ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26oct1653

From Human Capital to Human Capabilities: An Organisational Level Framework - Infusing Sen's Human Capabilities Approach and Kremer's O-Ring Complementarities in Becker's Human Capital Theory

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Publication Date: 2026/11/06

Abstract: The human capital theory of Becker essentially views investments in the knowledge, and skill sets of employees as productive assets that increase individual income, organizational productivity and growth. But a narrowly-focused notion of human capital may miss the subtleties of human development, employee autonomy, the quality of working life and individual possibilities in the workplace. The Capability Approach by Amartya Sen, moves the analytical focus away from resources and outcomes, and towards the substantive freedoms people have, to become the beings and to do the doings that they have reason to value. Human capabilities and skill levels also show high level of complementarity in modern production of goods and services, as suggested by Michael Kremer's O-Ring model. This paper develops a unified theoretical framework that integrates these three seminal concepts, which can be practically administered in business and non-profit organizations. We define individual capabilities as the result of skill investments required by Becker transformed through organizational conversion factors such as psychological safety, agency, and autonomy — following Sen's conversion principle. We then introduce these capability levels into a Kremer-style production framework characterized by strong task complementarity. However, instead of following the multiplicative model of production function used by Kremer, we would use Transcendental Logarithmic Production Function. The proposed framework consists of four key phases, namely, human-capital investment, conversion mechanism, enhanced employee capabilities and realized organizational goals. The mathematical model and the set of conceptual propositions developed in this paper provides a research agenda for empirically examining the framework.

Keywords: *Human Capital Investment, Capability Approach, Conversion Factors, Skill Complementarity, Conversion Mechanism, Organisational Goals, Translog Production Function.*

How to Cite: Dr. Annie Abraham S.; Dr. Janet Glory M. C. (2026) From Human Capital to Human Capabilities: An Organisational Level Framework - Infusing Sen's Human Capabilities Approach and Kremer's O-Ring Complementarities in Becker's Human Capital Theory. *International Journal of Innovative Science and Research Technology*, 11(10), 3079-3087. https://doi.org/10.38124/ijisrt/26oct1653

I. INTRODUCTION

Human resources are one of the most crucial inputs of productive capacity and sustainable organizational development. In knowledge intensive and increasingly complex work contexts, the organization relies not only on the knowledge and skills that its employees have but also on how well they can use those skills in other organizational settings. Traditionally, investments in education, training, professional development and work experience have therefore been understood as investments in human capital. One of the most important economic foundations of this view is Becker's[1] (1964) Human Capital Theory which sees education, training and other methods of acquiring skills as a type of investment that increases the productivity, earnings and economic performance of the individual. Using Becker's approach, human capital was recognized as a productive asset, and the value of education and on-the-job training for economic outcomes became apparent. However, the variations in autonomy, psychological safety, decision-making, organizational support, opportunities and freedom of judgments among two employees with similar qualifications can lead to vastly different results. Thus, a narrow perspective on skills stock can only partly explain the transformation of human potential to individual and organizational results.

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The Capability Approach of Amartya Sen is an important theoretical framework to overcome this. The Capability Approach highlights what matters to people for them to be able to do economically desirable actions: their substantive freedoms and opportunities. It is particularly relevant to organizational settings in that there is a distinction between resources, capabilities and functionings. Education, technical knowledge and professional skills may be possessed by the employee, but the extent to which these resources can be turned into valuable achievements, depends on the conditions in which they work. So, the organizational context may either enable or impede the transformation of human capital into actual capability. Sen defines capabilities as "the freedom that a person has in terms of the choice of functionings, given his personal features (conversion of characteristics into functionings) and his command over commodities." In the absence of an environment which is conducive to covert the skills into effective implementation of tasks, individuals will be in a situation of 'subjective bliss', where they would be contented with the minor achievements that they have. This concept in the context of macroeconomic development and individual welfare can be applied in the context of organizational goals and employee performance as well.

This viewpoint helps to identify the significance of organizational conversion factors. In the present context, psychological safety, agency and autonomy become mediators that can help make investments in human capital manifest in the capabilities of employees. This conceptualization moves the analytical focus from the amount of human capital that an employee has to the extent to which the organization environment allows the employee to translate human capital into value added outcomes and useful results.

Michael Kremer's O-Ring theory brought in the notion that modern production requires that many activities be done well together in order for any of them to amount to a high value. The O-Ring model suggests that the more skilled workers are, the more likely they are to be paired with other skilled workers, and the more skilled workers are, the more likely job performance and wages will be to rise at an increasing rate due to complementarities among jobs. This emphasizes that, in today's organizations value creation is seldom confined to one individual's efforts. Teamwork, cross-functional collaboration, technological interdependence and knowledge sharing imply that the ability of one employee is likely to impact the productivity of others. Kremer used the Cobb Douglas production function in order to demonstrate the strong complementarity and consequent failure of a project if any one task fails. Suppose that a production process consists of n tasks and we order the tasks by level of skill, q, required, where $0 \leq q \leq 1$. The higher the skill is, the higher the probability that the task will be "successfully completed". Then the O-ring production function would be of the form: $BF(q_iq_j) = q_iq_j$ where B is a parameter reflecting the production technology used.

The present paper presents an organizational level framework that integrates these theoretical perspectives to develop a comprehensive human capital theory that can be applied to a range of different organizational settings. The proposed framework has four phases, each of them interconnected: Human-capital investment, conversion mechanism, enhancement of the employee's capabilities, and realized organizational goals. Instead of following Kremer's original multiplicative production specification, the proposed specification includes a Transcendental Logarithmic Production Function (TLPF), which allows for potentially complex relationships between human capabilities and organizational output. The main point of the paper is that human capital cannot be identified just as a bank of labor skills that can produce organizational productivity. Rather, the organizational value will rely on the conversion atmosphere and the synergies between employee capabilities.

II. REVIEW OF LITERATURE

- *Human Capital:*

A Theoretical and Empirical Analysis with Special Reference to Education, by Becker (1964), has been the foundation for a thorough economic theory of human capital. Becker viewed investment in education, training, and experience as investments that improved productive skills, and thus would impact on earnings, productivity, and the economy. He built a good linkage between investment in human capital and economic returns. In practice, in the context of the organization, Becker's theory suggests that spending on training, education and skill development of employees may be viewed as an investment in increasing worker productivity and the performance of the organization. However, the conventional interpretation of Becker's theory largely considers employees in terms of their productive value. This study aims to go beyond this view and consider whether human-capital investment can also contribute to improving the substantive skills, freedom, agency and opportunities of employees in organizations.

The human capital theory forms the core principle of understanding why people represent an economic asset that is worthy of investment. Schultz (1961)[4] in his classic paper on Investment in Human Capital, has suggested that the cost of education, training, health and other activities which enhance human productive capacity should be considered as investment rather than consumption. He made the concept of productive capacities of human beings that can yield economic returns. This view served as the basis for subsequent evolution in human capital theory, which has moved the focus from investments in knowledge, skills and competencies. The current study is relevant to Schultz's contribution as it forms the basic premise that investment in employees can increase their productive potential and can help the organization be more productive.

Mincer (1974)[5], in Schooling, Experience, and Earnings, extended the human capital theory by exploring the link between the education level and the earnings and between the experience and the earnings. Mincer's analysis showed that differences in individuals' earning power are

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26oct1653

related to schooling and their investment in skills and experience after leaving school. His research gave the important empirical grounding needed to grasp the nature of human capital creation through education and work experience. The addition of Mincer's to the proposed framework supports the argument that human capital is a process that evolves over time through education, experience and learning. However, its emphasis is still on economic value and earning potential, providing an opportunity for a more comprehensive analysis of the opportunities and capabilities that employees gain by being involved in the organizations.

In turn, the Resource-Based View of the firm has broadened the focus on human resources from individual productivity to organizational competitive advantage. Firm Resources and Sustained Competitive Advantage (Barney, 1991)[6] asserted that resources that are valuable, rare, difficult to imitate and difficult to substitute can give organizations a sustainable competitive advantage. These can be qualities that human resources have, as the knowledge, skills, experience and relationships of the employees are not easily replicated by other competitors. Barney's work thus offers a welcome link between the human capital and organization level of analysis. It calls for the interpretation of employee knowledge and skills as a strategic resource that is to be seen beyond the individual employees. But the Resource Based View focuses mainly on the contribution to organizational advantage and neglects the freedom, well-being and substantive opportunities of employees to a lesser degree.

The resource-based view was applied to human resources by Wright, McMahan and McWilliams (1994)[7] in the article Human Resources and Sustained Competitive Advantage: A Resource-Based Perspective. They suggested that if the employees have valuable knowledge and skills which are hard for competitors to imitate or replace, then HR can be a source of sustained competitive advantage. Their contribution reinforced the strategic importance of human resource management and showed that the contribution of employees' competences could have implications at the organizational level. This literature is relevant to the current study as it sets the foundation for the relationship between individual human capital and organizational outcomes. It still sees its workers from the perspective of organizational value, however, the suggested framework attempts to embrace employee capability development and organizational performance.

In The Human Resource Architecture: Toward a Theory of Human Capital Allocation and Development, Lepak and Snell (1999)[8] extended the strategic HRM concept by suggesting that organizations need to engage in a variety of HRM and development practices based on the strategic importance and uniqueness of their HC. They provide a taxonomy of the various forms of human capital and employment arrangements, and the need to match human-capital development to organizational needs. This contribution is important for the suggested framework because it illustrates that the management of human capital does not exist without organizational structures and systems. There is a certain degree of correlation between the value of worker knowledge and skills and the ways in which organizations learn, grow, use and maintain their capabilities. The focus of the framework is, however, largely economic and strategic and can be integrated with a wider human development approach.

A significant paradigm change took place with Sen's Human Capabilities Approach. In Commodities and Capabilities, Sen (1985) identified two types of resources or commodities, capabilities and functionings. Just having resources doesn't necessarily give someone the real chance to use them to make something they value, Sen wrote. Capabilities are substantive opportunities and freedoms that people have to be and to do in various ways; functionings are the ways they are and do. This is very important in the context of human resource development as staff could have the education, knowledge and skills but lack organizational freedom and opportunity to apply them effectively. So Sen's approach offers the theoretical underpinning to the shift from attributes of what employees have to what they can do and are capable of being.

In Human Capital and Human Capability (1997)[9], Sen directly addressed the issue of the link between the human capital and human capability approaches. He acknowledged that both human capital theory and the capability approach share an interest in human qualities, but have different main goals. Human capital theory focuses largely on the productive consequences of human qualities, whereas the capability approach focuses on people's ability to achieve valuable states and activities and to exercise substantive freedoms. This is important for the present study since it directly informs the theoretical framework for expanding Becker's human capital theory. Human capital theory offers an indication of how investment in employees can enhance productive capacity, but the capability approach asks organizations to ask themselves whether the employees have the opportunities, autonomy and supports they need to use and develop their capabilities.

The capability concept was further developed by Sen (1999)[10] who defined development as the increase in freedom that people enjoy. Education, employment, and health and social participation are not only important for improving productivity or income, but also because they provide people with the ability to live and engage in an activity that they have reason to value. When directed at organizations, that view implies that employee development should not only include training people to be more productive, but also to develop them for other purposes. Organizations should also provide the conditions in which staff can make decisions, have a voice in decision making, challenge their potential, engage in meaningful work and have agency. This offers a critical stepping stone to shift the focus on employees from being seen as assets for production to assets of which capabilities need to be enhanced through organizational practices.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26oct1653

The capability approach has been extended to the field of work and human resource management more and more. Connecting Developments in Corporate Human Management Thinking to the Capability Approach as Used in International Development Research was a study undertaken by Cameron and Eyeson (2012)[11]. They linked human-management concerns with human-developing issues and emphasized the need to take a broader look at human workers' health and opportunities; not only on organizational productivity. Their contribution shows that the capability approach developed by Sen can be applied in an meaningful way in organizations and that it can serve as a stepping stone for the creation of a capability approach for HRM.

In A Capability Approach to Organizational Talent Management, Downs and Swailes (2013)[12], transferred Sen's approach of capability to Organizational Talent Management. They challenged the traditional ways of thinking about talent which focus mainly on the role that employees play in the organization and their professional capabilities. They had a capability-based approach which focused on employee learning, opportunities, differences and the context in which people can develop. This study is also relevant to the extent that it illustrates the potential of capability thinking to shift the focus of organizational talent management from a narrow performance-based approach to a broader talent development and opportunity-based approach.

Likewise, Subramanian et al. (2013)[13] in Bringing Sen's Capability Approach to Work and Human Resource Practices explored possible use of Sen's approach in the context of work and human resource. They believed that traditional HR practices can focus too much on employees as human capital and on the part of employees' competencies in the efficiency of the organization. The capacity approach provides a more comprehensive view of the workplace, as it includes employees' opportunities, agency and ability to produce valued outcomes through work. This research establishes a direct connection between Sen's theoretical presented ideas and organizational human resource practices and is thus a useful base for the proposed framework.

Sen's capability approach extends beyond productive skills to substantive opportunities, but it does not fully account for the interaction of the different kinds of capabilities among the employees needed for organizational performance. This can be solved by Michael Kremer's O-Ring Theory. In The O-Ring Theory of Economic Development, Kremer (1993) explained production as a set of interdependent tasks, with the quality of performance in one task influencing the value of performance in other tasks. There is a strong theoretical link between various skills and tasks. The absence of a key task may diminish the effectiveness or value of the entire production process, while the enhancement of complementary tasks may have a reinforcing effect on each other. The O-Ring theory was originally formulated to explain the productivity and economic development of a nation, but the theory can be adapted to explain the functioning of organizations because often the capabilities of a nation's employees are not independent but interdependent.

The O-Ring view is of special interest in terms of organizations as systems of interacting tasks. For instance, a highly skilled employee might have extensive knowledge and skills, but the value of these skills to the organization could also rely on the skills of other employees, managers, administrative staff, technologies, and other organizational units. The individual employee contributions can be multiplied when complementarities are teamed. But the downside of that is that if one key member is weak, other staff members will be as well. Thus, Kremer's theory provides a useful explanation of why organizations should not focus exclusively on developing individual human capital but should also develop complementary capabilities across employees, teams and organizational functions.

The literature thus shows three important theoretical trends. The first is the human capital approach, which is embodied in the work of Schultz (1961), Becker (1964) and Mincer (1974), and is in essence a view that the investment in skills, training, experience and education increases productive capacity. The second is the human capability perspective of Sen (1985, 1997, 1999) and later applied to organizations by researchers like Cameron and Eyeson (2012), Downs and Swailes (2013) and Subramanian et al. (2013), that focuses on substantive opportunities, agency, well-being and valued functionings rather than productive skills. The third is the complementarity view, which has been championed by Kremer (1993), who argues that interacting interdependent skills and tasks can produce a multiplicative increase in productivity and organizational results.

Despite the importance of the foregoing contributions, there is still a theoretical disunity in the literature. Human capital theory offers a robust account of how organizations invest in their human resources and reap productive benefits, and the capability approach offers a more general account of how people can transform resources into substantive freedoms and meaningful outcomes. Likewise, O-Ring theory has been developed to describe the concepts of how complementary skills and interdependent tasks can work to improve productivity, and not really employee freedom, well-being or agency. Thus, there is potential to combine these views in an overall approach of an organization.

III. METHODOLOGY

This paper develops a static production model to conceptualize the theoretical amalgam of the three aspects of human capital analyzed by Becker, Sen, and Kremer. The model features a flexible Transcendental Logarithmic (Translog) production function and an individual task quality function modelled using a bounded, sigmoidal capability-conversion function. The variables in the model are defined as follows:

➢ *Variables and Definitions*

- Y: represents total organizational output value (or aggregate project quality)
- N : Total number of sequential tasks required to produce a final organizational output.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26oct1653

- $q_i \in [0,1]$: The probability of task i being completed successfully (or the quality of output at stage i). This is a variable used by Kremer in his model
- H_i: Traditional human capital (Becker)—skills, credentials, and experience invested in worker i.
- $q_i = g(H_i, \Psi_0)$, realized capability is constrained by the organizational enabling environment Ψ_0
- $\Psi_0 \in [0,1]$: Operational agency and institutional support conversion factor.

➢ *Functional Forms Used in the Framework*

The model explicitly uses two mathematical functions to specify two distinct theoretical mechanisms:

- Intra-Worker Effect: capability conversion function within worker i, depicted by a sigmoidal logistic function[14] that models threshold effects—human capital investment has minimal impact until a minimum investment H_0 is met, after which capabilities expand rapidly. The function ensures that the limiting values of q_i are 0 and 1 as long as the limiting values of Ψ_0 are 0 and 1.
- Inter-Worker Complementarity in Production: Task dependencies connecting worker i and worker j, captured by a transcendental logarithmic production function [the properties of which are explicitly dealt with by Greene (2020)[15]], rather than the Cobb-Douglas function used by Kremer. Unlike the Cobb Douglas function, Y does not drop to zero whenever q_i for any one worker is zero. This function allows limited substitutability for critical tasks and flexible substitution for routine tasks. This function is used to model situations where employees with two capability levels (q_i and q_j) are easily substitutable at low-skill tasks, but become strictly complementary at high-skill tasks. It also allows the elasticity of substitution to be a variable, unlike the Cobb-Douglas or CES function. Elasticity of substitution changes dynamically based on skill levels required for tasks.
- Cost Function: The short run cost function has two terms-first term reflects the compensation; the second term reflects the cost of skill training. The long run function has an additional term presenting the investment on conversion factors.

The system and the optimization conditions are presented in Section IV to assess how organizational investments in structures for capability-conversion (Ψ_0) non-linearly augment returns on human capital (H_i) and mitigate failures across interdependent task chains.

➢ *Data*

While the approach of the paper is primarily theoretical exposition using economic and business logic, the functional form for the model are selected based on structured interviews of employees and team leaders at different levels of a multinational company. The constituents of conversion factor were identified based on these discussions and case studies.

IV. THE MODEL

➢ *The Production Function and the Constraints*

The key proposition in the model is that the quality of production in the organization determined by the capability of the human capital to deliver the required level of skill to complete each task in the production chain. At the organizational level, aggregate firm output (quality) Y is expressed as a second-order translog expansion across N interdependent task execution stages:

$$\ln Y = \alpha_0 + \sum_{i=1}^{N} \alpha_i \ln q_i + \frac{1}{2} \sum_{i=1}^{N} \sum_{j=1}^{N} \theta_{ij} \ln q_i \ln q_j$$

- This structural specification allowing Y to remain at reasonably high level even when q_i for some workers is close to zero, has the cross-parameter terms θ_{ij} to explicitly capture Kremer's O-Ring complementarities and task-level bottleneck susceptibilities.
- The Complementarity Parameter **(θ_{ij})** is empirically testable:

✓ If $\theta_{ij} > 0$, Sen-style capabilities display positive interaction (Kremer effect).
✓ If $\theta_{ij} = 0$, capabilities act independently (Becker baseline).

The second proposition of the model is the functional form of $q_i = g(H_i, \psi_0)$:

✓ Individual task quality $q_i \in [0,1]$ is modelled using a bounded, sigmoidal capability-conversion function $q_i = g(H_i, \psi_0) = \psi_0(1 - e^{-\lambda H_i})$

- Where realized capability depends on the organizational enabling environment $\psi_0 \in [0,1]$ (Sen's approach) and the individual human capital investments H_i (necessitated by Becker).
- A value of $\psi_0 = 1$ indicates a fully enabling organization, while $\psi_0 \to 0$ indicates severe institutional friction and capability suppression. When ψ_0 = 0, q_i also would be = 0. When $H_i \to \infty$, $q_i \to \psi_0$ and therefore when $\psi_0 \to 1$ (the maximum achievable level of the conversion factor), then $q_i \to 1$, the maximum potential capability level.
- The function also reflects the following aspects of the relation between variables:

✓ If $H_i = 0$, then $q_i = 0$.
✓ Since $\psi_0 \in [0,1]$ and $(1 - e^{-\lambda H_i}) \in [0,1)$, q_i is strictly constrained to the interval $[0,1]$.

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- ✓ Marginal impact of human capital investment on capability is positive: $\frac{\partial q_i}{\partial H_i} = \lambda \psi_0 e^{-\lambda H_i} > 0$, assuming $\lambda > 0$
- ✓ The cross partial $\frac{\partial^2 q_i}{\partial H_i \partial \Psi_0} > 0$, shows that the marginal return on human capital investment H_i is directly amplified by a higher Ψ_0

➢ *The Short-Run Maximization Problem*

By evaluating the system's optimization conditions, the model analytically demonstrates how organizational investments in capability structures (ψ_0) non-linearly amplify returns on human capital (H_i) and mitigate single-point production failures across interdependent task chains.

In the short run, the firm maximizes profit by choosing individual human capital investments (H_i) and target quality levels (q_i), taking the organizational conversion factor $\bar{\psi}_0$ as given. Treating Ψ_0 as fixed in the short-run, the firm's revenue would be the monetary value of output given by Y = f (q_1, q_2, ---, q_N), where Y is the exponent form of the translog production function and $q_i = f(H_i, \bar{\psi}_0)$

- *Objective Function (Profit Maximization):*

$$\max_{\{q_i, H_i\}} \Pi = Y(q_1, \dots, q_N) - \sum_{i=1}^{N} \left(w_i(H_i) + C_H(H_i)\right)$$

Where $Y(q_1, \dots, q_N)$ is given by $\exp[\alpha_0 + \sum_{i=1}^{N} \alpha_i \ln q_i + \frac{1}{2} \sum_{i=1}^{N} \sum_{j=1}^{N} \theta_{ij} \ln q_i \ln q_j]$ Where $w_i(H_i)$ is worker compensation tied to skill investment, $C_H(H_i)$ is the direct cost of training individual i.

- *Short-Run Sigmoidal Capability Constraints:*

$$q_i - \bar{\psi}_0 \left(1 - e^{-\lambda H_i}\right) = 0 \quad \forall i \in \{1, \dots, N\}$$

➢ *The Lagrangian Function for Constrained Optimization*

We construct the Lagrangian function by assigning a Lagrange multiplier μ_i to each of the N task quality constraints:

$$\mathcal{L} = Y(q_1, \dots, q_N) - \sum_{i=1}^{N} \left(w_i(H_i) + C_H(H_i)\right) + \sum_{i=1}^{N} \mu_i \bar{\psi}_0 \left[\left(1 - e^{-\lambda H_i}\right) - q_i\right]$$

➢ *First-Order Conditions (FOCs)*

Taking partial derivatives with respect to q_i, H_i, and μ_i:

- FOC 1: Optimal Execution Quality Choice ($\frac{\partial \mathcal{L}}{\partial q_i} = 0$)

$$\frac{\partial \mathcal{L}}{\partial q_i} = \frac{\partial Y}{\partial q_i} - \mu_i = 0 \Longrightarrow$$

$$\mu_i^* = \frac{\partial Y}{\partial q_i} = \left(\frac{Y}{q_i}\right)[\alpha_i + \sum_{j=1}^{N} \theta_{ij} \ln q_j]$$

But $\frac{\partial Y}{\partial q_i}\left(\frac{Y}{q_i}\right)$ *is the Translog output elasticity for task i.* (ε_i)

$$\varepsilon_i = \alpha_i + \sum_{j=1}^{N} \theta_{ij} \ln q_j.$$

$$\mu_i^* = \left(\frac{Y}{q_i}\right) \varepsilon_i$$

- FOC 2: Optimal Human Capital Investment Choice ($\frac{\partial \mathcal{L}}{\partial H_i} = 0$)

$$\frac{\partial \mathcal{L}}{\partial H_i} = -[w_i'(H_i) + C_H'(H_i)] + \mu_i [\lambda \bar{\psi}_0 e^{-\lambda H_i}] = 0$$

$$\mu_i [\lambda \bar{\psi}_0 e^{-\lambda H_i}] = w_i'(H_i) + C_H'(H_i)$$

- FOC 3: Constraint Recovery ($\frac{\partial \mathcal{L}}{\partial \mu_i} = 0$)

$$\frac{\partial \mathcal{L}}{\partial \mu_i} = \bar{\psi}_0[\left(1 - e^{-\lambda H_i}\right) - q_i = 0$$

$$\Longrightarrow q_i = \bar{\psi}_0[\left(1 - e^{-\lambda H_i}\right)$$

➢ *Economic Interpretation of the Lagrange Multiplier (μ_i)*

By substituting μ_i^* into the second FOC, you get the fundamental optimality condition:

$$\underbrace{\left[\left(\frac{Y}{q_i}\right)\varepsilon_i\right]}_{\mu_i^* \text{ (Shadow Value)}} \cdot \underbrace{\left[\lambda \bar{\psi}_0 e^{-\lambda H_i}\right]}_{\text{Marginal Capability Conversion}} = \underbrace{w_i'(H_i) + C_H'(H_i)}_{\text{Marginal Cost of compensation and Training}}$$

The multiplier μ_i^* represents the marginal organizational output value derived from a unit increase in task quality q_i.

- The Role of $\bar{\Psi}_0$: The fixed conversion factor $\bar{\Psi}_0$ acts as a fixed or exogeneous factor impacting the marginal return of human capital investment. If the short-run organizational environment is constrained by very low level of conversion factor, ($\bar{\Psi}_0 \to 0$), the effective marginal return on skill investments H_i collapses to zero, rendering additional human capital expenditure economically irrational.

➢ *The Long-Run Maximization Problem*

$$\max_{\{H_1, \dots, H_N, \Psi_0\}} \Pi_{\text{long-run}} = Y(q_1, \dots, q_N) - \sum_{i=1}^{N} w_i(H_i) - \sum_{i=1}^{N} C_H(H_i) - C_\Psi(\Psi_0)$$

Here, we include $C_\Psi(\Psi_0)$, the organizational cost function for institutional capability building (e.g., culture, autonomy structures, team building efforts, flexibility, well-being programs), with $C_\Psi' > 0$ and $C_\Psi'' > 0$. The functional form of C_ψ reflects that higher the value of ψ_0 higher the cost and very high level of ψ_0 is associated with faster growth in cost.

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Subject to:

- *Sigmoidal Capability Function:*

$$q_i = g(H_i, \Psi_0) = \Psi_0\left(1 - e^{-\lambda_i H_i}\right) \quad \forall i \in \{1, \dots, N\}$$

- *Translog Output Function:*

$$\ln Y = \alpha_0 + \sum_{i=1}^{N} \alpha_i \ln q_i + \frac{1}{2}\sum_{i=1}^{N}\sum_{j=1}^{N} \theta_{ij} \ln q_i \ln q_j$$

- *Feasibility & Boundary Constraints:*

$$\Psi_0 \in [0,1], \quad H_i \geq 0, \quad q_i \in [0,1]$$

➢ *First-Order Conditions (FOCs)*

To solve the system, we apply the chain rule using the output elasticity

$\varepsilon_i = \frac{\partial \ln Y}{\partial \ln q_i} = \alpha_i + \sum_{j=1}^{N} \theta_{ij} \ln q_j$:

- FOC 1: Optimal Individual Human Capital ($\boldsymbol{H_i^*}$)

$$\frac{\partial \Pi}{\partial H_i} = \frac{\partial Y}{\partial q_i} \cdot \frac{\partial q_i}{\partial H_i} - \frac{\partial w_i}{\partial H_i} - C_H{}'(H_i) = 0$$

$$\Rightarrow \left[\left(\frac{Y}{q_i}\right)\varepsilon_i\right] \cdot \left[\lambda_i \Psi_0 e^{-\lambda_i H_i}\right] = w_i{}'(H_i) + C_H{}'(H_i)$$

✓ Interpretation of this condition: The marginal return of skill training H_i (amplified by organizational capabilities Ψ_0) must equal the marginal cost of training plus wage compensation.

- FOC 2: Optimal Organizational Capability Environment ($\boldsymbol{\Psi_0}^*$)

$$\frac{\partial \Pi}{\partial \Psi_0} = \sum_{i=1}^{N}\left(\frac{\partial Y}{\partial q_i} \cdot \frac{\partial q_i}{\partial \Psi_0}\right) - C_\Psi{}'(\Psi_0) = 0$$

$$\Rightarrow \sum_{i=1}^{N}\left[\left(\frac{Y}{q_i}\right)\varepsilon_i \cdot \left(1 - e^{-\lambda_i H_i}\right)\right] = C_\Psi{}'(\Psi_0)$$

✓ Interpretation of this condition: The marginal cost of expanding institutional capabilities $C_\Psi{}'(\Psi_0)$ must equal the summation of marginal returns across all N workers. Because capability structure Ψ_0 operates as an internal non-rival public good inside the firm, it shifts the productivity ceiling of the entire workforce simultaneously.

The long-run equilibrium pairs high-capability organizational environments ($\Psi_0{}^* \to 1$) with high individual skill investments (H_i^*). Since Y incorporates cross-task complementarities (θ_{ij}), an underinvestment in organizational capability Ψ_0 depresses performance output across all N tasks, creating a systemic organizational bottleneck.

V. DISCUSSION

The model can be empirically tested to verify the statistically significance of θ_{ij}, to find evidence for the complementarity of tasks. We have considered the pair wise complementarity of employees only, but it could be extended to a greater number of employees. It could also be taken as a pair of one employee and the leader of the team. Thus, it is possible to generalize the production function to a range of scenarios. It would also be possible to check if the employee's performance improves when paired with a different manager. By empirically testing the sigmoidal capability function, we can estimate the impact of ψ_0 on the skill level of the employees. We also can estimate the $C_\psi(\psi_0)$ function and statistically verify its nature. Instead of treating $C_\psi(\psi_0)$ as a function, we may also treat this just as a variable, if no functional form fits the data sets. In that case, $C''_\Psi = 0$. Once these functions are estimated, we will be able to suggest, based on the model, the optimum level of spending on conversion factors.

In order to empirically test the model, we should further develop a criterion for measuring the core variable Conversion Factor (ψ_0). Incorporating all these qualitative factors, one should be able to measure the value of the Conversion Factor on a scale of 0 to 1. Similarly, criteria for measuring the q_i value for employees on a scale of 0 to 1 can also be developed. Empirical analysis of the Sigmoidal Capability Function allows us to statistically test the significance of ψ_0 and λ (the impact of H_i on q_i). The equilibrium conditions provide the optimum level of H_i which can be used as guideline for the desirable level of human resource investment for individual employees.

This variable ψ_0 is of extreme relevance today as the number of Gen Z persons joining the workforce is increasing. While it has always been acknowledged that the work environment is important, earlier generations remained silent if they do not get a proper work-life balance. However, the Gen Z are not willing to sacrifice their personal goals to be in the workforce. They ask for a relaxed and peaceful atmosphere and they question rigid rules. They should be given tasks and teams, which are suitable to their tastes and talents. They also should be given more information about the goals of the company and processes other than the ones they are directly involved. All the more essential is the clarity about their role- what exactly should be done and shouldn't be done. In order to achieve the optimum level of ψ_0, the company has to take its induction and training process vary seriously and it should be based on psychometric tests before and after the training. Focused programs should be designed for individuals who do not show any change in their test results. Then after the half yearly reviews, the special needs should be addressed. Some companies have the mentorship program, but not very well organized in all cases. Employees should have the freedom to raise their opinions and question the traditional way of functioning of well-established companies. Leadership should be approachable, impartial and

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26oct1653

empathetic. It is also suggested that the senior personnels are provided with training to deal with the young graduates who are joining the workforce. A Framework for developing conversion factors that enhance the capabilities of the employees is presented in Table 1.

In short, institutions should identify the individual conversion barriers and provide differentiated support according to legitimate individual needs. Give employees agency or choice rather than prescribing a specific process to achieve outcomes. Monitor outcomes and establish feedback mechanism through which employees can report barriers to conversion. Continuously redesign HR practices when particular groups are unable to convert resources into opportunities.

VI. CONCLUSION

The business world has always been conscious of the importance of quality in the output as well as quality of the work environment. The theoretical model developed here would be of use for them to establish measurable relations between the variables involves in the realm of quality. The mathematical model and the set of conceptual propositions developed in this paper provides a research agenda for empirically examining the framework. The paper theorizes the impact of the variables – human capital investment, organizational conversion factor, human capabilities on the value of the organization's output and present the relationships in mathematical form that can be empirically verified. Based on empirical findings, the model can be further modified to suit the realities of the organizations. After such fine-tuning, it could also be converted into a dynamic model to trace the growth path of conversion factor and capability structure over different time periods. Once the company is able to determine the optimum levels of investment in human capital, expenditure on conversion factors and the capability level; these values could be incorporated in their system of control. Establishing such a control mechanism where quality is a vital part, improves the overall performance of the organization.

Table 1 The Organizational-Level Framework

Dimension	Base Level	Capability Enhancing Level
Hiring Strategy	Hire for technical skills and maximum possible individual output	Pair highly skilled people together and grant them the autonomy to innovate.
Training	Intensive training to meet current job descriptions	Provide learning opportunities that expand an employee's personal agency and future adaptability
Quality	Surveillance and micromanagement to avoid errors.	Build a culture of mutual accountability and psychological safety so that complex, interdependent tasks do not fail.
Work culture	Transactional -Time exchanged not only for money, but also for good vibes.	Aligning organizational goals with individual human flourishing.

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