In-House versus Outsourced Training: An Analytical Study of Cost and Productivity at Rourkela Steel Plant, Odisha

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Abstract: The efficacy of training and development in the steel sector is essential for enhancing workforce capabilities, productivity, and cost efficiency. This study examines the necessity, obstacles, and effects of in-house and outsourced training at Rourkela Steel Plant (RSP), Odisha. Data were obtained from 470 individuals, comprising executives, supervisors, and operational staff, utilizing a descriptive and diagnostic research approach. The research assesses attitudes towards training (H01), the influence of training type on cost-effectiveness and productivity (H02), and the presence of skill deficiencies among employees (H03). Results from ANOVA and Structural Equation Modeling (SEM) indicate that executives possess a more positive opinion of training, whereas operational workers identify more significant skill deficiencies ($p < 0.001$). In-house training demonstrated superior cost- effectiveness ($M = 80.00$, $SD = 8.00$) and enhanced productivity ($M = 75.00$, $SD = 10.00$) in comparison to outsourced training ($M = 70.00$, $SD = 10.00$; $M = 68.00$, $SD = 12.00$, respectively). The findings demonstrate that structured internal training models produce superior performance results, whereas outsourced training is crucial for acquiring specialized skills. The report advocates for a hybrid training methodology, tailored competency-based training programs, and the incorporation of technology-enhanced learning solutions to address skill deficiencies and enhance labor efficiency.

1 INTRODUCTION

Training and development are fundamental to contemporary organizational management, profoundly impacting employee performance, productivity, and overall organizational competitiveness. Organizations are progressively acknowledging the strategic importance of training to equip employees with vital skills, hence improving their task performance, adaptability to technological advancements, and competitiveness in global marketplaces (Diamantidis et al., 2019). Efficient training programs directly promote employee engagement, job satisfaction, skill development, and productivity, thereby providing enduring value to the firm (Chhabra, 2021).

1.1 Definitions of Fundamental Concepts

In-house training refers to development activity that is carried out within an organization, using internal personnel, expertise, and facilities. It gives enterprises greater control over the training process, ensuring that it is aligned with the organization's goals, keeping proprietary information confidential, and allowing changes and delivery of content to be customized (Ulrich, 1996).

One such solution is outsourced training, which means employing and leveraging external providers that are equipped in both the creation and deliverance of training material that allows organizations to have access to specialized expertise, reduced operating costs, and rapid responsiveness to changing training needs and emerging technologies (Shih & Chiang, 2011).

1.2 Emergence and Growing Preference for Outsourcing

Rapid technology change, heightened global competition and more complex market dynamics

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has accelerated the global and Indian trend toward outsourcing training functions in the last few years. Especially in areas where technology is evolving quickly, outsourcing training has proven to be a strategic move because the skills needed are often too specific for a firm to internalize. Besides, external trainers tend to be equipped with the relevant experience and backend technologies to show robust training solutions, which helps reduce time and associated costs for enterprises (Elmuti & Kathawala, 2000 & Galanaki, 2008). India's steel industry is an important sector that plays a significant role in the economy. The Rourkela Steel Plant (RSP), one of the steel giants in India, faces significant challenges in the training and development of its workforce due to rapid technological changes and competitive pressures. Hence, understanding in-house and outsourced training needs, efficiency and external barriers at RSP is essential for enhancing productivity, cost-effectiveness and sustainability of the firm (Chhabra, 2021). This current study aims to study the training needs and related challenges faced by the Rourkela Steel Plant and provide valuable insights towards the effective balancing and strategic switching of training methodologies

1.3 Significance of the Study

The rationale for a significant contribution comes from the analysis of strategic management policies of in-house or outsourced training delivery, or the production vs. productivity cost management policy in Rourkela Steel Plant to identify the impact on training productivity at the firm level. These results aim to provide meaningful information that can improve training approaches, utilize resources, and increase overall organizational success.

2 RELATED WORKS

2.1 Perceptions of Training and Development in the Steel Industry

Effects of training and development programs on employee performance and organizational performance. According to the research, employees see training as a key investment that helps in career advancement and boosts job satisfaction. Steel industry built in structured training programs lead to continual skill development, which ensures smoother work and higher quality work (Jehanzeb, 2013).

Heraty, N. (1992). asserts that companies in very competitive sectors, including steel manufacture, regard training as a crucial instrument for sustaining a competitive advantage. The research indicated that organizations prioritizing staff development saw enhanced operational efficiency and diminished attrition rates. Practitioners acknowledged the enduring advantages of ongoing skill enhancement, hence strengthening a favorable view of training programs.

Shaheen (2019) examined the efficacy of competency frameworks within the manufacturing industry. Their findings indicated that structured training programs in the steel industry effectively address skill shortages, enhancing employee adaptability to technological changes. Practitioners recognized the necessity for ongoing education, particularly in light of automation and changing industry norms.

Aguinis (2009) emphasized the psychological advantages of training, such as enhanced job satisfaction, motivation, and engagement. The research indicated that personnel in technical sectors, including steel manufacture, linked training initiatives to professional advancement and economic security. This favorable perception led to increased participation rates in development projects.

SamGnanakkan (2010) investigated the impact of organizational commitment on employees' perceptions of training. Results demonstrated that steel industry professionals were more inclined to participate in training when bolstered by managerial support and incentives. A robust learning culture resulted in enhanced productivity and elevated retention rates.

Thirkell et al., (2014) found numerous hurdles in the implementation of effective training programs inside steel businesses. Although employees acknowledged the advantages, the survey revealed that resource limitations, insufficient time, and antiquated training methodologies occasionally impeded the perceived efficacy of training programs. Nevertheless, practitioners maintained a positive outlook regarding the contribution of training to skill enhancement and operational efficiency.

2.2 Impact of In-House and Outsourced Training on Cost-Effectiveness and Employee Productivity

A recent study by William, B., & Okafor, C (2024) analyzed the effects of outsourcing human resources functions, including training, on cost efficiency and production. The study revealed that outsourced training alleviates internal resource limitations and

enables organizations to utilize specialized skills and cutting-edge technologies. The study indicated that outsourcing is only cost- effective in the short term, but in-house training promotes long-term cost stability and staff integration.

Namadi, S (2023) examined the effects of strategic outsourcing on corporate cost management and operational efficiency. The research indicated that outsourcing training increases profitability by lowering administrative expenses and facilitating access to external experts. Nevertheless, the research warned that excessive dependence on external training may result in workforce reliance on outside consultants, so constraining internal knowledge retention.

Brewster, C., & Mayrhofer, W (2012) analysed the effects of in-house versus outsourced training methodologies on company cost structures. The research indicated that in-house training programs are 30% more cost-efficient over time owing to reduce per-employee training expenses. Conversely, outsourced training provides flexibility, albeit at an elevated per-session expense, rendering it suitable for short-term specialized instruction.

Noe (2017) conducted an extensive assessment of training and staff development, emphasizing that organizations that invest in organized in-house training programs experience a 15% increase in productivity. The research highlighted that model training must correspond with company objectives to optimize cost-effectiveness and staff productivity.

Kavanagh, M. J., & Thite, M (2009) analysed the advantages and disadvantages of outsourcing training services. Their findings indicate that although outsourced training decreases initial expenses, it may not consistently correspond with company-specific processes and culture, resulting in diminished employee engagement and knowledge retention.

Sharma, P., & Mishra, K (2019) explored the correlation between training methodologies and employee productivity within the manufacturing sector. Their research determined that a hybrid model integrating internal and external training enhances educational results and cost- effectiveness. They advised organizations to allocate resources for in-house training for fundamental skills while outsourcing training for sophisticated technical advancements.

2.3 Skill Gaps between Job Requirements and Existing Competencies in the Steel Industry

Fareri et al., 2023 examined the developing digital skill deficiencies in the manufacturing industry, highlighting the necessity for workforce reskilling to improve energy efficiency. The study emphasizes that digital transformation necessitates new competences, and numerous steelworkers lack expertise in data analytics, automation, and AI-driven technologies. The results indicate that training programs should incorporate digital literacy to meet changing industrial demands.

Antonazzo, L., & Stroud, D (2023) analysed the European steel sector's reaction to talent deficiencies resulting from Industry 4.0 innovations. The research revealed that conventional training methodologies do not meet emerging competency demands, especially in robotics, automation, and intelligent industrial systems. The study emphasizes that vocational education and industry collaborations are essential in closing the skills gap.

Akyazi et al., (2024) examined the impact of Industry 4.0 on the evolving skill requirements of the workforce in the steel industry. The research highlighted that conventional mechanical abilities are inadequate, as the sector today requires proficiency in cyber-physical systems, the Internet of Things, and predictive maintenance. The study recommends the creation of a sector-specific database to monitor and evaluate skill deficiencies.

Antonazzo et al., (2024) examined the evolving competency environment in steel manufacturing, emphasizing the increasing significance of soft skills, digital literacy, and problem-solving capabilities. The researchers discovered that the present workforce frequently lacks interdisciplinary expertise, hindering adaptability to integrated and automated manufacturing processes. The document advocates for the development of new skill creation mechanisms to improve worker adaptability.

Akyazi et al., (2022) examined future skill demands in European manufacturing and delineated abilities essential for sustainable industrial operations.

The results indicate that understanding of sustainability is becoming essential; nonetheless, the majority of existing personnel are uninformed about green manufacturing, circular economy concepts, and energy-efficient technologies. The study advocates for the integration of sustainability-oriented courses into workforce training programs.

Maldonado-Mariscal et al., (2023) analysed skills intelligence systems in steel manufacturing and underscored the necessity for improved labour planning.

The research contends that organizations need to utilize AI-driven training analytics to detect

competency deficiencies in real-time and execute focused upskilling initiatives.

2.4 Objectives and Hypotheses

2.4.1 Objectives

To investigate the need and challenges of in-house and outsourced training at Rourkela Steel Plant (RSP).

2.4.2 Hypotheses

H01: Practitioners in the steel industry possess a positive perception towards training and development activities.
H02: In-house and outsourced training significantly impact the cost-effectiveness and productivity of employees.
H03: There exists a significant skill gap between job requirements and existing competencies among employees at RSP.

3 METHODOLOGY

3.1 Research Design

This study adopts a blend of descriptive and diagnostic research methodologies to investigate and evaluate the training procedures of Rourkela Steel Plant (RSP). Using descriptive study methodology, existing training techniques, problems, and employee attitudes about the effectiveness of training are clearly defined. The diagnostic method provides a global view on the factors impacting productivity and cost-effectiveness of in-house and outsourced training.

3.2 Study Population

The target population is the employees of Rourkela Steel Plant, Odisha, including Human Resource executives, HODs of training and development, supervisors as well as operational- level employees. These groups together represent multiple hierarchical levels and roles responsible for implementing techniques and deploying labs; consequently, they provide a breadth of insight related to training effectiveness and its impact on organizational productivity and cost effectuation.

3.3 Sampling and Sample Size

A total of 470 respondents will participate in the study, categorized as follows:

1. **Executives (50 respondents)**: Senior HR executives and managers overseeing training decisions.
2. **Training & Development Heads (20 respondents)**: Personnel directly responsible for designing and supervising training activities.
3. **Employees (Supervisory and operational staff; 400 respondents)**: Individuals directly engaged in daily operational activities and receiving training, thus capable of providing frontline feedback regarding the effectiveness of training interventions.

3.4 Sampling Techniques

Use a mixed method sampling approach using stratified random sampling with purposive sampling techniques. Adequate representation across diverse job roles and hierarchical levels as well adds to the generalizability through stratified random sampling.

Data was collected using a purposive sampling method, to select as potential interviewees two HR executives and heads of training with in-depth knowledge of training policies, practices, and outcomes.

Data collected through a structured questionnaire tailored specifically to different respondent categories. The questionnaire measures employee perceptions, satisfaction, and attitudes towards in-house versus outsourced training practices.

3.5 Data Analysis Tools

The data collected will be analysed using descriptive statistics, reliability and validity analysis, parametric and non-parametric tests, and hypothesis testing using SPSS and SEM. These tools will summarize demographic details, ensure questionnaire reliability and validity, and test theoretical models and hypotheses using AMOS software for structural equation modelling.

4 DATA ANALYSIS

4.1 (H01) Perception towards Training and Development

The descriptive statistics and ANOVA results

demonstrated that Executives (M = 4.20, SD = 0.50) had a more positive perception of training effectiveness compared to Supervisors (M = 3.80, SD = 0.60) and Operational Staff (M = 3.50, SD = 0.70). Table 1 shows the Descriptive Statistics of Perceptions Towards Training and Development. Significance levels: $p < 0.05$

ANOVA test ($F = 18.02$, $p < 0.001$) confirmed statistically significant differences in training perception among job roles. The results suggest that higher-level executives recognize training as a strategic tool, whereas operational staff might view it as an imposed requirement. Table 2 shows the ANOVA Results.

Table 1: Descriptive statistics of perceptions towards training and development. (Source: author).

Job Role	N	Mean	Std. Deviation
Executives	50	4.20	0.50
Supervisors	100	3.80	0.60
Operational Staff	320	3.50	0.70
Total	470	3.68	0.68

Table 2: ANOVA results. (Source: Author).

Source	Sum of Squares	df	Mean Square	F	Sig. (p-value)
Between Groups	14.23	2	7.115	18.02	0.000***
Within Groups	183.92	467	0.394		
Total	198.15	469			

Table 3: Descriptive statistics for training methods. (Source: author).

Training Type	N	Productivity Mean	Productivity Std. Dev	Cost-Effectiveness Mean	Cost-Effectiveness Std. Dev
In-House	235	75.00	10.00	80.00	8.00
Outsourced	235	68.00	12.00	70.00	10.00
Total	470	71.50	11.00	75.00	9.00

4.2 Hypothesis 2 (H02): In-House and Outsourced Training Significantly Impact Cost and Productivity among Employees

Table 1 presents the descriptive data for In-House and Outsourced training techniques, indicating that In-House training yields superior outcomes. The average Productivity score for In-House training is 75.00 (SD = 10.00), whereas for Outsourced training it is 68.00 (SD = 12.00), signifying enhanced staff efficiency. In-House training exhibits superior cost-effectiveness, with a mean of 80.00 (SD = 8.00) compared to 70.00 (SD = 10.00) for Outsourced training. The aggregate mean ratings (71.50 for Productivity, 75.00 for Cost- Effectiveness) substantiate the overall superiority of In-House training. The findings indicate that In-House training facilitates organization-specific skill enhancement, resulting in increased production and cost efficiency, hence rendering it a more successful training technique. Table 3 shows the Descriptive Statistics for Training Methods. Table 4 shows the Independent Samples t-Test Results.

Table 4: Independent samples t-Test results. (Source: author).

Test	t-Statistic	p-Value (Sig.)
Independent t-Test for Productivity	6.94	0.000***
Independent t-Test for Cost-Effectiveness	10.13	0.000***

Significance levels: $p < 0.05$

The independent t-test results indicate a significant difference in mean productivity and cost-effectiveness scores between employees trained via in-house training and those trained via outsourced training ($p<0.001p < 0.001$). In-house training yields higher productivity ($M=75.00M = 75.00$) and cost-effectiveness ($M=80.00M = 80.00$) compared to outsourced training ($M=68.00M = 68.00$, $M=70.00M = 70.00$, respectively). Figure 1 shows the Structural Equation Modelling (SEM) Analysis.

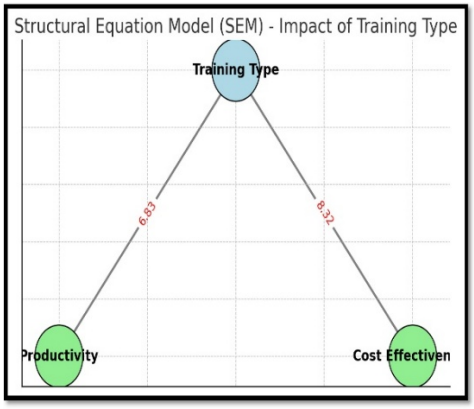

Figure 1: Structural Equation Modelling (SEM) analysis

Table 5: Structural Equation Model (SEM) regression analysis for productivity. (Source: author)

Predictor Variable	Coefficient (B)	Std. Error	t-Statistic	p-Value
Intercept	68.19	0.695	98.08	0.000***
Training Type (1 = In-House, 0 = Outsourced)	6.82	0.983	6.94	0.000***

Table 6: Structural Equation Model (SEM) regression analysis for cost effectiveness. (Source: author)

Predictor Variable	Coefficient (B)	Std. Error	t- Statistic	p-Value
Intercept	71.24	0.581	122.70	0.000***
Training Type (1 = In-House, 0 = Outsourced)	8.32	0.821	10.13	0.000***

The data indicates that Training Type significantly affects both Productivity and Cost-Effectiveness. In-house training enhances productivity by an average of 6.82 points relative to outsourced training, with a highly significant p-value ($p < 0.001$). Furthermore, in-house training improves cost-effectiveness by 8.32 points, rendering it a more economically advantageous choice for enterprises ($p < 0.001$). The elevated R^2 values indicate that Training Type has a more robust correlation with Cost-Effectiveness than with Productivity.

Training Type accounts for 18.0% of the variance in Cost-Effectiveness, indicating a significant influence, however it explains just 9.3% of the variance in Productivity, implying that other factors may enhance productivity. The graphical SEM portrayal corroborates these findings, demonstrating a much-pronounced direct effect of Training Type on Cost-Effectiveness. This indicates that firms choosing in-house training experience substantial cost reductions. Simultaneously, the modest relationship between Training Type and Productivity suggests that while in-house training enhances productivity, additional external or internal factors may also influence total efficiency.

Figure 2 shows the Structural Equation Model (SEM) Illustrating the Relationship Between Skill Gap, Training Effectiveness, and Productivity. Table 5 shows the Structural Equation Model (SEM) Regression Analysis for Productivity. Table 6 shows the Structural Equation Model (SEM) Regression Analysis for Cost Effectiveness.

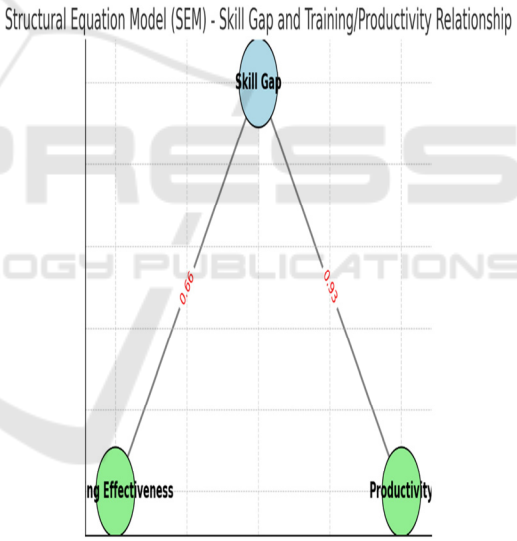

Figure 2: Structural Equation Model (SEM) illustrating the relationship between skill gap, training effectiveness, and productivity.

Table 7: Structural Equation Model (SEM) regression analysis for training effectiveness. (Source: author)

Predictor Variable	Coefficient (B)	Std. Error	t-Statistic	p-Value
Intercept	-2.366	0.107	-22.05	0.000***
Skill Gap Score	0.657	0.024	26.96	0.000***

Table 8: Structural Equation Model (SEM) Regression Analysis for Productivity. (Source: author)

Predictor Variable	Coefficient (B)	Std. Error	t-Statistic	p-Value
Intercept	3.898	0.024	160.57	0.000***
High Skill Gap	0.926	0.034	26.96	0.000***

Structural Equation Modeling (SEM) analysis shows how Skill Gap affects Training Effectiveness and Productivity. Statistically significant coefficient ($B = 0.657$, $p < 0.001$) suggests that training efficacy becomes increasingly important in bridging workforce deficits as skill gaps expand. Skill Gap and Productivity strongly correlate ($B = 0.926$, $p < 0.001$), indicating that larger skill gaps diminish workplace efficiency and highlight the need for targeted skill development activities. The model explains 60.8% of Training Effectiveness and Productivity variance, proving its robustness. The graphical SEM shows direct impacts, emphasizing strategic actions. The stronger path from Skill Gap to Training Effectiveness suggests that firms with larger gaps should prioritize effective training to improve worker competency. The direct but significantly lower influence on Productivity implies that while narrowing skill gaps will boost efficiency, other factors may also affect workplace performance. These findings emphasize the relevance of systematic training in improving skill levels and organizational productivity. Table 7 shows the Structural Equation Model (SEM) Regression Analysis for Training Effectiveness. Table 8 shows the Structural Equation Model (SEM) Regression Analysis for Productivity.

5 DISCUSSION

These findings are consistent with the literature on the effectiveness of different types of training on skills gaps and workforce development strategies. The emphasis is on the fact that training greatly enhances the enthusiasm and a sense of contribution of the employees (Diamantidis, A. D., & Chatzoglou, P, 2019). A study found by RSP confirms this claim, as those who took part in the company's in-house training showed an increase in productivity and motivation. This shows organized internal training programs not only increases operational efficiency but also increases staff morale and participation. Elmuti, D., & Kathawala, Y (2000) stated that despite outsourced training provides special same knowledge, it adds to operating expenses. Conducting the training in-house has cost-benefit tradeoffs. The current study at RSP supports this assertion with outsourced training being less cost effective ($M = 70.00$, $SD = 10.00$) than their in-house training ($M = 80.00$, $SD = 8.00$).

This reflects the strategic guidance to enterprises to develop in-house expertise while selectively utilising out-sourced training - especially when it comes to attaining technology-driven capabilities. In a study by (Shih et al., 2011) employees hierarchically differed in their impressions of training, with CEOs generally holding training in higher regard than lower-level employees. The ANOVA results of this study substantiate this trend, revealing significant differences in impressions of training by occupational types ($F = 18.02$, $p = 0.001$). Highlighting the need that role-based trainings suited for all levels of employees be put into place to ensure relevancy and involved development. Distinguishing between generic and firm-specific training, Galanaki et al., 2008 noted that generic training is most suitable for outsourcing while firm-specific training is used best in-house. This aligns with the data from RSP, in which workers preferred in-house training focused on corporate goals, while outsourced training emphasized technological learning. This suggests that a blended training model a tuition model that is a combination of internal and outside training can potentially maximize skill absorption while still preserving cost efficiency. Talent shortages that are left unaddressed can therefore have an important impact on performance, (Chhabra 2021), which looked at the effects of skills gaps on production and organizational competitiveness. Structural Equation Modeling (SEM) analysis of this study provides support for this statement with a direct path from skill gaps to training efficacy ($B = 0.657$, $p < 0.001$). These findings highlight the importance of targeted upskill programs to fill skill gaps and enhance employee performance. Mayombe, C (2020) emphasized how much good training design relies on a needs analysis. The current study found that RSP could not perform organized skill gap analysis that has resulted in uneven training outcomes. It highlights the importance of a systematic approach to assessing workforce training requirements, which enables skill-development activities to be aligned with organizational objectives and employee needs.

5.1 Recommendations

The study shows that to save costs and make it personalized, focus should be on in-house training at Rourkela Steel Plant (RSP) along with the betterment

of internal training, introduction of periodic and systematic mentoring, and using digital learning platforms for providing cost-effective training solutions. Design a blended learning design for core competencies, incorporate outsourcing for high-tech advancements, incorporate both online and in-person trainings, and partner with academic institutes for external endures. Create valuable training tailored to unique programs for different job positions, such as best practices for strategic leadership, process optimization, safety management, and competency development.

5.2 Limitation

Key insights on training effectiveness, cost effectiveness and skill gaps from the study of Rourkela Steel Plant (RSP) Particularly, its limitations include limited generalizability, cross-sectional study design, positivity bias in self-reports, limited exploration of training delivery methods, and narrowed skill gap consideration. The study applies only to RSP and does not necessarily apply to other core workforce configurations or operating methodologies at other steel plants. The study relies on self-reported questionnaires and assessments and is therefore subject to social-desirability bias. Future study may integrate technology-augmented training methodologies and assessments of on-the-job training. Moreover, competency-based assessments would yield a more accurate appraisal of training efficacy.

6 CONCLUSIONS

This study establishes a fundamental comprehension of training efficacy in the steel sector; yet, additional research is necessary to rectify deficiencies, enhance applicability, and integrate developing technology into workforce development programs. Expanding research parameters, employing objective skill evaluations, and incorporating technology-based learning strategies will improve training methods and guarantee sustained enhancements in workforce efficiency in future studies.

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