

HUMAN RESOURCES ENGINEERING THEORY (HRET): RE-ENGINEERING WORK AND WORKFORCE FOR AI-ENABLED ORGANIZATIONS

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ABSTRACT

This paper argues that although HR technology may be insufficient, it is not the case that the human work system itself has not been systemically designed. This is addressed by developing a domain-specific, mid-range theory called Human Resources Engineering Theory (HRET) from the more general Business Engineering paradigm. HRET offers a comprehensive understanding of how to restructure work systems, human capabilities and workforce architecture to ensure sustainable performance in the age of Artificial Intelligence. It is viewed as a medium-range theory that may, as empirical evidence increases, bring about a paradigm shift instead of just being a paradigm. The development of HRET is done by the theory building method, which consists of an integrative literature review and comparative theoretical synthesis. A PRISMA flow framework is used to document the selection and screening procedures of studies. The theory is conceptually based on Socio-Technical Systems (STS) Theory and Dynamic Capabilities Theory (DCT). HRET presents a core theory and a multi-phase causal mechanism (from Engineering Design to Human–AI Alignment, to Dynamic Capabilities, to AI Transformation, to Institutional Sustainability). In addition, five engineering principles, five engineering capabilities, a five-level maturity model, explicit boundary conditions, and five testable theoretical propositions are identified. HRET's most important contribution is the shift from the HR as an administrative function perspective to the human technical system as an engineered, re-configurable perspective on organizational design objects. In this context Algorithmic Engineering is named a distinguishing capability and the integrated engineering architecture is the distinguishing structure of the theory. The study is not presented as an instrument of measurement, so it is not a contribution to the concept. Rather, it suggests indicators of operation and specifies an agenda of research to be pursued in the future across various organizational settings.

Keywords:

Human Resources Engineering Theory; Business Engineering; Human–AI Alignment; Algorithmic Engineering; Socio-Technical Systems; Dynamic Capabilities.

1. INTRODUCTION

The adoption of artificial intelligence (AI), machine learning (ML) and large language models (LLMs) in the workplace has redefined the question of central management. As AI, machine learning and LLMs have infiltrated organizational life, the central management question has been redefined. The question is no longer one of how to use AI in HR but, how to re-engineer the human system in line with the technical system. It isn't a rhetorical question. The first question is an approach of having AI as a tool to be implemented to an existing function, while the second is an approach of re-engineering a human–technical system as a design object. This paper contends that the second framing is the right one; and the ongoing lack of success in the area of AI transformation is fundamentally a matter of system design, not of technology implementation. The starting point of this argument is the logic of engineering that is inherited from Business Engineering, rather than the field of human resource management (HRM) itself. From this perspective, Human Resources Engineering Theory (HRET) can be regarded as a domain-specific theory based on Business Engineering and can be seen as a theory of engineering design logic for the work, workforce and human engineering capabilities of an organization in the context of AI. Thus, the substantive contribution is not in the HR itself, rather it is the logic of systematic design that is transferred into the HR. "Engineering" is used in this sense, which refers to the logic of systematic design, the integration of analysis, design, optimization and verification into a system that performs its functions efficiently, and not to the literal sense of civil and mechanical engineering. A couple of terms are used purposefully and distinctly, Human Resources Engineering (HRE) representing the concept or perspective while Human Resources Engineering

Theory (HRET) represents the integrated theoretical structure developed herein. The need for this re-framing is driven by the fact that the AI's capabilities are accelerating at a rapid pace, while the organizational systems are still geared towards AI environments. The integration of intelligent technologies intensifies the binding problem, which is no longer the availability of the technology, but the redesign of the human–technical system, which is able to operate effectively together with the algorithmic agent. It is this discrepancy that HRET aims to explain and to correct. There is a wealth of information on Digital HR, data-driven HR and predictive HR, but these are largely approaches that focus on tool and process improvements rather than on re-engineering the human system (Marler & Boudreau, 2017). The human–technical system is the unit of analysis in HRET, and questions the way in which systems within the system should be designed, rather than the tools within them upgraded. The paper is organized as follows: The research gap is derived from a review of the theoretical foundations and previous literature in Section 2. Section 3 presents the central thesis of HRET, the causal mechanism, variables, boundary conditions, the theoretical standing of HRET, and the neighbors of HRET. Problem, Objectives, and Significance is given in sections 4 and 5. Theoretical propositions are presented in Section 6 along with their scientific underpinning and indicators of their operations, as well as test-ability. The theory building design is described in Section 7. The conceptual framework is presented in Section 8 including the Principles, the capabilities and the maturity model. Recommendations, limitations and conclusion are found in Section 11, 12 and 13 respectively. Contributions are discussed in Section 9, while a broader research program is discussed in Section 10.

2. THEORETICAL FOUNDATIONS AND LITERATURE REVIEW

2.1 Theoretical Anchors: STS and Dynamic Capabilities

Socio-Technical Systems (STS) theory. The concept of STS, which was first introduced by Trist and Bamforth (1951) and further developed by Davis et al. (2014), suggests that the social and technical subsystems need to be designed together in order to improve the performance of the organization. Any optimization of one subsystem gives dysfunction of the whole. STS provides HRET with its core design principle – "human and algorithmic subsystems must work together, not sequentially". Dynamic Capabilities Theory (DCT). Teece et al. (1997) and Teece (2007) describe dynamic capabilities as the ability of the firm to sense, seize, and transform re-configuring its resources base to adapt to the changing environment. DCT provides HRET with the logic of the model for maturity: Engineering capabilities build up and evolve over time.

The construction rests on the integration of these two theories, and not on either one or the other as each of them focuses on a dimension the other doesn't. While STS elucidates the co-alignment of the human and technical subsystems at design time (static–structural dimension), DCT elucidates evolution and continuous reconfiguration over time (dynamic–developmental dimension). To make the theory explain design and evolution at the same time HRET needs STS to explain how alignment occurs and DCT to explain how the organization moves between maturity levels.

2.2 Historical Background of HRE

Human Resources Engineering is not a mature and complete science, the paper is not saying that. It outlines the concept of HRE as a mid-range theory and suggests that it could be used as a stepping stone for further research that would push the HRM field forward in an AI driven work environment. The unit of analysis is the human–technical system within the organization which involves interaction between structures, skills, processes, data and algorithms.

2.3 An investigation of the current insights gained

There are three literature that are relevant to this argument. The first is digital transformation and Business Engineering, which sets the logic of redesigning the organizational system, not automating tasks (Österle et al., 2011; Galbraith, 2014; Puranam, 2018). AI in management and HRM focuses on applications and tensions, such as algorithmic recruitment, performance analytics, predictive attrition, and the automation-augmentation paradox (Brynjolfsson & McAfee, 2014; Tambe et al., 2019; Raisch & Krakowski, 2021; Vrontis et al., 2022; Budhwar et al., 2022), but it usually treats AI as a collection of tools instead of a design problem. The human–AI relation is also being conceived as agency and system-level collaboration, as seen in growing literature (e.g., Daugherty & Wilson, 2018; Murray et al., 2021; Anthony et al., 2023; Rai et al., 2019), and critical work on algorithmic management has brought to the fore the importance of control, fairness, and contested judgment (e.g., Kellogg et al., 2020; Lebovitz et al., 2022; Cheng & Hackett, 2021). The third, socio-technical and sustainable design, provides the idea of joint optimization and the long-horizon thinking about governance and sustainability (Clegg, 2000; Baxter & Sommerville, 2011; Winby & Mohrman, 2018; Pasmore et al., 2019; Kramar, 2014; Aust et al., 2020). None of the streams is related to or contributes design theory for the human–technical system, and recent

appeals for a more relational, system-level thinking about emerging technology (Bailey et al., 2022; von Krogh, 2018) highlight the need addressed by HRET.

2.4 Human–AI Collaboration, Hybrid Intelligence, and Organizational Design

With the emergence of recent developments in the field of Artificial Intelligence, there has been a huge surge in studies on the interaction between humans and AI in organizational environments. Modern research on AI does not see AI merely as an automated actor but rather as a collaborating actor that is an integral part of the process of organizations, engaging in their activities through decision support, prediction, coordination and knowledge generation. This transition has led to a number of related sub streams of research such as Human-AI Collaboration, Human-AI Teaming, Human-AI Augmentation, Hybrid Intelligence and Human-Algorithm Interaction all of which aim to understand how value emerges from the complementary strengths of humans and intelligent systems in an organization. Common to this literature is the idea that the quality of human–algorithmic interaction is one of the key determinants of organizational performance. Rai et al. (2019) suggest that digital organizations of the future are becoming human–AI hybrid systems where humans and algorithms participate in value co-creation. Likewise, Murray et al. (2021) define organizations as “conjoined agency” human and technological aspects both shape the outcome of the organization. The views presented depart from the traditional notion that technology is a tool for human labor, and instead envision intelligent systems as agents of the organizational processes.

The research on Human–AI Collaboration also indicates that collaboration between humans and AI is not necessarily productive, but can be so depending on the circumstances. However, as shown by Lebovitz et al. (2022), people do not accept the recommendations of AI systems automatically – especially when uncertainty or professional judgment is involved. Similarly, Raisch and Krakowski (2021) discuss the automation–augmentation paradox, which holds that while technology can be used to automate certain processes, it cannot fully replace the uniquely human attributes that are necessary. The results show that technology alone is not the answer, as the successful integration of AI into the workplace also relies on the design and organization of interaction between human skills and AI algorithms.

This change in focus from examining AI as a technological artefact to AI as a collaborative organizational actor has been encouraged by recent research in organizations. Anthony et al. (2023) promote the systems perspective to Human–AI collaboration, which focuses on the design of the relationships among people, technologies, structures and workflows, rather than on individual technological interventions, to achieve effective organizational outcomes. Likewise, Tarafdar et al. (2023) define algorithms as co-workers within organizations, whose performance relies on role clarity, organizational designs for coordination, and designs of their interactions. These studies highlight the overall conclusion that the AI transformation is truly an organizational-design problem, and that careful consideration of the organization's architecture of human–algorithm interaction is required. The literature offers valuable insights into the dynamics of Human–AI collaboration but is largely focused on understanding the circumstances in which Human and AI systems can effectively collaborate. But, HRET moves beyond these contributions, and constructs a more comprehensive organizational-design point of view. Specifically, Human–AI Alignment in HRET involves more than just collaboration; it's the human–AI relationship itself as an engineered outcome of an organizational design process. The theory thus does not focus on collaboration, but rather on elements that enable sustainable collaboration in an organization: engineering principles, system-design mechanisms, and organizational capabilities. With this in mind, Human–AI Alignment is the bridge between socio-technical design, organizational capabilities, and outcomes of AI transformation, placing HRET in and bridging to the growing body of literature on Human–AI collaboration and the era of hybrid intelligence.

2.5 The need for new concepts

The concepts that have been developed regard transformation from a singular perspective: HRM is about the human person; Strategic HRM (SHRM) is about alignment; Digital HR is about digitizing HR processes; HR analytic is about data; Sustainable HRM is about the human–environmental balance. They both have a common shortcoming: they both lack the ability to re-engineer the human–technical system as a whole design object; and they both lack a systematic understanding of the algorithmic dimension method as part of a comprehensive design logic. This is an area in which HRET can fill the void.

Table 1. Research-Gap Matrix

Theme	Representative literature	Gap
Digital transformation & Business Engineering	Österle et al. (2011); domain studies	Focus on enterprise engineering without designing the human system
Organizational technology	Process- and IT-centric work	Adoption emphasized over system redesign
AI in HRM	Tambe et al. (2019); Huang & Rust (2021); Meijerink et al. (2021)	No engineering framework for AI applications in HR
Socio-technical systems	Baxter & Sommerville (2011); Davis et al. (2014)	Principle stated but not operationalized for HR
Sustainability	Kramar (2014); Aust et al. (2020)	Sustainability detached from technical transformation
Dynamic capabilities	Teece et al. (1997); Eisenhardt & Martin (2000)	Capabilities not linked to engineering of the human system

2.6 What distinguishes this study?

1. It changes the paradigm of the unit of analysis from “function” or “process” or “data” to “human–technical system” as a system.
2. It does not treat the three literatures (organizational, digital, algorithmic) as three distinct literatures, but as one.
3. Uses a dual theoretical perspective (STS and DCT) rather than using only one.
4. It provides a conceptual maturity model that is staged and moves from theory to practice, but does not claim to have a ready-to-use measurement instrument.

3. HUMAN RESOURCES ENGINEERING THEORY: FROM FRAMEWORK TO THEORY

The study does not stop at building an integrative framework, but offers a theory with an integrative central thesis, a causal mechanism, well-defined constructs and boundary conditions. The difference is key: a framework tends to describe and classify important features rather than to provide an explanation of how they interact to generate the results, while a theory helps explain the mechanisms in which they interact.

3.1 Central Thesis**3.1.1 Central Thesis of HRET**

According to Human Resources Engineering Theory (HRET), the AI transformation challenge is not a technology-adoption challenge, it's a system-design challenge. The theory holds that deliberate re-engineering of work systems, workforce architecture, and human capabilities must be done to ensure alignment among human actors, organizational structures and algorithmic systems, for successful AI transformation. In this view, organizational failures in AI transformation are more likely to be a result of the lack of a human work system that is deliberately designed to work with algorithmic systems than a lack of digital technology. This proposition moves the focus of explanation from the quality of the technology towards the quality of the system design, and is one that differs from much of the Digital HR literature, which tends to focus on the sophistication of technological tools as the basis of explanation of outcomes of transformation. HRET, however, takes Human–AI Alignment as its key explanatory construct of the theory. The human system is engineered in such a way that it becomes congruent to the algorithmic system, and organizational value is generated and transformation proceeds. In contrast, when there is no such alignment, misalignment will become evident and resistance, inefficiency, and transformation will come to a standstill no matter what the technology is. While it is called Human Resources Engineering, the theory is not limited to the confines of the HR profession, but can be applied to the engineering of work systems, workforce structures and human capabilities throughout the organization. The central role of HR is not confined to a boundary of the theory itself but is an initial entry point to the system.

3.1.2 Why is it that Human resources engineering is not Work system engineering?

For the theory's focus on Work Design, Workforce Design and Workforce Capability Development, it may be wondered why the theory is not called Work System Engineering. There are three reasons for this designation being called Human Resources Engineering. Firstly, it pinpoints the main theory explanation. The human subsystem is the subsystem that is most often off-balance in the causal chain throughout the process of transformation, and most often, when the process of transformation fails, it is through the failings of the human subsystem. The theory is also named after its main restriction rather than the system that it is a part of. Secondly, the title reflects the "end-goal" of engineering. The industrial systems and technologies aim at producing and sustaining values of human being in a more and more algorithmic world. The work system is the design object while the human resources are the design goal of the design. Third, the label maintains the intellectual continuity of the theory, and the distinct contribution it made and still makes. HRET stands in the dialogue between the theories of Strategic Human Resource Management (SHRM), High-Performance Work Systems (HPWS), HR Architecture and Algorithmic HRM. By preserving a designation of 'human resources', the theory can be in dialogue, challenge and extension with these traditions from within those traditions as they have been traditionally defined. Therefore, the addition of scope to HRET should not be considered an incongruity with the title; rather, it indicates the need for the redesign of the work and workforce systems around the human subsystem for meaningful engineering.

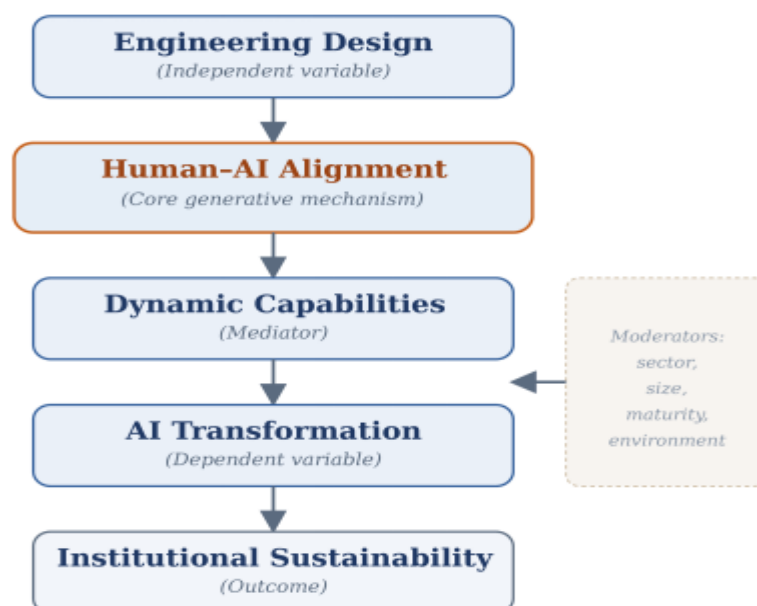
3.2 Causal Mechanism

HRET is a type of causal chain that describes how engineering interventions result in organizational outcomes in a multi-stage process. The theory states that engineering design of the human–technical system leads to Human–AI Alignment, which in turn builds dynamic human and organizational capabilities, allowing for successful AI transformation, which eventually aids in institutional sustainability. So the sequence of causes can be represented as:

The engineering design process and human-AI alignment are drivers toward dynamic capabilities and AI transformation, which in turn leads to institutional sustainability.

Human–AI Alignment is the theory's foundation of generation in this sequence. The process in which the impacts of engineering design are converted to transformation outcomes is the critical process. Hence HRET does not presume that system design is directly related to organizational performance. Instead, it elaborates on the way engineering interventions induce alignment, how alignment produces adaptive capability, and how adaptive capability brings about transformation and sustainability over time. This causal logic involves both Socio-Technical Systems Theory (STS) which theories the process of alignment and Dynamic Capabilities Theory (DCT) which theories the process of transforming alignment into continued organizational adaptation through the various developmental phases.

Figure 1. The HRET Casual Model



3.2.1 Defining Human–AI Alignment

Human–AI Alignment is the generative mechanism of the theory and thus needs to be precisely defined. In HRET, Human–AI Alignment is a designed level of congruence between the human subsystem (Roles, Skills, Structures, Norms) and the algorithmic subsystem (Models, Data, Decision Logic) where congruence does not degrade the other subsystem; instead, it enhances it to create value for the organization. It's not a characteristic of the people, but of the property.

Alignment in this way is multidimensional, and includes five aspects: (1) task alignment, in which task design, team configuration, and task allocation between human and algorithmic components are aligned to leverage complementary strengths; (2) cognitive alignment, in which human mental models and algorithmic representations align to enable calibrated trust; (3) structural alignment, in which roles, authority, and accountability are redesigned around human–algorithm interaction rather than because of structures from before the advent of AI; (4) value alignment, in which the goals of algorithms align with organizational and ethical commitments (fairness, transparency, sustainability); and (5) strategic alignment, in which AI systems, the capabilities of the workforce, and organizational design choices are aligned with long-term strategic objectives of the organization. Combined these elements make Human–AI Alignment a multi-faceted concept that can be measured in the future. Three adjacent constructs need to be differentiated. The notions of alignment and fit, which, in the contingency tradition, refers to a static correspondence between structure and context, is a dynamic and engineered one, which is reconfigured with the development of the algorithmic subsystem. From the perspective of socio-technical theory, it is different from congruence between the social and technical subsystems, as congruence pertains to the social and technical subsystems in general; HRET focuses on congruence between the human and algorithmic subsystems, and considers it as a design goal that can be measured along facets. It is different from human–AI collaboration, in which the interaction is at the level of tasks or teams; alignment is the condition at the system level that enables effective collaboration. Collaboration is a behavior, alignment is an engineered behavior.

3.3 Builds and Nomological Structure

To increase the theoretical precision, and to ease future empirical testing, HRET importantly names its key constructs and their causal relationships. Engineering Design is the antecedent condition that leads to Human–AI Alignment, and alignment in turn is an enabling condition for developing dynamic capabilities that underpin successful AI transformation, which in turn can contribute to the sustainability of institutions.

Table 2. The constructs and their theoretical roles are summarized below

Construct	Role in the theory
Engineering Design	Independent variable (antecedent)
Human–AI Alignment	Core generative mechanism
Dynamic Capabilities	Mediating variable
AI Transformation	Dependent variable
Institutional Sustainability	Outcome variable

HRET posits that AI transformation is not a direct outcome of adopting AI technology, but instead comes from a sequential causal process: Engineering Design → Human–AI Alignment → Dynamic Capabilities → AI Transformation → Organizational Performance → Institutional Sustainability. The intensity of these relationships should be contingent on different organizational contexts, industry traits, digital maturity, organizational size, and environmental dynamism (causal model moderators). This network provides a conceptual framework for all kinds of empirical research to test and expand the theory.

3.4 Falsifiability

A scientific theory should include an explanation of under what conditions it might be contradicted. HRET identifies such conditions explicitly, as per the principle of falsifiability. If empirical studies in the future continue to show that sustainable AI transformation is possible in organizations without engineering the human–technical system – or without creating Human–AI Alignment the theory would be immediately challenged. If Human–AI Alignment is demonstrated to be unrelated to transformation outcomes in a variety of organizational settings, then it would also need revision. These conditions allow for a range of empirical testing, revision, and extension instead of preventing it from being dis-confirmed.

3.5 Central Theoretical Proposition

The second theoretical proposition that follows is that the way the human–technical system is designed dictates the extent of the success and sustainability of AI transformation. All five propositions in Section 6 develop aspects of this one explanation claim.

3.6 Alternative Explanations

There are multiple attempts to explain the organizational AI transformation success: technology quality, leadership commitment, organizational culture, digital maturity or availability of resources. HRET does not deny these accounts; it suggests that their influence is passed on in form of the engineering quality of the human–technical system. Technology, workforce, and algorithmic systems are not aligned, even with advanced technology, value is not created. HRET does not replicate causes of rival mechanisms, rather it reorders them moving the locus of explanation from technology adoption to system engineering and incorporates the rival causes as conditions through which the latter's effect is achieved by aligning.

3.7 Levels of Analysis

HRET is an explanation that is primarily organized at the organizational level, the architecture of the human–technical system, but extends to neighboring levels. On the individual level, this involves adapting to and interacting with AI, on the team level, collaborative work design and team coordination, on the organizational level, system architecture, and on the institutional level, long-term sustainability and governance. This multi-level reach is not exhaustive but rather bounded; the organizational level is the "home" of the theory, and the others are the locations of the theory's "mechanism" and the possibilities of future "cross-level" work.

3.8 A Potential Paradigm Shift: From Digital HR to HRE

HRE is not offered as a quantitative extension of Digital HR but as a potential qualitative shift in foundational logic one that requires cumulative empirical validation to confirm. The contrast is summarized below.

Table 3.

Dimension	Prevailing model (Digital HR)	Proposed model (HRET)
Unit of analysis	HR function / process	Human–technical system
Logic of change	Digitize and automate existing tasks	Re-engineer the system from its foundations
Role of AI	A tool added to the function	A design dimension around which the system is reshaped
Explanation of failure	Weak tools or insufficient skills	Socio-technical misalignment from absent design
Stance	Adaptive / incremental	Generative / architectural

3.9 Original Contribution

HRET's original contribution is of twofold. First and foremost, it changes the unit of analysis, from HR being an administered function to an engineered, re-configurable system. It is the theory's key contribution to the re-framing, not any particular technique. Second, the defining capability of HRET is the algorithmic engineering that distinguishes it from its surrounding schools as an enabling capability: HRET shares organizational, digital, enablement, and sustainability as enabling capabilities with its surrounding schools, and uniquely also has algorithmic engineering as a capability around which the human system is reshaped. Algorithmic Engineering is basically the differentiation of HRET, engineering architecture, in short, is the definition of it. Human–AI Alignment should not be confused with the generative mechanism that gives rise to HRET, the causal relation between engineering design and transformation; Algorithmic Engineering is its distinguishing capability, its design competence, that distinguishes it from neighbouring schools. The former concerns the generative logic of the theory, whereas the latter establishes its theoretical distinctiveness the second is what makes it new.

3.10 Why HRET Is a Theory, Not a Framework

The difference between a framework and a theory is that the former is a descriptive organization of the parts of a phenomenon without propositions, while the latter is an explanatory and predictive one. Following the Whetten (1989) model for developing a theory, it ought to identify What, How, Why and Who/When. The following are reasons why HRET meets these criteria.

Table 4.

Criterion	Question	Realization in HRET
What	Which constructs?	Five principles, five capabilities, five maturity levels, precisely specified
How	How are they related?	Causal chain: design → alignment → capabilities → transformation → sustainability
Why	Why are they related?	Central thesis: absent engineering design yields socio-technical misalignment that blocks value
When/Who	Under what conditions?	Explicit boundary conditions (moderators: sector, size, maturity, environment)

3.11 Theoretical Positioning

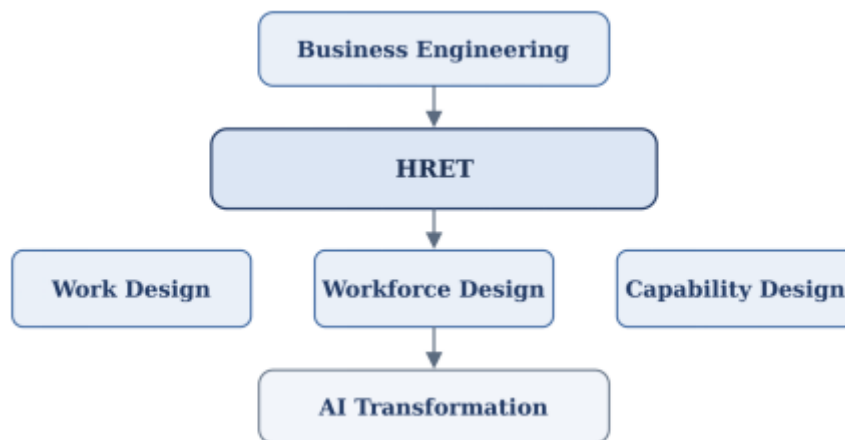
HRET's identity is clarified by comparison with the nearest schools and theories, in terms of focus and point of differentiation.

Table 5.

School / theory	Focus / unit of analysis	How HRET differs
Strategic HRM (SHRM)	Aligning HR practices with strategy	Aligns an existing system; HRET re-engineers the system's architecture itself
High-performance work systems (HPWS)	Bundles of practices that improve performance	Improves practices; does not re-engineer the human–algorithmic relation as a design unit
HR Architecture	Differentiating human-capital categories	Describes an existing structure; HRET supplies a design logic and causal mechanism
Socio-Technical HR	Social–technical congruence	Adopts its principle but adds the algorithmic dimension and a measurable maturity model
Algorithmic HRM	Effects of algorithms on managing people	Describes a phenomenon; HRET frames the algorithm as an engineering capability within a design theory
Dynamic Capabilities / RBV	The firm and resource reconfiguration	Operates at the firm level; HRET descends specifically to designing the human–technical system

HRET neither adds a new HR function nor merely improves existing practices; it proposes re-reading the HR system itself from “an administered function” to “an engineered, re-configurable design object.” In this sense HRET is a distinct theoretical nucleus. It complements Strategic HRM rather than replacing it indeed it logically precedes it, by explaining how work systems are engineered before strategic alignment can be achieved; a system cannot be strategically aligned before its design has first been engineered.

Figure 2. HRET as a Domain-Specific Theory Derived from Business Engineering



This section clarifies why HRET should be understood as a domain-specific theory derived from Business Engineering rather than merely an application of it.

A natural question that may come to mind is, “If HRET is related to Business Engineering, how is it a theory, and not just an application in the domain of business engineering?” But, the answer is that derivation is not reduction. HRET is inheriting from Business Engineering a design orientation taken for granted in the design of organizations, the attitude that sees them as engineered objects but it adds to this theoretical content at the level of the human–technical system, content that neither B.E. nor any other parent paradigm can and does specify. It has three arguments which make it stand on its own as a theory. One first has to have a distinct unit of analysis and explanation. The business level (LEL) is the level where Business Engineering is a theory of the enterprise as a whole: its explainable is enterprise-level design. HRET proposes a new explanation (the reasons for AI transformation to succeed or fail) and a new object (the human–technical system, where the employee considers intelligent systems and algorithmic agents as if they were their own). An application of its parent is not a theory itself but a derivative theory, one which is different from others and has its own phenomenon.

Secondly, domain-specific generative mechanism. There is no causal mechanism to Human–AI Alignment offered by Business Engineering. HRET presents this mechanism and outlines the implications that derive from it (P1–P5), and limits its scope, or the theoretical commitments that are not necessarily entailed by the parent paradigm and are, therefore, absent from it. What happens in a derived theory is that it goes beyond installation of a nomological net and introduces new mechanisms and propositions that are not deducible from this network. Thirdly, it is not a relationship of subsumption but a generative one. HRET is to a Business Engineering as a orienting assumption is to a grand theory in Merton's terms: The grand theory provides the orienting assumption, the mid-range theory provides the structure to a bounded domain that is specific and testable. This position supports, but does not replace, HRET's contribution: the theory becomes part of a coherent research program (enclosed in a box, Figure 8), and maintains an explanatory autonomy. Accordingly, HRET should be viewed as a derived but theoretically autonomous mid-range theory situated within the broader Business Engineering research program is not an application of Business Engineering, but rather the first theory of business engineering and not the last.

Importantly, this is more than a logical dependency: HRET stands on its own and is not dependent upon any specific formulation of Business Engineering. In this paper, constructs, mechanism, propositions and boundaries of it are defined and defended in their own terms, and can be evaluated and tested independently from the parent paradigm. Business Engineering is called in to situate HRET in a broader program, to make it clear that HRET is an engineering-oriented program, and not as part of the argument for its legitimacy. A business engineering, skeptical reader or a reader who is not familiar with business engineering, may evaluate the HRET as a mid range theory on its own.

3.11.1 HRET and Socio-Technical Systems Theory

Because Human Resources Engineering Theory (HRET) draws extensively on Socio-Technical Systems (STS) Theory as one of its foundational anchors, it is important to clarify the relationship between the two and the ways in which HRET extends beyond traditional socio-technical thinking. HRET is neither a replacement for STS nor a simple restatement of its principles. Rather, it adopts STS as a foundational explanatory lens while introducing

additional constructs, mechanisms, and design capabilities specifically intended to explain organizational transformation in AI-enabled environments.

The central contribution of STS Theory is the principle of joint optimization, which holds that organizational effectiveness depends on the simultaneous design of social and technical subsystems rather than the optimization of either subsystem in isolation (Trist & Bamforth, 1951; Clegg, 2000; Baxter & Sommerville, 2011). This principle has provided an enduring foundation for understanding organizational design, technological change, and work-system performance. However, STS was developed in an era in which technology primarily functioned as a tool or infrastructure supporting human work. Contemporary AI-enabled organizations increasingly operate through algorithmic systems that participate in decision-making, learning, prediction, and coordination. Consequently, the challenge is no longer limited to achieving congruence between social and technical subsystems but extends to designing organizational systems in which human actors and algorithmic agents continuously interact as complementary contributors to organizational outcomes.

HRET extends STS in three important respects. First, whereas STS offers a general theory of socio-technical congruence, HRET provides a domain-specific design theory focused on the re-engineering of work systems, workforce architecture, and human capabilities under conditions of AI integration. The theory therefore shifts attention from the principle of joint optimization itself to the organizational processes through which such optimization can be deliberately engineered and sustained. In this regard, HRET moves from describing the importance of alignment to explaining how alignment can be systematically designed, developed, and maintained across different stages of organizational maturity.

Second, HRET introduces Human–AI Alignment as a distinct generative mechanism. Although alignment is implicit within STS thinking, STS does not specify a causal pathway through which alignment produces organizational transformation outcomes. HRET addresses this limitation by proposing a multi-stage mechanism in which engineering design generates Human–AI Alignment, alignment develops dynamic organizational capabilities, those capabilities enable AI transformation, and successful transformation contributes to institutional sustainability. Alignment therefore functions not merely as a desirable design condition but as the mechanism through which engineering interventions are translated into organizational outcomes.

Third, HRET incorporates Algorithmic Engineering as an independent organizational capability. Traditional socio-technical approaches generally treat technology as a subsystem that must be coordinated with human activity. HRET recognizes that AI-enabled organizations increasingly depend on algorithmic systems that shape decision processes, workflows, and capability development. As a result, algorithmic logic becomes an explicit object of organizational design rather than a passive technical component. Algorithmic Engineering therefore represents a capability for intentionally designing and integrating algorithmic systems within the broader human–technical architecture of the organization, a dimension that is largely absent from classical STS formulations.

A further distinction concerns maturity and organizational evolution. While STS provides design principles for achieving socio-technical congruence, it does not offer a structured explanation of how organizations progressively develop such congruence over time. HRET addresses this gap through its five-level maturity model, which conceptualizes organizational transformation as an evolutionary progression from organizing and digitizing work systems to automating, AI-enabling, and ultimately sustaining them through governance and continuous learning mechanisms. This maturity logic introduces a developmental dimension that complements the largely static design orientation of traditional STS approaches.

Accordingly, the relationship between STS and HRET should be understood as complementary rather than competitive. STS supplies the foundational principle that organizational performance depends on alignment between human and technical elements, whereas HRET builds upon that foundation to explain how organizations can intentionally engineer, measure, and mature such alignment within AI-enabled environments. In this sense, STS provides the theoretical starting point, while HRET extends it into a domain-specific explanatory theory of human–technical system redesign for the age of artificial intelligence.

3.12 Theory Boundary

The boundaries of HRET are clearly drawn. It is not intended to explain all the behavioural and psychological phenomena of individuals but it applies to the design of the human–technical system of an organization that is going through a digital or AI transformation. Not to replace strategic HRM theories, it is a design theory which explains the rebuilding processes of the human system in environment of AI. It focuses on the organizational–systemic level, rather than the individual–psychological level or the macro-economic level; it also takes as a given a certain level of digital infrastructure that allows “engineering design” to have meaning.

To reinforce this scope: HRET doesn't attempt to explain individual behaviour or the psychological characteristics of the workers; it focuses on explaining the design of the human–technical system at the organizational level, it is a system level theory, not an individual level theory.

While connected with the logic of design theories, HRET is more than a simple design theory: it is more than a description of what it means to design, it specifies a causal mechanism, variables, testable propositions and explicit boundaries. HRET provides causal mechanisms, propositions, boundaries and testable relationships, which are not provided by generic design theories.

Like other mid-range theories, HRET is the more successful when applied to certain sets of circumstances and less successful when circumstances deviate. It has been summarized in the table below, showing its applicability by organizational context.

Table 6.

Organizational context	Applicability of HRET
AI-enabled and digitally transformed organizations	High
Knowledge-intensive organizations and technology startups	High
Public-sector organizations undergoing AI adoption	High
Traditional organizations undergoing digitalization	Moderate
Manufacturing organizations	Moderate
Micro-enterprises with limited digital infrastructure	Limited
Organizations lacking digital infrastructure	Low

Accordingly, HRET should be understood as a theory of human–technical system design in organizations pursuing AI-enabled transformation. Its explanatory scope is narrower than grand organizational theories yet broader than context-specific frameworks, occupying an intermediate position that bridges foundational organizational theories and practical transformation models precisely the bounded focus that supports cumulative development without over-extension.

4. PROBLEM STATEMENT

Previous studies have found two gaps. From one side, the current body of knowledge on the application of AI in HRM enhances the tools without altering the underlying HRM system itself. On the other hand, the literature already available in the field of HRM and AI enhances HRM tools without changing the system of HRM. On the other, organizational transformation is seldom conceptualized as an engineering task and in doing so the design of the human–technical system is under-theorized. As such, the study examines the main question:

4.1 Central Research Question

To what extent can “Human Resources Engineering” (HRET) be theoretically based, and what conceptual framework and maturity model does that represent as a theory of re-engineering the human–technical system in the organization in the AI era?

5. OBJECTIVES AND SIGNIFICANCE

The study objectives are to:

1. Establish HRET as a mid-range, domain-specific theory from Business Engineering
2. State its central thesis, its causal mechanism, variables and boundary conditions
3. Develop a conceptual framework of principles, capabilities and maturity levels
4. Formulate testable theoretical propositions and provide operational indicators.

This has three implications: Firstly, it moves the unit of analysis from the human/technical system; Secondly, it shows theory-building through the integration of a synthesis; Thirdly, it is a diagnostic logic for the AI transformation in organizations.

6. THEORETICAL PROPOSITIONS AND THEIR GROUNDING

The following are not advanced as empirical relationships, but rather as theoretical propositions, and a starting point for researchers to create and test in future research within different organizational settings as they construct and implement HRET. They are introduced with their scientific basis and suggested operation indicators.

Theoretical Proposition 1 (P1): The premise is if the HR system is more engineered, then the more successful the organizational AI transformation will be. Based on Dynamic Capabilities Theory (Teece et al., 1997) that relates resource reconfiguration to performance and SHRM evidence (Becker & Huselid, 2006) of performance effects of engineered human systems.

Operational indicators suggested: Degree of HR-process redesign, degree of HR-digital-systems integration, degree of organizational flexibility.

Theoretical Proposition 2 (P2): Human-AI Alignment is positively related to the success of organizational change and accounts for the variability of success in organizational change across organizations. Based on Socio-Technical Systems theory (Trist and Bamforth, 1951; Baxter and Sommerville, 2011) and the idea of joint optimization, and on the concept of Human-AI symbiosis.

Potential operational measures: Human-algorithm integration; Acceptance of human algorithms; dependence on human algorithms and quality of human-algorithm collaboration.

Theoretical Proposition 3 (P3): The five engineering capabilities are not independent of each other, but are integrated to increase the maturity of HR engineering. Based on integrative-design logic of Business Engineering, and on DCT's explanation of Accumulation and Reconfiguration of Capabilities.

Indicators suggested: 1) Maturity level of each of the five capabilities; 2) The extent of the integration among the five capabilities; 3) The coherence of the design across the dimensions.

Theoretical Proposition 4 (P4): The theory is that the HR engineering goes through sequential maturity levels and the lack of any of those levels would reduce the effectiveness of HR engineering transformation. Based on literature on capabilities and maturity, and DCT's 'sense-seize-transform' sequence (Teece, 2007).

Proposed operational indicators: Organizations position on the maturity ladder; completeness of pre-conditions for each level before stepping up; impact of level-skipping on the effectiveness of the transformation.

Theoretical Proposition 5 (P5): It is theorized that as HR-engineering becomes more mature, the institutional sustainability over the long term increases.

Scientific justification: Based on sustainable HRM literature (Ehnert, 2009; Kramar, 2014) and backed by evidence in the Saudi context (Abuhaimed et al., 2025).

Operational indicators suggested: Governance and algorithmic-fairness indicators; continuity of human capabilities; continuous organization learning and improvement. It provides no initial instrument for the testing of the arguments presented above; it sets out some conceptual markers that could be used in the development of instruments to test these arguments, and that could also be used to test the validity and reliability of instruments in future research. The propositions are thus tested without it being a scale developmental study.

6.1 Test-ability of HRET

While HRET is a conceptual theory, it meets one of the most critical requirements for theory building test-ability. The study therefore suggests as preliminary operational indicators for each proposition, but does not claim to be an exhaustive measure instrument. Future research is needed to develop measures and to establish their psychometric properties. HRET thus merges the conceptual with the empirical verifiable, the hallmarks of a theory-building paper and an alternative closed descriptive framework.

7. STUDY DESIGN

7.1 Method

The study applies theory-building approach involving integrative literature review combined with comparative theoretical synthesis with the goal of formulating a mid-range theory rather than testing empirical hypotheses. Such methodological combination is well-established in theory-building research: theoretical constructs are generated by synthesizing existing literature rather than collecting empirical data in the field.

7.2 Sources and Selection

Sources include peer-reviewed journal articles from management, information systems, and human resources fields in Arabic and English languages covering the period from 2010 to 2026 with key foundational articles included. Inclusion criteria required the paper to be relevant to digital/AI transformation, socio-technical design, or organizational capabilities; purely technical AI papers that did not consider organizations were excluded.

7.3 Data and Coding

Data are academic papers and their conceptual content. Reference data was collected in an extraction spreadsheet and included metadata, research stream, concepts used, the theory involved, and contribution to constructing HRE. Coding was thematic and consisted of two stages: open coding to extract concepts from individual sources and

then axial coding to group them into five streams/dimensions (ORG, DIG, ALG, ENB, SUS), from which the principles and capabilities were formulated.

7.4 Analysis and Documentation (PRISMA)

Source selection procedure followed a PRISMA methodology (identification → screening → eligibility → inclusion), which helped to document source selection process and minimize potential selection bias during the synthesis.

8. Conceptual Framework: Principles, Capabilities, and Maturity

8.1 The Five Engineering Principles

HRET rests on the following five design principles:

1. Joint optimization design the human and technical subsystems simultaneously
2. Work before jobs, engineer the work system first and then re-design the jobs
3. Capabilities before skills, develop organizational capabilities, not just individuals' competencies
4. Human-AI complementary design for complements, not for substitutions
5. Engineering before administration consider the system first as an engineering object and then as an administered function.

8.2 The Five Engineering Capabilities

These five capabilities have not been chosen randomly; they come from theoretical synthesis among the five literature streams discussed in Chapter 2 (digital transformation and Business Engineering; organizational technology; AI in HR; socio-technical systems; and sustainability). Each of the five capabilities corresponds to the engineering implementation of one of these streams in the human-technical system, thus providing a balanced coverage of all its dimensions without repetitions or omissions.

Table 7

Capability	Definition	Theoretical anchor
Organizational Engineering	Redesign of structures, processes, and policies	STS: joint design
Digital Engineering	Building the digital infrastructure and data integration	DCT: sensing
Algorithmic Engineering	Embedding algorithmic logic and decision support by design	Distinguishing capability
Enablement Engineering	Building workforce readiness, skills, and continuous learning	Human capital
Sustainability Engineering	Governance, algorithmic fairness, and continuous improvement	DCT: transforming

Describing these dimensions as “engineering” (organizational, digital, algorithmic, sustainability) does not imply that they are independent, free-standing engineering disciplines; they are interconnected engineering capabilities within a single architecture, Human Resources Engineering. The label denotes the shared design logic that governs them all, not their fragmentation into separate fields

8.2.1 Algorithmic Engineering as a Distinct Organizational Capability

Algorithmic Engineering has a unique role within the five engineering capabilities proposed by HRET since it deals with the integration of algorithmic systems into the organization's human-technical architecture. The conditions to enable transformation are characterized in organizational, digital, enablement and sustainability capabilities, whereas Algorithmic Engineering is concerned with the design, integration, governance and ongoing adaptation of algorithmic systems in work processes and decision structures. It is thus the ability of organizations to actively design the interaction between human actors and algorithmic agents, and not just as a technological instrument. Algorithmic Engineering can be said to be the organization skill to design, integrate, control and continuously evolve algorithmic systems to run in accordance with organizational goals, processes, and human capabilities. The idea is not just about the technical aspects of implementing AI, but also about the intentional design of interactions between algorithms, work systems and workforce structures. Algorithms are not a passive technology that is integrated into organizational structures, but an active design element that shapes decision-making processes, coordination, learning, and value creation, from HRET's point of view. The adoption of AI technologies, then, is not a standalone process, but one that involves creating the organizational conditions that support the collaboration of these technologies with human skills in a way that is effective. It is inspired by various

sources of literature, such as algorithmic management (Kellogg et al., 2020), algorithmic human resource management (Meijerink et al., 2021), human–AI hybrid systems (Rai et al., 2019), human–technology co-agency (Murray et al., 2021), and AI-enabled organizational design (Anthony et al., 2023). But, HRET brings these views together in a framework of engineering, which sees algorithmic systems as objects of organizational design not as technological artifacts or governance issues. This orientation is in keeping with the broader philosophy of the theory, that the task of AI transformation is not a technology-adoption challenge, but rather a system-design challenge. There are various related concepts which should be distinguished from Algorithmic Engineering. Algorithmic Management mainly focuses on the role of algorithms in coordinating, monitoring, evaluating or controlling human work (Kellogg et al., 2020). AI Governance is primarily about ethical supervision, accountability, transparency, fairness and risk management of AI systems (Leicht-Deobald et al., 2019). AI Capability is the ability of an organization to buy, build and apply AI technologies strategically, whereas Digital Transformation is the strategic adoption of digital technologies by an organization as a whole. Algorithmic Engineering is not unique from any of these vantage points, as it is primarily focused on the intentional design of the nature of the human–algorithm relationship. It is not only about the use, governance, or strategic use of algorithms, it's about how organizational systems can be designed to be a symbiotic part of the algorithm-human system. In HRET's causal reasoning, there is a capability, called Algorithmic Engineering, which allows for Human–AI Alignment. The operational interface that brings humans together with algorithmic systems is defined by Algorithmic Engineering, which complements organizational engineering that structures the work system, digital engineering that provides technological infrastructure and enacts workforce readiness, and sustainability engineering that governs long-term sustainability. It is not simply an issue of technical functionality; it sets the conditions for algorithmic systems to complement human judgment, aid decision-making and facilitate organizational learning, while not causing the misalignment that often prevent AI transformation projects. This ability is the major difference between HRET and other theoretical neighboring perspectives. While some existing HR and organizational theories have already begun to recognize the significance of the new type of work enabled by AI, few have considered algorithmic systems to be a new element of design that necessitates specific organizational capabilities. In HRET, Algorithmic Engineering is added to the theory's overall engineering architecture to solve this problem. Thus, Algorithmic Engineering is not just a complementary piece to HRET, but the means by which the theory can be extended to the context of AI-infused organizations. That is why Algorithmic Engineering is the distinguishing characteristic of HRET and the integrated engineering architecture is the theory.

8.3 The Conceptual Maturity Model

The proposed maturity model is not an empirically validated instrument; it is an initial theoretical schema outlining organization's journey from organizing the human system to digitizing it, to automating it, to AI-enablement of it, and ultimately to sustainable governance of it. The model implies that HR-engineering capabilities develop cumulatively; each level requires the previous ones so that successful AI enablement can be achieved only when the preceding steps of organizing, digitizing, and automating have been accomplished.

Table 8

Level	Label	Focus	Anchor
1	Organize	Re-engineer processes and structures	STS
2	Digitize	Build digital infrastructure and HRIS	DCT: sensing
3	Automate	Automate routine processes	DCT: seizing
4	Enable AI	Integrate algorithmic models	STS: technical congruence
5	Sustain	Governance and continuous learning	DCT: transforming

9. DISCUSSION

9.1 Interpreting the Construction

The theoretical synthesis built upon in this study further supports the notion that the HR transformation is not a one-way technological process, but a continuous process of redesign and re-engineering the organization. The results indicate that effective change requires ongoing evolution of work systems, workforce structure

(Proposition P2) and human capabilities (Proposition P3) based on ongoing feedback and adaptation. The interpretation fits with the Bondarouk & Brewster's (2016) understanding that digital transformation often ends up failing because of the organizational aspect ignored by the organizations. The need for Human–AI Alignment as the key mechanism that has to be aligned to transform engineering interventions into transformation outcomes is extended by HRET. In this regard, the results validate the theory's main premise that success in changing is not only a matter of the digital tools' quality but more importantly of the quality of the human–technical system in which digital tools are used.

9.2 Expected Empirical Patterns

The propositions of HRET are empirical patterns which have been suggested as a conceptual theory. Empirical studies in future would be expected to report positive relationships between HR-engineering maturity and success of AI transformation; between the HR transform success and a greater degree of Human–AI Alignment and between the HR adapt ability and a higher maturity of engineering capability. These expected patterns serve as a first approximation to the theory's ability to explain and predict in the various organizational contexts.

9.3 Theoretical Contribution

The major contribution of this study is to create the Human Resources Engineering Theory (HRET), which falls into the domain specific theory under the umbrella of the Business Engineering paradigm. HRET is a new way to think about HR – from administration to design, and from humans to their capabilities in alignment with AI-enabled environments and systems. The theory moves the unit of analysis away from HR activities towards the human–technical system as a reconfigurable organizational object, and offers a unified explanation for the interactions between engineering design principles, organizational capabilities, maturity transitions and transformation results. In this contribution, the principles of Business Engineering are applied, translated and adapted from the enterprise to a more focused level of work-system and workforce design. One of the unique aspects of HRET is the use of Algorithmic Engineering as an organizational capability on its own. HRET is unique in identifying algorithmic logic as a specific design dimension against which the human system needs to be specifically reconfigured, whereas other views see organization, digital, enablement, and sustainability as capabilities. The Algorithmic Engineering as a defining proposition, therefore, is that it distinguishes HRET and the theory of engineering is the engineering architecture. This contribution is more significant than differentiation. HRET aims to fill gaps in the existing HR and digital-transformation theories that have a limited focus on socio-technical congruence, especially in the case of frequent failures in technologically advanced transformation projects. In addition, the theory has a predictive element, suggesting that the higher an organization has progressed with its maturity, the more Human–AI Alignment, deeper Organizational Capabilities, more socio-technical congruence, and likelihood of a sustainable change outcome it will have. These expectations are put into words in Propositions P1–P5 and are subject to empirical testing.

9.5 Scientific Value and Contributions to the field

In addition to its applications, HRET is a reaction to the growing demand in academia for frameworks that can help understand the processes and patterns of change in work, workforce structures and organizational capabilities in the context of growing algorithmic integration (Bailey et al., 2022; von Krogh, 2018). The value of it, then, is not in it being another management model for digital transformation, but in offering a theory from which the process of change in the organization within an environment enabled by AI can be explained, predicted and evaluated. Secondly, the theory is, by design, an open research framework that is cumulative, not a closed explanatory model. There is a focus on constructs, propositions, maturity logic, and causal mechanisms that are formulated to favor further development of measurement, empirical testing, comparative inquiry, and theoretical development in a variety of contexts. In this aspect, HRET is intended to contribute to an emerging body of knowledge on the engineering of human systems in the age of artificial intelligence., but retains to the same degree that of any mid-range theory, the boundlessness. He has made a significant contribution to the research in Business Engineering. HRET also directly supports the scholarship of Business Engineering by showing how a more general engineering paradigm can be broken down into a domain-specific theory that can be utilized in work system, workforce architecture and in human capabilities design. In this way, it takes Business Engineering out of the world of enterprise design and process design (and digital transformation) and into the world of human-system design. The link between this and domain-specific theories is similar to that between the broader paradigmatic theories and the domain specific theories, like the relationship between the resource-based view and the intellectual-capital theory, or Dynamic Capabilities Theory and digital dynamic capabilities. Therefore, the main advantage of this study may not be that it presents a completely new theoretical leap, but that it, to the author's knowledge, is one of the first domain-specific theories that originated from the Business Engineering paradigm and was explicitly used in the design of human–technical systems, in AI-enabled organizations.

HRET is also a case study in how Business Engineering can have the potential to both be a managerial and design oriented paradigm, but also a source of cumulative theoretical development more broadly. The theory implies that there is a more general family of domain-specific theories which could blossom out of the Business Engineering tradition, including the future development of the theory of governance engineering, process engineering, capability engineering, etc. This theoretical branch in this case enhances the academic credibility of Business Engineering as a paradigm which can provide the following theories: theories of explanation and theories of implementation.

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