BARRIERS IN EMPLOYING AND IMPLEMENTING REVERSE LOGISTICS IN THE CONSTRUCTION INDUSTRY OF PAKISTAN

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A thesis submitted in partial fulfillment of the

requirements for the degree of

Bachelor of Science

In

DEPARTMENT OF CONSTRUCTION ENGINEERING AND MANAGEMENT

SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING

NATIONAL UNIVERSITY OF SCIENCES AND TECHNOLOGY

Year 2020

CERTIFICATION

This is to certify that thesis entitled

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For bachelors in Civil Engineering

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Dedication

We would like to dedicate our work about our final year project to our loving parents, our friends of batch of 2016 for their never ending support throughout our final year. It is because of them that these four years have been enjoyable rather than intolerable.

We would also like to dedicate our work to Sir Muhammad Hasnain for his continuous support whose words of encouragement not only served as a motivating force to work more vigorously but also helped us to improve our vision about how to learn new things.

ACKNOWLEDGEMENTS

We are grateful to Almighty Allah for giving us the strength, courage and the patience to finish our final year thesis in construction engineering and management department at National University of Science and Technology and in achieving our task meticulously.

We would like to thank Sir Lecturer Muhammad Hasnain, our supervisor for the project, for his constant support and guidance as well as resolving our queries throughout 7^{th} and 8^{th} semesters. It is because of his motivation and encouragement, that we have been able to explore the world in a number of manners and have groomed ourselves not only as professionals but also as humble human beings.

ABSTRACT

Lately the rapid increase in the amount of construction and demolition waste has posed serious threats to a sustainable construction practices in the industry. Many countries across the world has already implemented several techniques and methods to tackle this problem. However, Pakistan has still not implemented any method to solve this massive issue of C & D waste. This study was aimed at identifying barriers that hinders the adaptation of revere logistics in construction industry of Pakistan. Main and sub-factors were identified by conducting an extensive literature review. These factors were ranked on the basis of relative important index. A questionnaire was developed to take responses from industry professionals who had both field experience and modern technical understanding. After analysis, detailed recommendations were provided as to how to overcome these barriers to ensure the implementation of reverse Logistics in the construction industry of Pakistan.

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CHAPTER 1

INTRODUCTION

1.1 Aim

The aim of this paper is to identify and investigate the hurdles in implementation of reverse logistics in construction and demolition of waste management.

1.2 Objectives

The objectives set out for this research paper are summarized and mentioned below:

- To identify different reverse logistics' techniques and their implementation in the construction industry.
- Identification and ranking of the factors that hinder the implementation of reverse logistics.
- To identify the challenges encountered when implementing these factors in Construction Industry of Pakistan.
- To perform statistical analysis on the obtained data and to investigate the economic, social and sustainability aspects of these factors.

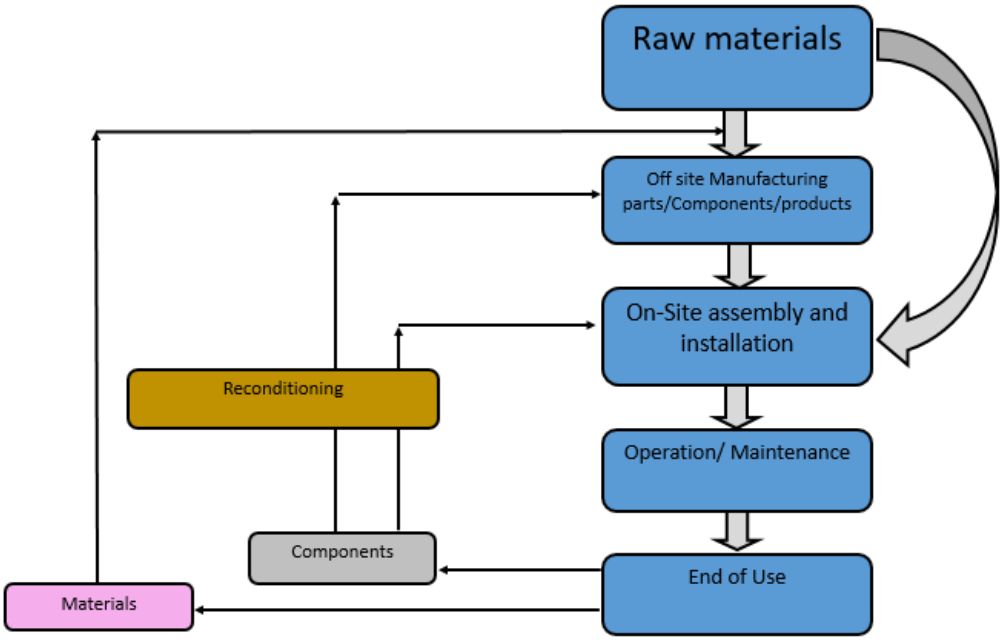
1.3 SCOPE AND LIMITATIONS

- This study only concerns with the major reverse logistics techniques and their role in construction and demolition waste management.
- Due to time constraint, the interviews and questionnaire survey to collect data will be conducted only from organizations located in Islamabad and its locality.
- This study takes into consideration the opinions of construction industry experts, contractors, consultants, project managers and concerned stake holders.

1.4 Overview

Significant construction and demolition waste (C&D waste) is the reason behind people to be wary and thoughtful of the impacts and indemnities that it inflicts upon the environment. This realization on part of the people associated with the construction industry as well as the governments has prompted them to employ waste management practices in their standard operation procedures (SOPs). Previously, developing a waste management plan was a novel thing to do, but in recent years it has become a crucial aspect that must be planned beforehand and implemented during the project run. However, the steps taken by the industry personnel have hardly achieved the desired objectives and the practice of disposing off C&D waste in landfill sites still persists at large. The reasons identified of negating waste management practices are namely – surged overhead costs, lack of enforcement of policies by the governments and seemingly fiscal burden. After having gone through various techniques and practices to control waste management, and the use of reverse logistics seems to be the most feasible and achievable technique of all. Reverse logistics as a sustainable technique was first introduced by Lambert and Stock in 1981, who elaborated it as the role of logistics in which an end products integrates back into the supply chain as an ingredient thus making the process more productive, efficient and sustainable.

Figure 1: Working Model for Reverse Logistics



Reverse logistics as a process to recycle and reuse end and by products has been used by different industries such as automobile, consumer goods and manufacturing industry which has not only altered their aims and objectives of doing business, but also has made a name for themselves by employing such greener practices. These steps has changed the outlook of companies from an enemy of the planet to a savior of the environment. Though this brand image has reduced their profit margin from a single project, it has surely increased the number of projects that the organization acquires. Construction industry, on the other hand, has resisted to the mentioned changes because the construction projects usually have a much longer useful life when compared with other industries such as FMCGs. There are no incentives provided in monetary terms and because since this practice requires continuous interaction between the supplier and the purchaser, it is quite tedious to employ such practices.

Construction is responsible for a number of adverse effects that are not only limited to the local environment but also impact global climate change (Kucukvar and Tatari, 2013). Thereafter, a growing sense of controlling waste, pollution and improving energy and water efficiency persists. Keeping in mind the need of the hour, steps must be taken to mitigate such impacts (Abidin, 2009).

1.5 Significance

Construction sector is among the prime sectors of economy that contributes greatly to GDP of a country that is especially evident in case of developing countries as there is always need of more infrastructure. In Pakistan, the GDP of the country has steadily increased for the past decade despite small vicissitudes, but the construction industry has not increased and expanded that effectively and proportionally to total increase in the GDP. Construction sector is also one of the largest employers of Pakistan. Like other developing countries, Pakistan faces a number of Management problems in construction industry that are owed to a number of reasons.

A number of researches and careful analysis shows that Poor construction waste management and ineffective reverse supply chain techniques is the bottleneck on project management techniques in construction industry. Thus accounting for loss of productivity, sustainability and efficiency. In addition, construction and demolition waste management is comparatively new as compared to other solid waste management as the Municipal waste management, thus how to reduce and manage C& D waste is a major challenge in front many economies of the world.

At present there are a large number of methods available for construction waste management and widely used in most developed countries but despite sound efforts made by western countries, 35% or more construction and demolition waste or (C&D waste) still not integrated back in the supply chain and disposed of as land fill. Developing Asian countries have yet to adopt this on an impactful level.

The Methods for managing C&D waste include but not limited to establishing C&D waste centers working to ensure that the concerned waste is integrated back into the supply chain as raw materials. Often the major waste received at many land disposal sites is C&D waste. It is therefore of great importance to properly manage C & D waste as it can not only save many scarce land resources but also mitigate its adverse effects on environment.

The uses and applications of reverse logistics in construction waste management range from fulfilling the huge demand of aggregates in housing and road sector, as sub base layers to soil stabilization.

Thus, it is a matter of undeniable importance to practically implement and ensure proper reverse logistics procedures to expedite expansion and consolidation of construction sector in Pakistan. This thesis aims to highlight Importance and barriers of reverse logistics in construction industry.

CHAPTER 2

LITERATURE REVIEW

2.1 RL in construction

Love et al. (2004) describes logistics with respect to the construction industry as "the network of facilities and activities that provide customer and economic value to the functions of design development, contract management, service and material procurement, materials manufacture and delivery, and facilities management".

Rogers and Tibben-Lembke (1999) has defined RL as "the process of planning, implementing, and controlling the efficient, cost effective flow of raw materials, in-process inventory, finished goods, and related information from the point of consumption to the point of origin for the purpose of creating or recapturing value, or proper disposal". This definition was later improved upon as "the movement of product or materials in the opposite direction for the purpose of creating or recapturing value, or proper disposal". Furthermore, most of the earlier researches about reverse logistics were concerned about the eco-friendliness of the returned product (Andel, 1997; Byrne and Deeb, 1993). The mechanism of this practice and business plan was thoroughly thought out including its operation, control of flow of information coming from numerous delivery channels and how this mechanism would add value to the product. It includes the legal, corporate, economic and sustainable aspects Leite (2003), cited in Nunes et al., (2009).

2.2 Conceptualization of the RL system

To determine the most crucial barriers faced by the construction industry, it is pertinant to define the idea of reverse logistics. The definition given by Pokharel and Mutha (2009) describes the reverse logistics system where RL is envisioned as being comprised of three sorts

consisting of inputs, the processes and the structure and the outputs. In view of that, it is recommended that any research that may be undertaken on RL be initiated and fixated according to the mentioned categories. Considering the example, Pokharel and Mutha (2009) who state that being part of RL, the "processes and structure" are generally linked with process efficiency or a location–allocation optimization problem, however, the obtained outcomes of the RL system are the idealized outputs in form of remanufactured products, and recycled materials and spare parts.

Logistics and supply chains relating to the construction industry have faced dissimilar challenges when compared with other industries which have reduced their waste through reuse and recycle (Arantes et al., 2015). The resistance to employ waste reduction practices through reverse logistics is mainly due to reduction in profits, and because handling of the huge amount of waste is difficult and time consuming though it has numerous environmental benefits (Vrijhoef and Koskela. 2000). The hostile effects that the prevalent practices have on the climate and the environment has prompted not only the governments to take serious action but also has caused awareness among the industry professionals and the clients as well. Therefore, the urgency to modify prevalent practices has been highlighted by many researchers (Love et al., 2004 and Arantes et al., 2015). Moreover, the construction industry has fixated its efforts on reducing waste as a major target rather than revising the supply chains (Dainty and Brooke, 2004).

Some of the major concerns relating to C&D waste are mentioned by researchers throughout the world. The Australian Bureau of Statistics (ABS) demonstrates the significance of the South Australian (SA) construction demolition industry which does not only helps their GDP by 7% but is also the seventh biggest employer in SA (Chileshe et al., 2012). Nevertheless, it still is a major producer of construction waste that requires some serious thinking to do.

Likewise, several studies describe this concern for China which produces almost 300 million tons of construction waste annually which is about 40% of the total waste by one of the largest country (Wang et al., 2010 and Chen et al., 2010). Similar concerns are shown by researchers in different parts of the world, by Jindal and Sangwan (2011) for India, by Barros (1998) for Europe and by Shakantu (2008) for South Africa. Seeing this, a significant quantity of studies have been performed to identify the more serious issues and promote practices of waste reduction, its reuse and remanufacture (Pokharel and Mutha, 2009).

The literature we have regarding the developing and the developed countries among various industries such as manufacturing, services and construction is full with studies and research on the major factors influencing the practical application of RL. Considering the perspective and outlook observed by Walker et al. (2008) from the public and also the private view point and Ho et al. (2012), studies are concentrated to analyze the prominent factors that can persuade industries to make use of RL techniques. These barriers can be divided into either the internal (relating to intra-organizational) and external (relating to inter-organizational). Consequently, the seminal study by Carter and Ellram (1998) , although aimed on the catalysts instead of the barriers, conceptualized proponents into either “internal” or “external”, also associated “company factors” with the internal with the “task environment” as external.

The preceding sub-sections gives a comprehensive discourse of the construction-related literature regarding these recognized categories:

2.3 Internal barriers

The more significant internal barriers for implementation of RL in the construction industry include the following:

- Major initial costs and expenses are incurred as a result of adopting RL procedures (Schultman and Sunke, 2007a, b)
- Greater dangers of using salvaged material and items (Addis, 2006a, b). Such outcomes make the companies indifferent to the liabilities (Gorgolewski, 2008)
- Dearth of awareness with regard to the potential benefits for companies (Chini and Bruening, 2003)
- Certain operational hurdles tend to make people oblivious to the potential advantages of using this practice such as inflation costs (Sassi, 2004), the time consuming nature of RL (Schultman and Sunke, 2007b)

2.4 External barriers

These can be bifurcated under the following headings

- Associated with environment
- Nature of projects

2.4.1 Barriers associated with the environment

- Absence of procedures and machinery to handle waste (Schultmann and Sunke (2007))
- People having no knowledge of recycle and reuse for civil works (Sassi, 2004)
- Lower profit margin in projects (Addis, 2006a, 2006b)
- Perception of clients that the quality of final product may be compromised (Chini and Bruening, 2003)
- Disposal of materials is more easy and cheaper than taking them to the new project site (Chini and Bruening, 2003)

2.4.2 Nature or projects

- The life of buildings is too long with chances of more than one owners in its life
- Waste may be obtained from different projects which may be difficult to mobilize
- Presence of hazardous material may be harmful
- It may be difficult to ensure proper disassembly as it requires specialized labor and it may make it seem unfeasible (Kibert et al., 2000b)
- Lastly, it would be difficult to implement as there may be a variety of materials and the location of the project may be too far from the demolition site (Schultmann and Sunke, 2007b).

On the other hand, Huscroft et al. (2013), has identified a set of criteria that should be fulfilled by people adopting reverse logistics:

- Effective in conveying information
- Sound financial knowledge
- Comprehensive know how of environmental issues
- How effectively operations can be run with the usage of recycled materials
- He must enjoy full backing of high ups from the management

Moreeover, Zhou et al. (2007) carried out a study related to China's battery manufacturing industry and found out the major obstacles for adopting RL as a practice. This was done to have a helicopter view of using this practice in any given industry but the major takeaways remains the same. He identified the following impediments:

- Dearth of policy
- Deficiency of workers and experts in the practice of RL
- Increased cost of production

- Unavailability of technology for treatment and screening procedures
- Indifference of the business owners as well as the public

Nonetheless, the civil works sector has been lagging in adopting a recycle and reuse policy due to their continuation of the prevalent practices (Schultmann and Sunke, 2007b; Kibert, 2012; Chileshe et al., 2015). However, the failure to adaptation of reverse logistics can be attributed to the complex nature of the construction industry which makes it more difficult to perform under desirous conditions (Nakajima and Russell, 2014) and mainly due to the disjointed nature of logistics of the construction sector (Dainty and Brooke, 2004). Pan (2010) has posited that such novel methods and techniques can only be utilized if it reduces the contingencies it entails. Only then such practices can sustain in an environment where profitability is given the greatest weightage. Furthermore, it would also impart a company's profile with a brand image necessary to reap benefits in the longer run.

2.5 Classification of reverse logistics drivers

To enable targeted research aimed at various aspects of supply chain management and construction waste management, it was deemed necessary to group various factors into certain categories. The study done by Shaikh and Abdul Qadir (2012) tried to group the previous stated factors in the literature review available into factors mentioned below:

- Monetary
- Law and regulation
- Industry
- Market trend
- Product and technology

The classification done by Brito and Dekker (2004) grouped such drivers into the following categories:

- Financial
- Environmental
- Social

Such classification narrowed down the approaches of researchers into one of the aspects mentioned, enabling a more comprehensive understanding of such novel ideas. While there are number of related aspects which require further study to be done, the majority of researchers chose to study mainly two attributes of reverse logistics:

1. **Environment**

   According to Bleek (2013), this can enable us to divert the waste generated from a landfill to an ongoing project. Addis (2006a, b), Aidonis et al. (2008), and Shakantu et al. (2008) have emphasized upon the improved health condition for the local populace. Moreover, since this practice reduces the usage of new materials in construction, it can play a significant role in mitigating the adverse impact construction activities have on the environment as mentioned by (Macozoma, 2002).

   Bouzon et al. (2015), however, gives the idea that this may not be suitable to employ in countries where there is a lack of legislation done for achieving the social and environmental benefits of a sustainable environment. Regulatory drivers, on the other hand, are difficult to manage as it can go both ways. With enforced regulation, it can help in adopting this practice making companies self-compliant whereas, with no regulation, it will fail to make a significant impact in the existing industry.

2. **Financial feasibility**

Endicott et al. (2005) believed that a project can utilized about 85 percent of the materials procured through disassembly of a building that is deemed to be demolished in the near future. Gorolewski (2008) speculated that this practice can reduce the cost of a project by about 40 percent, but also mentioned an increase of 21 percent cost in the disassembly for the materials to be useable. Moreover, Guy and Mclendon (2002) have estimated that construction could become cheaper by 37 percent if done according to the mentioned processes. Though the motivation is always to achieve environmental sustainability, its financial and social advantages cannot be neglected (Schultmann and Sunke, 2007b).

2.6 Aspects prompting the application of reverse logistics

- Prices of procedures, such as treating and screening, and the cost of related machinery to be used to perform such tasks. An example could be a sorting machine to screen appropriate material in lesser time as mentioned by Brauchle AA.
- This practice can be more readily implemented if it were provided a set of rules and laws which includes both stoppage of waste dumping as well as provision for successfully practicing reverse logistics in the construction industry.
- Laws relating to disposure of construction waste and ensuring recovery and recycle of materials must be adequately enforced.
- A green image attained by successfully adopting reverse logistics, would surely lead to higher competitiveness companies and would be beneficial for companies in the longer run.
- Knowledge at all levels, from the site workers to the executive, is a must to successfully implement this practice on any project. Therefore, all the people involved are equal.
- The backing of a government is the only thing that can successfully push the industry

onto the next level as there won't be any legal consequences for the businesses. It may even be regarded as a prerequisite for the successful implementation of reverse logistics.

- Practical and analytical improvement regarding overall performance and reduction of cost in Construction Industry is vital. Moreover, continuous observation with regards to its performance is also necessary to make the required changes.

In short, the literature review of reverse logistics as a tool to mitigate environmental damages and as a practice to improve efficiency and efficacy of projects can be segmented into 3 broader categories namely the problems associated with its use, its advantages over other prevalent practices and its implementation in the contemporary world.

2.7 Problems associated with the usage of RL

- The usage of waste materials may come across strict competition from latest products making it too risky (Horvath et al., 2005).
- For proper implementation of RL, backing from all concerned stakeholders of the construction industry is necessary.
- It requires continuous efforts to make people realize the true benefits of adopting this practice.
- Tibben lembke (2002) have posited that the novelty of this practice as well as dearth of research are the main reasons there is limited understanding of this practice.
- Lastly, there is not enough empirical evidence to support the findings and the benefits this to adopt this practice.

2.8 Advantages of RL

Studies relating to the practice of reverse logistics have shown as to how and why this practice should be adopted. One of the main reasons identified by Chiou et al. (2012) is that it helps not only to reduce costs and improve profitability but also improves the brand image of the company. Other reasons identified in studies are:

- To improve performance (Richey et al., 2005b)
- To increase market stake (Daugherty et al., 2002)
- For resource and waste reduction (Carter and Ellram, 1998)

2.9 Implementation of RL in the current world

- The practice of RL has gained greater consideration mainly due to reclamation of used materials and that the current governments are becoming more involved with environmental problems including legislations and executive orders (Ravi and Shankar)
- There is also greater attention given to cost cutting for businesses which tend to make use of recycled materials (Revlog, 2004).

Moreover, Dainty and Brooke (2004) believe that there should be a joint agreement among contractors, clients, suppliers and designers.

CHAPTER 3

METHODOLOGY

3.1 METHODOLOGY

- An extensive theory and literature review will be carried out regarding Reverse logistics in context of Construction and Demolition waste management
- A study will be carried out with the help of a Form filled with questions, in order to obtain opinion about factors acting as hurdles in utilization of RL in Pakistan.
- All those factors will be further analyzed and ranked in order of their relative importance.

3.2 Accumulation of the Data

Following course of actions were adopted to accumulate the whole data for our survey;

As we mentioned before, that literature review was carried out in chapter 2. Our survey is based upon the broader categories prevalent in the literature review. Secondly, our questions will also provide an assistance in acknowledging clients inclination, industry professionals and attitude of the consultants for the use of Reverse Logistics in construction industry.

Table 1: List of Main Factors

Factors identified	MENTIONED BY
CLIENT	SIDDIQUE SF, LUPI F, JOSHI SV (2010)
COST	RAVI AND SHANLAR (2005)
TIME	SCHULTAMN AND SUNKE (2007)
RISK	HOSSIENI ET AL. (2015), ADDIS (2006)
PROJECT CHARACTERISTICS	EUROPEAN UNION(WWW.EUROPA.EU)
EXTERNAL ENVIRONMENT	HADRILL (2014)

Moreover, there are some factors with local occurrence that can be preferred by professionals working in the industry. Combining this to the conducted literature review and also with the recommended points of interviews.

Conducting Interviews:

On the first hand, before conducting the interview a sort of draft form of questions was sent to the interviewee and then particular time and date were selected for the interview. These interviews were conducted in an informal and unstructured manner. To create an open and friendly atmosphere, all members were supposed to introduce them in a good manner. Ensuring the interviewee that the whole collected information is just going to be utilized for the study purpose was obligatory. Time duration of every interview was decided to remain within thirty minutes. These interviews were conducted to supplement and complement the barriers that we identified, ensuring that we were on right track.

In these all interviews, each and every participant had the right to have a say in all matters relevant to construction waste management along with the feasibility of Reverse Logistics in the local industry. All those interviews, provided us information of ground realities and sharp insights with total clarity.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

As the name suggests, this chapter will be depicting the overall results that have been carried out using the survey of fifty responses by highly professional Engineers. The very first part comprise of the information regarding that particular Official. Secondly, the next two parts are purely for the analysis of all the factors and their sub divisions. This would provide us acknowledgment about the hindrance in adapting RL Method in our Construction Sector. At last, the fourth part will be discussing about the techniques of RL Methods that are currently being utilized. Furthermore, discussion of the information gathered by the Experts are also mentioned in this very chapter.

4.2 Part - One: Information about the respondents

This segment would be providing overall information about the Officials along with their designation and work experience

4.2-1 Work Experience of Respondent

On the literal level, experience is the combination of one's understanding and wisdom regarding the specific skill and practical knowledge through the exposure of going through all phenomenon.

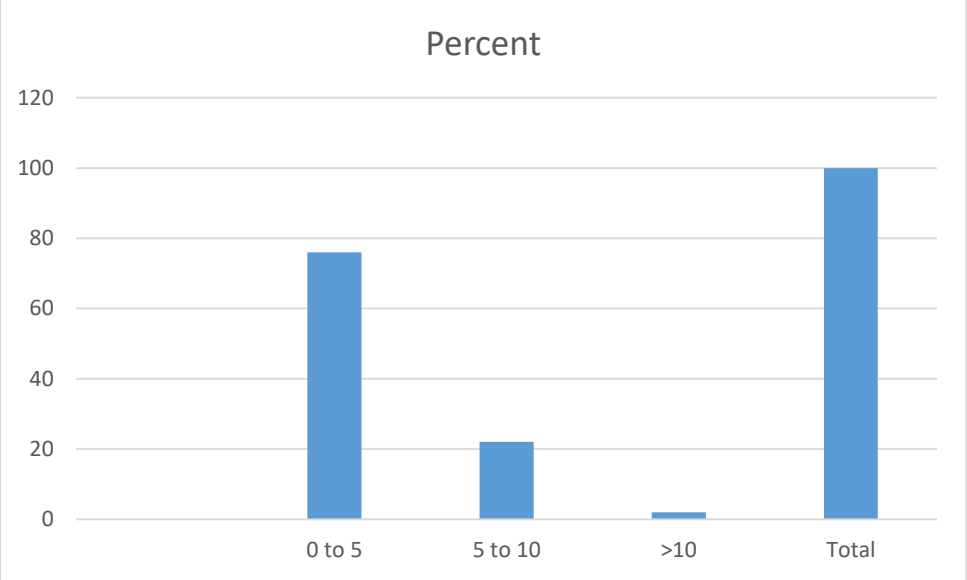
The table given below clearly depicts that 76% of the professionals have work experience from 0 to 5, 22% of respondents have experience 6-10 years, 2% of respondents have experience greater than 10 years. Majority of respondents have experience in intermediate range. These ratios give a pleasant indication about the respondents having significant work experience in the field as well as they are up to date with ongoing technical developments in the field.

Additionally, the more diversified data of professionals will be the provision of more expanded knowledge, across many fields.

Table 2: Work Experience

Work experience (years)	Frequency	Percent
0 to 5	38	76
5 to 10	11	22
>10	1	2
Total	50	100

Figure 2: Bar Chart for Work Experience



4.2 Part two: Main factors impacting the adaptation of REVERSE LOGISTICS methods

This section comprises of discussion about results of major factors/barriers groups hindering the overall adaptation of REVERSE LOGISTICS methods in Pakistan. These all points are grouped into six principle groups. The first factor constitutes of all the points associated with Client. Second factor is associated with cost relevant points. Third factor is associated with Time elements. Afterwards, fourth factor is associated with Risk and fifth factor deals with the

hurdles due to various project characteristics and the last factor is associated with the points that affects negatively due to External Environment.

All those outcomes of this segment impart us with an insight of the Relative Importance Index along with the the portrayal of the rankings of all main Factors which are acting as hurdles in Implementation of Reverse Logistics. Table given below, shows the summarized ranks of all six factors, with total view of the respondents.

Table 3: Main factors ranked on RII

No	Factor groups	Mean	RII (%)	Rank
1.	Client relevance	3.92	73.6	3
2.	Cost related	4.02	81.6	1
3.	Time	3.74	74.8	2
4.	Risk	3.16	62.4	5
5.	Characteristics of Project	2.96	59.2	6
6.	External environment	3.34	66.8	4

Factors associated with client

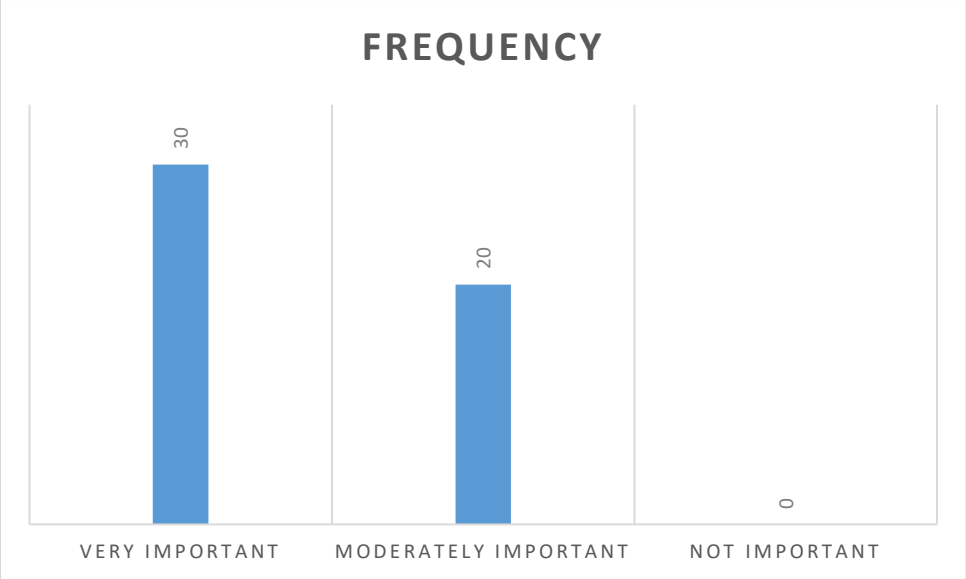
It is evident that the factors associated to the Cost factor are placed by all the personnel (different firms) in top 3 positions with RII equal to 73.6%. This factor group is an essential one, and it is apparent that this factor and its sub-divisions have a different importance if we compare it to others, because Reverse Logistics methods mainly rely on the Owner (Client) requirements and have to fulfill the project with total understanding of his inclination. Primarily, this is totally bound of the finances related to Client and consequently it's regarded as necessity for the stake holders to abide by it. Additionally, all respondents asserted that all the points in relevance to the Client factor characteristics, are strongly influencing the adaptation of Reverse Logistics procedures.

Frequency and percentage of factors associated with client is given in Table below;

Table 4: Importance of factors associated with client

Importance Level	Frequency	Percent
Very important	30	60
Moderately important	20	40
Not important	0	0
Total	50	100

Figure 3: Frequency Graph for factors associated with client



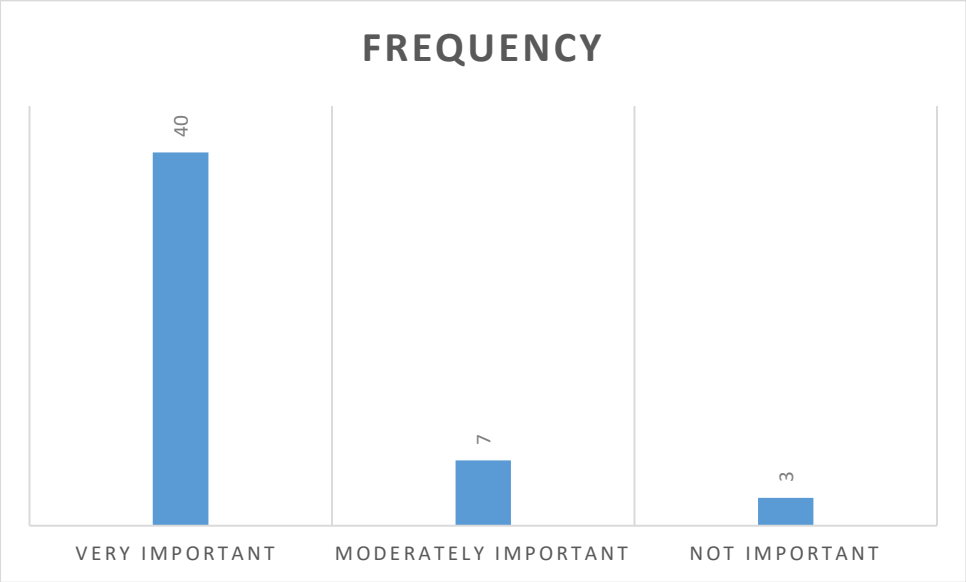
Factors associated with cost

Factors related to the Cost category are ranked as the Ist (First) by all the respondents with RII equal to 81.6%. This category is most essential because with the additional procedures like Screening, Reconditioning and Design cost overall project cost can increase which can eventually, leads toward low competitiveness in Bidding Competitions

Table 5: Importance of factors associated with cost

Importance Level	Frequency	Percent
Very important	40	80
Moderately important	7	14
Not important	3	6
Total	50	100

Figure 4: Frequency Graph for factors associated with Cost



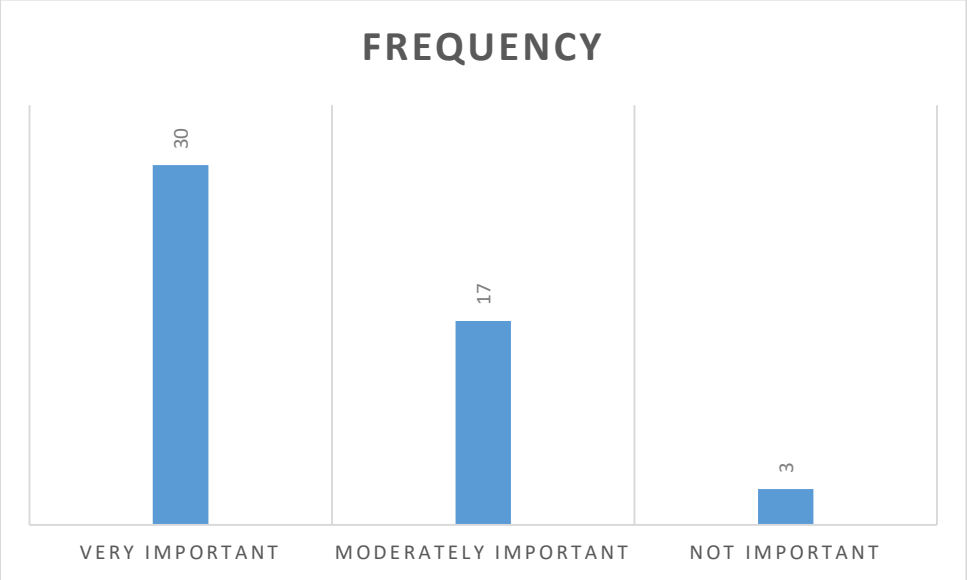
Factors associated with time

Factors associated with time group has been placed in the third rank by all the respondents with RII equal to 74.8%. This group is significant in affecting the adaptation of Reverse Logistics because of the lengthy process and more time consumption.

Table 6: Importance of factors associated with time

Importance Level	Frequency	Percent
Very important	30	60
Moderately important	17	34
Not important	3	6
Total	50	100

Figure 5: Frequency Graph for factors associated with time



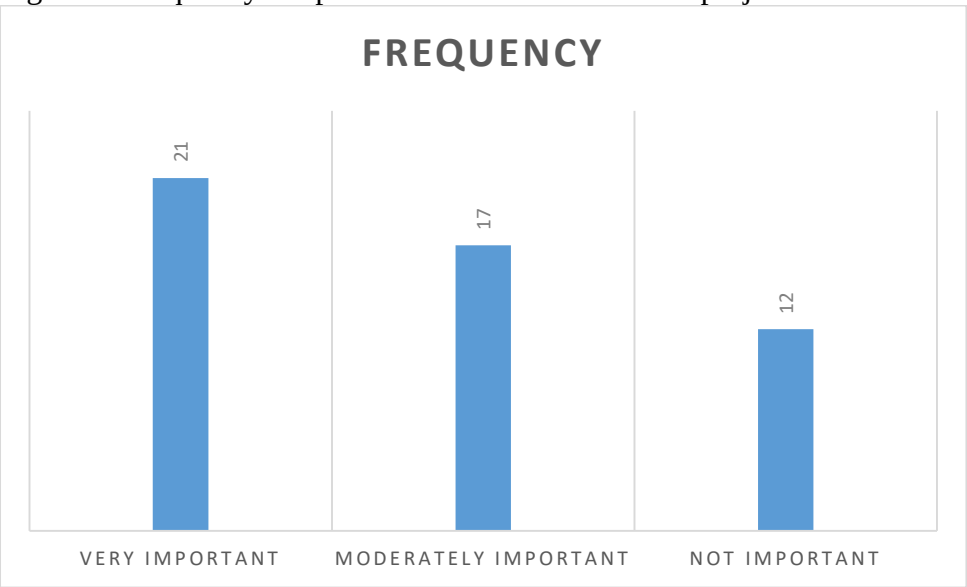
Factors associated with project nature

Factors associated with project characteristics group has been placed in last position with RII equal to 81.71%. This is also important factor for adaptation of RL. The project characteristics such as project location, size, uniqueness and complexity, should be taken into consideration as it also influences other parameters such as project time, cost and risk etc.

Table 7 Importance of factors associated with project Nature

Importance Level	Frequency	Percent
Very important	21	42
Moderately important	17	34
Not important	12	24
Total	50	100

Figure 6: Frequency Graph for factors associated with project Nature



Factors associated with External environment and Risk

Factors linked with external environment and risk groups have been ranked in fourth and fifth place with RII equal to 66.8% and 62.4% respectively. It is deduced that these groups are not very much important for respondents and rarely considered by clients due to unstable economic and political conditions in Pakistan.

Table 8: Importance of factors associated with risk

Level of importance	Frequency	Percent
Very important	24	48
Moderately important	16	32
Not important	10	20
Total	50	100

Figure 7: Frequency Graph for factors associated with Risk\

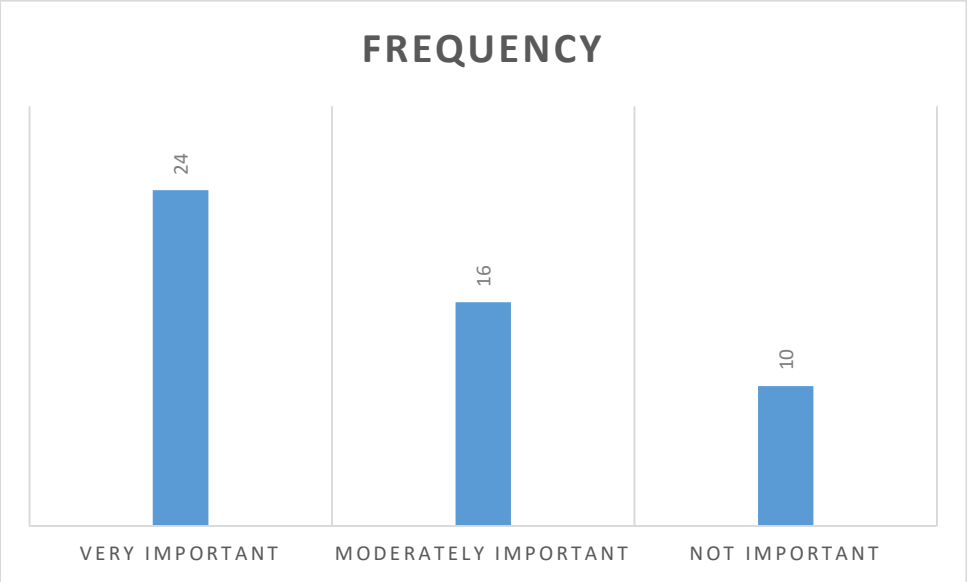
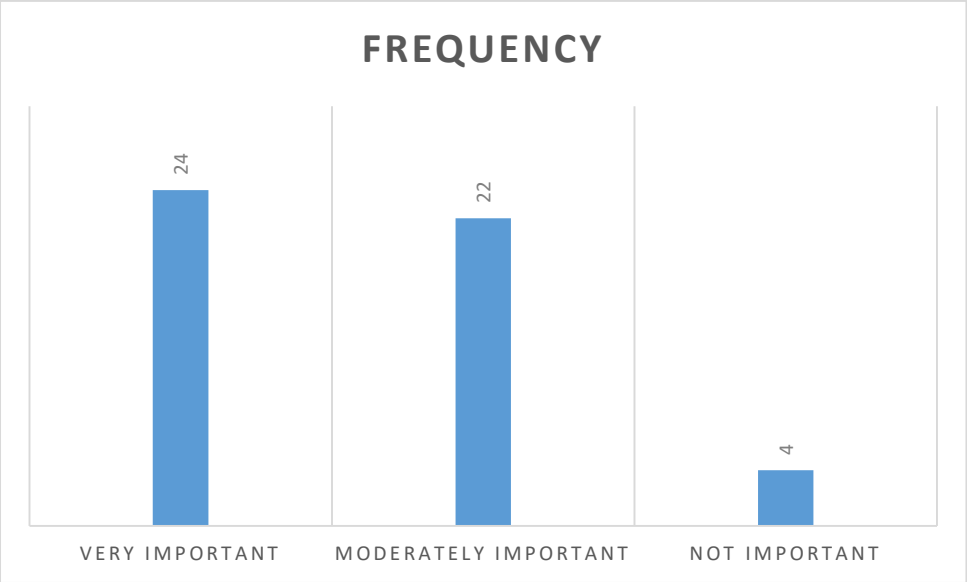


Table 9: Importance of factors associated with external environment

Importance Level	Frequency	Percent
Very important	24	48
Moderately important	22	44
Not important	4	8
total	50	100

Figure 8: Frequency Graph for factors associated with External Environment



4.4 Third Part: Sub-factors influencing the adaptation of RL

4.4.1 1st Group: Sub-factors associated with client

Relative importance index and rank of sub-factors associated with client are shown in the Table below i.e. Table 10

Table 10: Rank and RII for sub factors associated with client

No	Factors	Mean	RII (%)	Rank
1	Client Reputation	3.7	74	1
2	Clients experience in waste management	3.56	71.2	2
3	Clients inclination to adopt RL	2.56	53.2	4
4	Availability of qualified personnel	3.12	62.4	3

In Table 10, reputation of client has been placed by the all responders in the top position having RII 74% and Mean=3.7. We conclude this is the most important sub-factor in this group.

Client's experience in waste management has been placed in the 2nd place having RII 71.2% and Mean=3.56

Availability of qualified staff has been placed in the 3rd place having RII 62.4% and Mean=3.12.

Clients inclination to adopt RL has been placed in the last position having RII 53.2% and Mean = 2.56

4.4.2 2nd Group: Sub-factors associated with cost

The relative importance index and rank of sub-factors associated with cost are shoin Table below i.e. Table 11

Table 11: RII and rank for factors associated with cost

No.	Factors	Mean.	RII (%).	Rank.
1.	Price competition.	4.06	81.2	2
2.	Cost of screening procedure.	4.36	87.2	1
3.	Increased expenditure due to novelty	2.32	46.4	4
4.	Availability of funds	2.64	52.8	3

From table 11, cost of reverse Logistics process has been placed by all the respondents in the first place having RII 87.2% and Mean=4.36. It is evident that the respondents agreed that this sub-factor is the most critical one in factors associated with cost group.

Price competition s has been placed in second place having RII 81.2% and Mean=4.06.

Availability of funds sub-factor has been placed in third position having RII 52.8% and Mean=2.64. Thus, we conclude that the respondents agreed that this sub-factor is not important sub factor in cost group.

Increased expenditure due to novelty sub-factors have been placed in last position with RII 46.4% and Mean=2.32

4.4.3 3rd Group: Sub-factors associated with time

The relative importance index and rank of sub-factors associated with cost are shown in Table 12 below:

Table 12: RII and rank for factors associated with time

No.	Factors	Mean	RII(%)	Rank
1	Time for screening and treating	4.18	83.6	1
2	Increased design time	3.14	62.8	4
3	Hesitation in project approval	3.68	73.6	2
4	Better time management	3.4	68	3

From table 12, Time for screening and treating has been placed by all respondents in the first place having RII 83.6% and Mean=4.18. It is concluded that this is the most important factor associated with time.

Hesitation in project approval has been placed in the second position having RII 73.6% and Mean=3.68.

Better time management has been placed in the third position having RII 68% and Mean=3.4.

Increased design time has been placed in the fourth and the last position having RII 62.8% and Mean=3.14.

4.4.4 Fourth Group: Sub-factors associated with Risk

The relative importance index and rank of sub-factors associated with risk are shown in Table 13 below

Table 13: RII and rank for factors associated with risk

No.	Factors	Mean	RII(%)	Rank
1	Changed risk allocation	3.48	69.6	2
2	Frequency of dispute	2.12	42.4	3
3	Strict quality control	4.8	80.4	1

As evident from Table 13; Strict quality control has been placed in the first position in this group with RII 80.04% and Mean=4.8. It is concluded that strict quality control is the most important sub-factors associated with risk.

Changed risk allocation sub-factor has been placed in the second place having RII equals 69.6% and Mean=3.48.

Frequency of dispute sub-factor has been placed in the third and the last place having RII 42.4% and Mean=2.12.

4.4.5 Fifth Group: Sub-factors associated with project nature

The relative importance index and rank of sub-factors associated with project nature are shown in Table 14 below:

Table 14 Rank and RII for factors associated with project nature

No.	Factors	Mean	RII(%)	Rank
1	type and nature	3.76	75.2	1
2	size and complexity	2.7	54	2
3	Quality of project	2.24	44.8	3
4	Expected performance	1.92	38.4	4

From table 14, it is noticed that project type and nature has been placed in the first place having RII 75.2% and Mean=3.76. This indicates that all respondents agree that project type and nature is the most crucial subfactor in the group.

Size of the project and complexity has been placed in the second rank having RII 54% and Mean=2.7.

Quality level of project has been placed in the third rank having RII 44.8% and Mean=2.24

Expected performance sub-factor has been placed in the fourth place having RII 38.4% and Mean= 1.92.

Other sub-factors associated with project characteristics are identified as less significant relative to the sub-factors mentioned earlier in this group.

4.4.6 Sixth Group: Sub-factors associated with External environment

The relative importance index and rank of sub-factors associated with project external environment are shown in Table 15 below:

Table 15: RII and rank for factors associated with external environment

No.	Factors	Mean	RII(%)	Rank
1	Stakeholder integration	2.96	59.2	3
2	Available technology	2.14	42.8	4
3	Environment impact	4.08	81.6	1
4	Availability of RL procedures in market	3.86	77.2	2

From table 15, Environment impact has been placed in the first place having RII 81.6% and Mean=4.08. It is concluded that environment impact is the most crucial sub-factor in this group.

Availability of RL procedures in the market has been placed in the second place having RII 77.2% and Mean=3.86.

Stakeholder integration sub-factors have been placed in the third place having RII equals 59.2% and Mean=2.96.

Available Technology sub-factors have been placed in the fourth place with RII equals 42.8% and Mean=2.14.

CHAPTER 5

CONCLUSIONS

5.1 CONCLUSIONS

Numerous amount of barriers exist which can hinder or drive the adaptation and implementation of RL. Different RL techniques can be implemented in construction projects to achieve several objectives. The adaptation and implementation of RL is crucial for sustainability and efficiency. For the provision of help to our Clients and Contractors in adaptation and implementation of RL, a criteria of definite factors for consideration was adopted. A preliminary investigation of barriers hindering adaptation of RL methods was carried out to get some hard facts which can acknowledge us with the importance of each factor. Challenges faced in adaptation and implementation of RL process were also identified and effect of each barrier on the performance parameters (cost, quality and time) of project was discussed in detail.

After the analysis of whole investigation/survey, we can make following conclusio

- Mostly, in our country the cost domain affects the adaptation and implementation of RL in construction industry. Using the whole study, 81.6% of professionals had opinion of it being the prime barrier in their organizations.

- A specific amount of secondary factors from the main six factors were also influential. Survey collected from the 50 professionals reported the twelve most crucial barriers which can hinder the adaptation of Reverse Logistics, which are following;

1) Client Reputation

2) Clients experience in waste management

3) Cost of screening procedure

4) Price competition

5) Time for screening and treating

6) Hesitation in project approval

7) Strict quality control

8) Changed risk allocation

9) Sort and nature of the project

10) Environment impact

11) Techniques available in the Market

12) Better time management

• The five least influential factors identified from study were expected performance, frequency of potential disputes, increased expenditure due to novelty and client's inclination to adapt RL.

• Considering the individuality of each and every project to be different, we have to consider all the barriers mentioned carefully. Because eventually, these all will determine the overall performance and profitability in the project.

5.2 RECOMMENDATIONS:

• It is truly essential; accordance with Pakistan Construction Industry, for all the construction sectors to be acquainted of the various RL techniques which can be utilized for different projects

• There can be provision of orientations, trainings, study groups and webinars which can increase the adaptation of these procedures on the broader level.

- Eradication of all legal issues and encouragement through the laws and regulations for adapting RL methods in our country is highly recommended.
- It is preferable, to have this survey after some periodic time to keep the check on the trends of importance of barriers.

APPENDICES

Appendix 1:

Developing the Questionnaire

Developing of the questionnaire form consisted of four sections and was translated to a Google form

Part One: Respondent's Information (General)

Part Two: Ranking of the main factors

Part Three: Ranking of the Sub factors

Part Four: Relevant queries regarding, whether or not this practice can be employed and anything that can be done to ensure its implementation in the local industry.

Part One: **General information**

Name	
Firm/organization/Department	
Designation	
Total experience (in years)	

Section Two: Major factors hindering the implementation of Reverse Logistics

Identification of the importance of major barriers affecting implementation of Reverse Logistics for projects in your organization

Most important: 05 Important: 04 Somewhat Important: 3

Barely important: 02 Not important: 01

No.	Main Factor	Degree of Importance				
		5	4	3	2	1
a)	Client relevance					
b)	Cost relevance					
c)	Time relevance					
d)	Risk relevance					
e)	Characteristics of the Project					
f)	Outside Environment					

Section Three: Secondary factors hindering the implementation of Reverse Logistics within their firms

Identification of the secondary barriers hindering the utilization of this technique in Pakistan.

Most Important: 05 Important: 04 Somewhat Important: 03

Barely Important: 02 Not Important: 01

A. Factors related to client

No	Factors	Degree of Importance				
		5	4	3	2	1
1	Client Reputation					
2	Clients experience in waste management					
3	Clients inclination to adopt RL					
4	Availablity of qualified personnel					

B. Factors related to Cost

No	Factors	Degree of Importance				
		5	4	**3**	2	**1**
1	Price competition					
2	Cost of screening procedure					
3	Increased expenditure due to novelty					
4	Availability of funds					

C. Factors related to Time

No	Factors	Degree of Importance				
		5	4	**3**	2	**1**
1	Time for screening and treating					
2	Increased design time					
3	Hesitation in project approval					
4	Better time management					

D. Risk Factor

No	Factors	Degree of Importance				
		5	4	**3**	2	**1**
1	Changed risk allocation					
2	Frequency of dispute					
3	Strict quality control					

E. Characteristics of Project

No	Factors	Degree of Importance				
		5	4	**3**	2	**1**
1	Project type and nature					
2	Project size and complexity					
3	Quality level of project					
4	Expected performance					

F. Related to Outside Environment

No	Factors	Degree of Importance				
		5	4	**3**	2	**1**
1	Stakeholder integration					
2	Available technology					
3	Environment impact					
4	Availability of RL procedures in the market					

Part Four: General questions

1. Do you think adopting RL procedures would improve your brand image?

   YES/NO

2. What is the most common barrier face by your organization for adopting RL as a practice?

   a. Prevalent practices in the construction industry

   b. Increased fiscal costs

   c. General awareness

   d. Lack of expertise

   e. Disjointed supply chain network

3. How do you think we can improve the supply chain practices with an aim to reduce construction and demolition waste? Comment.

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