju przemysłowego i intensyfikacji produkcji, zużywa się coraz więcej surowców, co z kolei wpływa na stan środowiska. Logistyki zwrotna (RL) to koncepcja dobrze rozwinięta w krajach rozwiniętych w stosunku do krajów rozwijających się. Wdrożenie logistyki zwrotnej jest w swojej początkowej fazie ze względu na wiele czynników ograniczających i utrudniających jej wprowadzenie. Celem pracy jest identyfikacji barier wpływających na logistykę zwrotną poprzez przegląd literatury oraz sprawdzenie wpływu tych czynników na wdrażanie praktyk logistyki zwrotnej jak również sprawdzenie czy mają one wpływ na działalność przedsiębiorstwa czy nie.
Metody: Dane do badania zostały zebrane od pracowników przedsiębiorstw produkcyjnych oraz odpowiednich instytucji rządowych i poddane analizie przy zastosowaniu metody modelowania równania strukturalnego. Nowatorski model strukturalny uwzględnia w sobie wszystkie analizowane zmienne w celu oceny wpływu barier logistyki zwrotnej na rozwój zrównoważony przedsiębiorstwa.
Wyniki: Badanie wykazuje, że czynniki: Infrastruktura i technologia, Finanse i ekonomia, Wiedza i doświadczenie, są czynnikami krytycznymi i mają negatywny wpływ na zaadoptowanie praktyk logistyki zwrotnej. Wdrożenie praktyk logistyki zwrotnej ma pozytywny efekt na działalność ekonomiczną i środowiskową przedsiębiorstwa.

Wnioski: Osiągnięte rezultaty pozwalają na poszerzenie dostępnej literatury, pokazując, że modernizacja ekologiczna oraz nowe prawodawstwa związane z ochroną środowiska powinno być zintegrowane w przedsiębiorstwie w celu zniwelowania barier związanych z czynnikami z grup Infrastruktura i technologia, Finanse i ekonomia, Wiedza i doświadczenie poprzez odpowiednio szkolenia oraz przez promowanie rozwoju zrównoważonego wśród szczebla najwyższego kierownictwa przedsiębiorstw.

Słowa kluczowe: rozwój zrównoważony, wdrożenie logistyki zwrotnej, ograniczenia, przedsiębiorstwa produkcyjne, Pakistan

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