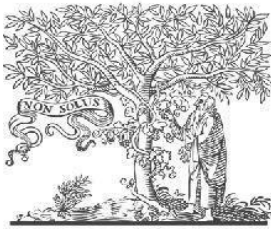


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Circular Procurement Awareness in Indian Railways

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Abstract

The Government procurement, because of its size and prevalence, is considered as an effective means for the promotion of green practices protecting the natural environment. Linear procurement strategies are focused on a “take-make-disposal” approach, aligned to the current linear economy agenda, which is unsustainable. India is aiming Net Zero by 2070, taken steps to Transition to Circular Economy (CE) and attainment of Sustainable Development Goals. Due to growing emphasis on India’s transition to Circular Economy (CE), public procurement procedures have lately been associated with the concept of CE. In spite of wide prevalence of CE practices in many countries little is known about the circularity in public procurement in India. It is essential to take steps in Indian Railways (IR), who procure currently nearly Rs 65,000 crores of materials and disposes scrap worth nearly Rs 6500 crore to bring efficiency in material cycles. IR initiated number of steps on energy side but little is done to conserve virgin resources thru resource efficiency in material utilization. This study proposes to fill this gap by assessing awareness of Sustainable and Circular procurement and extent of CE centric activities among Indian Railways (IR) key internal stakeholders. The findings support association of Circular Awareness with adoption of Circular Procurement in IR and there is a scope for further research in adoption of Circular Procurement in Indian Railways.

Keywords: Circular Economy, Circular Procurement, Circular Awareness

Introduction

World Bank in 2003, estimated the total value of public procurement in India of the order of 13% of the national budgets and it is about

20% as per study by Sanjay in 2010. The trend of spend on procurement of goods and services for Indian Railways is also well above 20% of the revenues. Nevertheless, the

problem is not the amount, but the concern is about the depletion of natural resources. The concerns of resource depletion, climate change, and pollution are increasingly rising, the notion of the Circular Economy (CE) has come to the fore (Li et al., 2021). To mitigate challenges from unsustainable production and consumption patterns, the CE concept has been receiving increasing attention from policymakers, practitioners, and scholars across the world. The CE focuses on transforming waste into resources, addressing the gap between production and consumption activities (Batista et al., 2018) leading to more efficient use of resources coupled with economic growth. With only 2% of the world's landmass and 4% of freshwater resources, a linear economy model of 'Take-Make-Dispose' model of Government of India for acquisitions of goods, works and services would constrain India's the overall economy due to its dependance on extraction of virgin materials and less recycling of waste.

Further, at COP26, India agreed to a goal of net zero carbon emissions by 2070, which calls for simultaneous strategies and actions on both energy and materials front. Net-zero greenhouse gas emissions, resource efficiency, and zero waste will be at the forefront of future activities.

Circular Economy: The circular economy has become an increasingly prominent part of national sustainability agenda for many countries. For example, the Netherlands strives to be 100% circular by 2050. In a circular economy, "the value of products and materials is maintained for as long as possible; waste and resource use are minimized, and resources are kept within the economy when a product has reached the end of its life, to be used again and again to create further value (EC, 2015). Within a circular economy, waste is reduced and seen as input

for other products or chains. Technical nutrients can be continuously reused, refurbished, remanufactured or recycled, while maintaining their quality (De Angelis et al., 2018). The circular economy, as a model of production and consumption, involves reusing, repairing, refurbishing and recycling existing materials and products as long as possible. In this way, the life cycle of products is extended. Many people, communities, nations, and organizations have already adopted this ideology known as the Circular Economy (CE). For instance, Luxemburg country achieved 100% transition to Circular Economy. CE and procurement have significant potential to achieve sustainable development goals (SDGs), as adopted by member countries of the United Nations (UN) in 2015.

Global Context: Circular economy is the strongest in China, Scandinavian countries, South America, and South Africa, and the concept of "sharing economy" is strongest in Russia, the USA, the core of the EU, and Australia (Toth, 2019).

Even in China, which is experiencing heavy industrialization process, where they have learned from the success and failures of other nations when creating policies of their own. China has primarily learned from the circular economy strategies of Germany and Japan, China adopted the legislation, *The Law for the Promotion of the Circular Economy*, on August 29, 2008. Under the law, any new industrial policies created by the Government must meet the criteria for promoting a circular economy. Industries must implement management systems that reduce resource usage and waste generation, while improving resource recovery and recycling. Through the *Law for the Promotion of the Circular Economy*, the Chinese Government encourages research, development, promotion and international

cooperation of science relating to circular economies, as well as supporting the education, publicity and popularization of scientific knowledge. The aim is to give citizens a better sense of better resource saving and environmental protection practices.

India context: Circularity in Indian culture is deeply rooted in its traditions and values. For centuries, Indians have practiced sustainable living and resource conservation, guided by their beliefs and customs, embedded in Indian culture include: Respect for Nature, Simplicity and minimalism and Strong sense of community and sharing, reflected in traditional practices such as joint families, community kitchens, and religious festivals. But with the advent of consumerism, these beliefs and values are replaced with use and throw practices relegating deep rooted CE values. As per Government of India (GOI), Circular Economy is a focused area (PIB note 18.03.2021). NITI Aayog views on Govt Driving Transition from Linear to Circular Economy (Posted On: 18 MAR 2021 by PIB Delhi). Hon'ble Prime Minister, Shri Narendra Modi, in his address to the nation on the occasion of 75th Independence Day on 15th August, 2021 had highlighted India's action on 'Mission Circular Economy'. Circular Economy Action Plans for 10 waste categories (Lithium-ion batteries; E-waste; Toxic and hazardous industrial waste; Scrap metal (ferrous and nonferrous); Tyre and Rubber; End of Life Vehicles; Gypsum, Used Oil, Solar Panels and Municipal Solid Waste have been finalized, and are under implementation. NITI Aayog, in consultation with the Ministry of Environment and Forest and Climate Change, identified 11 areas to facilitate transitioning from linear to Circular Economy. The Ecomark Scheme was launched by the Ministry of Environment and Forest in G.S.R. 85(E) dated 21.02.1991, as a tool for the consumers to pursue sustainable

consumption patterns as well as for the industry to implement an environment-friendly processes or production methods. Under this Scheme, Ecomark criteria for 17 product categories have been notified viz. Soaps and Detergents; Paper; Food Items; Lubricating oils; Packaging materials/ Package; Architectural Paints and Powder Coatings; Batteries; Electrical and electronic goods; Food Additives; Wood Substitutes; Cosmetics; Aerosols and Propellants; Plastic Products; Textiles; Fire-extinguisher; Leather; and Coir & Coir Products.

Indian Railways Context: Way back in 2003, it mandated that only low Sulphur diesel will be used for running of all locomotives and phasing out of M12 refrigerant, introduction of electronic choke in place of conventional choke, mandatory compliance of Green Building Code in all new projects etc. are other green initiatives to curb energy consumption. Further, Indian Railway has set a target of becoming Net Zero Carbon Emitter by 2030 (Refer Posted On: 15 MAR 2023 by PIB Delhi) . IR has taken a number of initiatives to reduce its carbon emissions which include use of energy efficient technologies like completely switching over to production of three phase electric locomotives with regenerative features, use of head on generation (HOG) technology, use of LED lights in buildings and coaches, star rated appliances and afforestation. Further, the key strategies that have been identified for achieving the Net Zero Carbon emission target are procurement of power through renewable energy sources; shifting from diesel to electric traction; promotion of energy efficiency; and afforestation. All these measures have been undertaken, in Indian Railways, with prime focus on energy saving.

Indian Railways (IR) consumes goods worth about Rs 65,000 crores annually which

includes; goods for Rolling stock (Locos, Coaches, Wagons) maintenance, electronic items, Lead Acid Batteries, plastics, steel items, air conditioners, vehicles, paper, lighting products, office supplies, furniture, apparel, fuel, IT services and products etc. The huge expenditure by Indian Railways on procurement of goods alone is indicative of the potential of CE with Indian Railways. Even a small shift towards green products through change in procurement policy and practices of Indian Railways can make great impact in creating circular capacity. Further, the special nature of items required by Indian Railways for its rolling stocks makes it more suitable for experimenting with circularity. GFR rule 143 mentions about use of environmental criteria in procurement without laid down environmental criteria and weightages between i) Price ii) Quality iii) Sustainability. There is hardly any progress in the use of environmental criteria in the selection of the supplier.

The UNEP under the Policy Support Component of the SWITCH-Asia programme facilitated the workshop (2012) for Indian Railways professionals, which has identified major challenges; a) Lack of skills, knowledge and expertise of Indian Railway Professionals on Sustainable Public Procurement b) No clear policy guidelines on integrating environmental criteria in public procurement c) Absence of sufficient green products in the market d) Lack of preparedness of vendors on developing greener products.

Remainder of this paper is organised as follows. Section 2 provides theoretical background and hypothesis. Section 3 presented Research Methodology. Section 4 gives the Data Analysis. The findings are given in Section 5. The conclusions and limitations are given in Section 6.

Section 2: Theoretical background and Hypotheses development: The European Union's (EU) action plan recognises public procurement as a key mechanism of the transition to CE (EC, 2017). The EC defines Circular Procurement as the "Process by which works, goods and services are purchased that seek to contribute to closed energy and material loops within supply chains, while minimising and ideally avoiding, negative environmental impacts and waste creation across their whole life cycle." (EC, 2017). The interface between CE and procurement gained increasing attention after European Union's (EU) public procurement directives in 2014 (**European Commission, 2014a, 2014b**).

Research specifically focused on circular procurement is still in its infancy. [Neessen et al. \(2021\)](#) explored the purchasing professionals characteristics in relation to adopting circular purchasing. The individual employee's contribution in the transition towards a circular economy is emphasized by Singh and Singh, 2019; Veleva et al., 2017 in their research. Purva Mhatre et al., (2021) identified the gap between the existing material management strategies and the potential to enable circularity in bitumen etc., used in Indian road infrastructure.

While lots of research have been carried out in the European and other developed countries in various areas of Sustainable Procurement (SP), there is hardly any work on development and implementation of SP in developing countries. Sjors Witjes, Rodrigo Lozano, 2016 highlighted limited research focusing on CE aspects. Further, no work on Sustainable Public Procurement (SPP) has been carried out in Government departments and public sector units to figure out potential challenges for implementing SPP in India. (Geng et al., 2008).

Research on Railways Procurement

IR attempts in the circular procurement of goods are limited to rules given in GFR, 2017. The availability circular frameworks are non-existent in the context of circular public procurement in the absence of Government of India (GOI) clear guidelines, notwithstanding substantial spend thru public procurement in India. In the context of Indian Railways, Sanjay Kumar project report titled “Implementing Green Procurement in Indian Railways” identified the challenges and emphasized the development of environmental criteria, cost implication of different green products vis-à-vis conventional products. The report given way forward for Railways to concentrate on GPP practices (Sanjay Kumar, 2010). An article from Roberto Sañudo, Universidad de Cantabria, 39005 Santander, Spain et al,(2022) on Efficient Reuse of Railway Track Waste Materials, presented an analysis of track scrap materials and the possibilities available to be re-used, in Indian Railways context. This article presents re-uses of secondary railway track materials.

Considering the vital role procurement can play and huge gap between government intentions and practices to conserve resources, the topic of Circular Public procurement is chosen for study, in the context of Indian Railways (IR).

Research Objectives

From the above, it is clear that IR initiated number of steps on energy side but little is done to conserve virgin resources thru resource efficiency in material utilisation. The objective of this study is to fill this gap by assessing awareness of Sustainable and Circular procurement related aspects (called as Circular Awareness) and extent of CE centric activities among IR’s key internal material stakeholders. These include **Procurers**, the procurement officials/department responsible for sourcing

and acquiring goods and services and **End Users**, the officials and departments within the Indian Railways who utilize the procured goods and services. Further, the study proposes to identify the association of Stakeholders’ Awareness of Sustainable Procurement and Circular Procurement related aspects with the adoption of circular procurement. The following hypothesis proposed for the study.

Null Hypothesis: H1o - The key internal material stakeholder’s awareness of Sustainable and Circular procurement related aspects is not associated with the adoption of circular procurement in Indian Railways.

Alternate Hypothesis: H1a: The key internal material stakeholder’s awareness of Sustainable and Circular procurement related aspects is associated with the adoption of circular procurement in Indian Railways.

Constructs used in the Survey: To examine the above, the author empirically examined the awareness of Sustainable and Circular procurement related aspects and extent of CE centric activities of IR’s key internal stakeholders.

Independent variables are Stakeholders’ Awareness of CP and SP related aspects, extent of CE centric activities and Dependent variables is adoption of Circular Procurement policies like focus on waste minimization, maximization of resource efficiency and circular requirements in terms of certification and labelling in tender documents and contracts.

Section 3: Methodology of the study: The methodology of the study discusses framework within which the study is conducted which includes research design which in turn includes sources of data, population to be studied, sampling unit, sample size, sampling method, statistical

measures and tools for analysis of the data collected.

Research Design: This study adopts a quantitative research method to validate the research hypothesis. The research uses a structured questionnaire to collect data from key stakeholders, including procurers, End users.

Survey Questionnaire Design: Surveys are used to collect data from stakeholders about their perceptions and experiences, using 5-point Likert scales to measure perceptions and experiences. Each question uses a Likert scale to measure respondents' agreement with various statements, ranging from Strongly Disagree (SD) to Strongly Agree (SA). However, for measuring Awareness 5-point Likert scale ranging from Negligible, Low, Medium, High and Very High used.

Population: The users or consumers of the goods, procurement officials at Officers grade are considered as population for the subject study, since they all are involved in procurement of goods in IR.

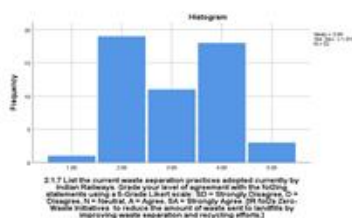
Sampling Unit: The required number of samples are collected from the population who fall in the category of Users and procurement officers The study was a pre-test and undertaken on South Central Railway at the officers' level.

Sampling: The target population includes; **Procurers**, who are officials responsible for sourcing and procurement within Indian Railways and **End Users**, the officials and departments utilizing the procured goods and services. A stratified random sampling method is used to ensure representation from each stakeholder group. Being a limited study, Sample Size is determined by well-established thumb rule of at least 10% of your planned sample size for the main survey, or a minimum of 30 respondents, whichever is higher (Ref. Thomas V. Perneger et al 2014). **Data Collection:** Data is collected through Questionnaire prepared on google forms and shared the **google link** to the selected population via email/whatsapp in the respective professional groups, with follow-up reminders to maximize response rates.

Data Analysis: Data analysis will involve **Quantitative Analysis**. Responses to the Likert scale questions are analyzed using statistical methods such as descriptive statistics, correlation analysis, and regression analysis to test the research hypotheses. Reliability of the questionnaire is assessed using Cronbach's alpha. Before applying statistical test, the data is tested for its normality, as well. This is further verified with Skewness and Kurtosis values, which confirms the data normality.

Tests of Normality and Internal Consistency/Reliability tests

Tests of Normality and Reliability Tests



Variable/Item Name	
Scale: 2.1 Cronbach's Alpha 0.868 N of Items: 11	
2.1.1 Separate, Recycle and Reuse	
2.1.2 Use of eco-friendly, green and recycled	
2.1.3 Segregation	
2.1.4 Processing of bio-waste and waste materials	
2.1.5 Sorting with recycled value	
2.1.6 Extract energy through incineration	
2.1.7 Segregation of different types of waste	
2.1.8 Biodegradable material processing	
2.1.9 Handling of bio-waste waste	
2.1.7 Zero-Waste Initiatives	
2.1.9 Recyclable Materials like bottles	
Scale: 2.2 Cronbach's Alpha 0.947 N of Items: 8	
2.2.1 Awareness of the Circular Economy principles	
2.2.2 Awareness of sustainable procurement	
2.2.3 Awareness of Circular Procurement	

Categorical Principal Component Analysis (PCA): The study uncovered the hidden connections between policies and their implementation by officials. Factor Analysis (FA) was used. FA reveals the underlying factors influencing the observed data, making hidden patterns more apparent. since the study utilized categorical data, where data was divided into categories (such as a Likert scale with five points) rather than continuous numbers, Categorical Principal Components Analysis (CATPCA) was employed. Using CATPCA, the most critical factors determining the effectiveness of a policy in circular procurement were identified. This technique simplified the data, enabling the categorization of policies into effective (implemented) and ineffective (not implemented) groups. Dimension "1" represents effectiveness in policy or concept implementation, while Dimension "2" represents ineffectiveness in understanding with a particular component. In Dimension

"1," any component score value greater than or equal to 0.6 is considered effective; otherwise, it is deemed ineffective, suggesting the need for improvement in those components. In Dimension "2," any component score value greater than or equal to 0.6 is considered effective; otherwise, it is deemed ineffective, indicating the need for motivation in those components. Negative values in Dimension 2, the item need more awareness, as well.

Section 4: Data Analysis: Analysis of primary data gathered from stakeholders analysed concerning various factors encompassing general information, roles, awareness, CE centric activities and CP adoption.

The Respondents, who participated in the study, profile is given below;

Responses								
Cadre	HAG	SAG	SG	JAG	SS	JS	Others	Grand Total
IRSE	6%	4%	2%	6%				17%
IRSEE	6%	4%		8%				17%
IRSME		8%	2%	6%		2%		17%
IRSS	6%	6%	2%	15%	2%			31%
IRSSE	2%	8%	2%	6%				17%
Others							2%	2%
Grand Total	19%	29%	8%	38%	2%	2%	2%	100%

Top Management (TM) is HAG and Middle Management (MM) consist of SAG, SG and JAG. The response indicates the representation of both TM and MM adequately across all cadres. The participation of various cadre officers varies from 17% to 30%. is considered reasonable. Even the participation of various levels of Management is considered reasonable

considering proportional participation of Officers from JS level to HAG level.

Prominent Roles performed by the respondents includes the a) disposal of end of use goods (64%, highest), Recovery of parts / useful material (54%), Refurbishment of goods to extend their life (52%) indicate their importance for everyone involved in

maintenance and procurement. Further, every technical officer is involved in all most all stages of Life cycle stages of public procurement barring Tendering (which is confined to Procurement officers) from 61% in Usage of the goods in the **maintenance** work, 60% **Disposal** of End of use or End of Life of goods or parts and also contract management, 55% in Planning of demand and adoption of the specified Design/technical specification. All the

Respondents considers all these Life Cycle Stage of procurement very important, as well.

Analysis of Respondents Awareness of Sustainable and Circular procurement related aspects in Indian Railways

Awareness: Out of 3 items, the highest awareness among respondents (44%) is on sustainable procurement and the lowest awareness is on CE principles with 24%.

Extent of awareness of the Circular Economy principles, sustainable procurement and Circular procurement							
	Negligible %	Low %	Medium %	High %	Very High %	Total %	Awareness %
2.2.1 I am aware of Circular Economy principles	10%	24%	42%	14%	10%	100%	24%
2.2.2 I am aware of Sustainable procurement	2%	18%	36%	34%	10%	100%	44%
2.2.3 I am aware of Circular Procurement	8%	27%	33%	22%	10%	100%	31%

The weighted score of CE principles is 148 as against average score of 153, indicating less favorable awareness of CE principles. The awareness about CE principles and Circular

procurement is not remarkable among IR key internal material stakeholders viz., End Users and Procurers.

CE centric activities:

Current waste separation practices	SA%	A%	N%	D%	SD%	Total%	Agreement%
IR have separate bins for segregation of different types of waste such as recyclables (paper, plastic, metal), organic waste, and general waste at the place where this scrap is generated.	27%	29%	19%	21%	4%	100%	56%
IR collects organic Waste food and other biodegradable materials separately and sent to composting facilities.	8%	23%	35%	29%	6%	100%	31%
IR handles hazardous Waste thru Special containers and procedures or the safe disposal of hazardous materials, like acids, chemicals etc	31%	31%	19%	17%	2%	100%	62%
IR follows Zero-Waste Initiatives to reduce the amount of waste sent to landfills by improving waste separation and recycling efforts.	6%	35%	21%	37%	2%	100%	40%
IR encourage use of Reusable Materials like bottles, glasses etc in place of single use and throw single-use plastic items	10%	33%	13%	37%	8%	100%	42%

a) 75% of the Officers agree that Indian Railways significantly repair (like bearings, equipment etc.), recover (like bogie components etc.) and recycle (like unserviceable lube oil from diesel locos as dashpot oil) the number of used items as part of its working.

b) 75% agree that Indian Railways employees take responsibility to collect and separate hazardous and toxic materials to handover the designated agencies for proper handling and prevent environmental degradation

- c) Further, 92% agree that Indian Railways employees take responsibility to collect and segregate scrap with residual value to handover to Scrap depots for further sale to scrap purchases in a way helping the scrap to recycle by third party agencies.
- d) However, 55% agree that there exists culture of minimizing waste by way of reduce, reuse and recycle, within the operational practices of Indian Railways, with 36% agree that Indian Railways employees take responsibility to collect and separate used materials to enable recycling and ultimately leading to use of less virgin materials.
- e) Only 25% agree that Indian Railways employees take responsibility to collect and segregate scrap with NIL residual value to extract energy through incineration instead of open fire / land fill.

From the above (a) to (e) findings, it can be inferred that there exists no remarkable individual belief in waste minimization. Further, very less effort is made to avoid open fires and land filling. This is further confirmed by the way the waste handling is done in IR, as can be seen from the info given hereunder;

Except hazardous waste handling and Waste separation practices enforced by Pollution Control Boards and handling of waste is not a favorable activity, specially handling of food waste and usage of single use plastic.

Section 5: Findings and Discussions

1. CATPCA analysis: Based on CATPCA analysis, the adoption of Sustainable and Circular procurement need motivation among IR technical Officers as the Dimension 2 values are either less than 0.6 or negative with positive Dimension 1 values, 0.6 and above. Respondents need motivation on Zero Waste initiative, Handling of food waste and single use items causing pollution in view of negative

Dimension 2 values and positive Dimension 1 values of 0.6 and above.

2. Testing of Hypotheses

Null Hypothesis: H1o - The key internal material stakeholder's awareness of Sustainable and Circular procurement related aspects is not associated with the adoption of circular procurement in Indian Railways.

Alternate Hypothesis: H1a: The key internal material stakeholder's awareness of Sustainable and Circular procurement related aspects is associated with the adoption of circular procurement in Indian Railways.

Findings: The p value (0.007) is less than the significance level of 0.05 and the F-statistic value (3.283) is greater than the critical F value (2.86). Based on these values, the null Hypothesis is not supported thereby supporting the **Alternate Hypothesis**. The unstandardized coefficient and t values, with 95% confidence interval, also, substantiate this finding. With R square value of 0.118, the awareness of SP and CP aspects explains 11% of the circular procurement adoption. The correlation of Awareness predictor with Dependent variable CP adoption is positive (0.34) with significant p values (0.00). The low R square value indicates that there are other factors affecting the adoption of CP in IR, which are need to be identified through further research.

Section 6: Conclusions:

1. Supports Alternate Hypothesis: The study supported the circular awareness association with the adoption of circular procurement in IR.

2. Practical Implications for Key

Internal Material Stakeholders of IR

Awareness: Increase awareness of circular economy principles, sustainable practices among Key Internal Material Stakeholders in

IR viz., Procurers and End users which in turn will motivate them to adopt circular procurement in IR.

Capacity Building: Undertake training and education so as to motivate procurement officers to acquire the knowledge and skills to implement circular procurement practices and the End Users to opt for circular products and circular maintenance practices.

3. Limitations: The study is limited to the extent that the findings are based on limited survey of the sampling unit. Hence, the generalizations can only be arrived with bigger sample size.

4. Scope for Further Research: The study was done with limited items in the construct measurement and also with limited constructs to measure the circular awareness. The items used in the constructs measurement for analysis can be enhanced in further studies. A greater number of factors affecting the adoption of circular procurement need to be analyzed.

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