Agility Drivers and Agility Capabilities: The Mediating Role of Agile HRM Practices-Insights from Steel Industry in Egypt

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Agility Drivers and Agility Capabilities: The Mediating Role of Agile HRM Practices-Insights from Steel Industry in Egypt.

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Abstract:

Purpose - This study investigates the mediating role of agile HRM practices (AHRMPs) in explaining the indirect relationship between agility drivers (ADs) and workers' agility capabilities (ACs) in dynamic business environments.

Design/Methodology/Approach– Using a cross-sectional survey, data were collected from 346 employees at Suez Steel Companies (SSC) in Egypt. The hypothesized model was analyzed through PLS-SEM technique. Semi-structured interviews with 27 key SSC positions provided qualitative insights, analyzed through thematic analysis technique.

Findings– Results indicate that the dimensions of ADs, specifically changes in customer requirements and competition, positively impact both workers' ACs and AHRMPs. Agile HRM practices, specifically agile training needs planning, teamwork, motivational planning, and organic remuneration, significantly influence workers' ACs and mediate the relationship between ADs (i.e., customer requirement, competition and technology) and ACs.

Research limitations/implications– Limited focus has been placed on how HRMPs equip workers with the competencies needed to recognize and respond to unexpected environmental changes.

Originality/value – This study addresses this gap by developing a novel agility methodology for managing changes in disruptive markets through exploring the interdependencies among the OA components of: ADs, AHRMPs, and workers' ACs. Resource Dependency Theory (RDT) is employed to elaborate on how AHRMPs enhance workers' agility competencies required to sense and response efficiently to unprecedented environmental changes.

Practical implications– This study emphasizes the critical shift in HR professionals' roles from operational to strategic partners, facilitating the realization and enhancement of agile competencies that enable organizations to adapt to environmental challenges.

Keywords: Agility Drivers, Agility Capabilities, Agile HRM Practices, Steel Industry, Egypt

الدور الوسيط لممارسات ادارة الموارد البشرية الرشيقة في العلاقة بين تحديات ومقومات الرشاقة التنظيمية بالتطبيق علي صناعة الحديد والصلب في مصر

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المستخلص:

تبحث هذه الدراسة في الدور الوسيط لممارسات ادارة الموارد البشرية الرشيقة في تفسير العلاقة غير المباشرة بين تحديات ومقومات رشاقة المنظمات التي تعمل في ظل بيئات عمل غير مستقرة. تم جمع البيانات من ٣٤٦ موظفًا في شركات السويس للصلب في مصر من خلال الاستبيان. تم تحليل البيانات باستخدام تقنية PLS-SEM. بالإضافة إلى ذلك، تم إجراء مقابلات مع ٢٧ موظفًا في مناصب قيادية تم تحليلها باستخدام تقنية Thematic Analysis. تشير النتائج إلى أن أبعاد تحديات الرشاقة التنظيمية مثل: التغير في طلبات العملاء وحدة المنافسة ـ تؤثر بشكل إيجابي على كل من مقومات رشاقة المنظمة وممارسات ادارة الموارد البشرية الرشيقة. كما تلعب ممارسات ادارة الموارد البشرية الرشيقة ـ مثل: تخطيط احتياجات التدريب الرشيق، والعمل الجماعي، وتخطيط الحوافز، ونظم المكافآت المرنة دورًا كبيرًا في تحسين رشاقة العاملين. كما تتوسط ممارسات ادارة الموارد البشرية الرشيقة العلاقة بين عناصر تحديات الرشاقة التنظيمية مثل التغير في طلبات العملاء، وحدة المنافسة، ودرجة التكنولوجيا ومقومات رشاقة المنظمة. تعتمد هذه الدراسة علي نظرية الموارد resource dependency theory في تطوير منهجية مبتكرة لإدارة التغير في الأسواق غير المستقرة؛ حيث توفر النتائج إرشادات واضحة لمديري الموارد البشرية لتحسين كفاءة العاملين، مما يعزز الأداء التنظيمي ويحافظ على تحقيق ميزة تنافسية مستدامة في البيئات الديناميكية. تُقدم هذه الدراسة إطار متكامل للرشاقة التنظيمية يشرح دور ممارسات ادارة الموارد البشرية الرشيقة في تفسير العلاقة بين متطلبات رشاقة المنظمة والتطوير اللازم في قدرات العاملين.

الكلمات المفتاحية: تحديات الرشاقة التنظيمية، مقومات الرشاقة التنظيمية، رشاقة العاملين، ممارسات ادارة الموارد البشرية الرشيقة، صناعة الحديد و الصلب، مصر.

1. Introduction

Nowadays, organizations are continually facing unprecedented environmental challenges, driving the need for customizing products and shortening life cycles (Jewell, Jewell, & Kaufman, 2022). Agility concept has thus emerged in organizational studies to discuss an organization's capabilities and practices that allow recognizing, anticipating and responding swiftly and efficiently to the ongoing environmental challenges (Elazhary, Popovič, Henrique de Souza Bermejo, & Oliveira, 2023; Zhang, Pu, Cai, Liu, & Liang, 2023), achieve sustainable competitive advantage (Saha, Gregar, & Sáha, 2017) and maintain high business performance (Walter, 2021). In this context, Žitkienė & Deksnys (2018) introduced the multidimensional organizational agility (OA) model, differentiating three core OA components: agility drivers, agility capabilities, and agility enablers. Agility drivers (ADs) emphasize internal and external environmental triggers that force the organization to change and search for competitive advantages (Darvishmotevali, Altinay, & Köseoglu, 2020). Boubaker, Jemai, Sahin, & Dallery (2019) identified four primary ADs—customer requirements, competition, technology and social factors. Nevertheless, agility capabilities (ACs) are certain competences (i.e.: responsiveness, relationship, flexibility, and services) that provide the organization with the capacity to respond swiftly and properly to the changes in ADs components (Koçyiğit & Akkaya, 2020). Finally, agility enablers emphasize the methods, tools, and practices (i.e.: technology, human resources, network, structure and organization) that work as a driving force to empower workers' ACs and enhance OA (Rasi & Namakavarani, 2020; Walter, 2021).

In OA literature, the process theory of change (PTC) emphasizes the process of recognizing and responding to the need for changes that arises from the interactions among stakeholders who represent the main source for changes (Wufka & Ralph, 2015). Building upon this, the

Dynamic capabilities theory (DCT) emphasizes the managerial competencies required for sensing and seizing the rapidly environmental changes and configuring flexible plans to respond promptly to the internal and external opportunities and threats that emerge in the surrounding business environment (Arsawan et al., 2022). A growing body of the PTC & DCT based OA literature underlines the sense-response cycle emphasizing the organization ACs needed to recognize, anticipate and react swiftly and efficiently to the environmental changes (Harsch & Festing, 2020; Koçyiğit & Akkaya, 2020; Garrido-Vega, Sacristán-Díaz, Moyano-Fuentes, & Alfalla-Luque, 2023; Arsawan et al., 2022; Ajgaonkar et al., 2022; Rafi et al., 2022; Al-Shboul, 2022; Aldhaheri & Ahmad, 2023). So far, however, we know a little about the agility methodology (the best practices leading to ACs) (Walter, 2021). Thus, agility is no longer a new concept but has become a new methodology that significantly transforms work-environment (Hammouri, 2023). Researchers examined OA over the past thirty years, yet, no consensus has been reached about a unified agility methodology (OA enablers) that fit all organizations, as researchers approached agility enablers in a specific industry or from limited perspective (Žitkienė & Deksnys, 2018; Walter, 2021). Here, OA studies addressing agility enablers has often been conducted from a fairly narrow angle giving special emphasis on OA enablers related to information Technology (Gunasekaran, Yusuf, Adeleye, & Papadopoulos, 2018), concurrent engineering and knowledge management (Khatri, Garg, & Dangayach, 2018), customized manufacturing, cross-functional integration, and suppliers relations (Sindhwani & Malhotra, 2017), yet, ,limited attention is paid to human-related practices (HRM enablers) that demonstrate a significant impact of building people capabilities, and designing agile HR functions on achieving a successful agility performance (Pan, Pan, Song, Ai, & Ming, 2020; Harsch & Festing, 2020; Agarwal, 2021; Kavitha & Suresh, 2021; Ajgaonkar et al., 2022; Hammouri, 2023).

From this standpoint, this study aims to bridge the aforementioned research gap in the current OA literature through elaborating on how Agile HRM practices AHRMPs (i.e.: agile training need plan, cross-functional team building, agile incentive plan and organic remuneration system with multiple components) realize, and enhance workers' ACs (i.e.: responsiveness, relationship, flexibility, and service) to respond efficiently to the unprecedented changes in ADs (i.e.: customer requirements, competition, technology and social factors). According to Walter (2021), the OA studies, until now, still seems disconnected with regard to the interdependencies among OA components of: agility drivers, agility capabilities, and agility enablers. This study thus proposes a novel, integrated approach to managing change in disruptive markets by aligning PTC and DCT with resource dependency theory (RDT). Managerial implications are also discussed, highlighting HR's role in enhancing workforce competencies to maintain high performance and competitive advantage in dynamic environments.

Accordingly, this study addresses the primary question: "How can Agile HRM Practices explain the relationship between changes in Agility drivers and the necessary adaptations in workers' Agility Capabilities"?

The present study has been organized as follows. The next section reviews the literature that emphasizes the interdependencies among OA components leading to the hypothesized framework. Then, the research methodology is discussed. The empirical results of the study are then presented and analyzed. Finally, the concluding section summaries the theoretical contributions, practical implications, and research limitations in addition to future research.

2. Reviewing the literature and developing the hypothesized framework:

The concept of "agility" originated in 1991, when scholars proposed a shift from mass customization to agile manufacturing to restore U.S. economic leadership (Walter, 2021). Interest in agility as an organization-wide phenomenon has grown due to ever-changing business environment (Jewell et al., 2022). Today, organizational agility (OA) is widely recognized as a crucial tool enabling organizations to adapt to turbulent business conditions (Zhang et al., 2023). The original OA framework was developed by Sharif and Zhang (1999) in manufacturing organizations. However, Sharif and Zhang (1999) framework didn't consider potential interdependencies among agility components of: agility drivers, capabilities and enablers (Žitkienė & Deksnys, 2018). Building on this, the present study provides a coherent and holistic OA view through reviewing recent literature that highlights the interdependencies among OA components.

2.1: Agility Drivers (ADs):

Changes in business environment are recognized as the primary driving force behind agility (Darvishmotevali et al., 2020). Thus, ADs are the pressures arose from the surrounding environmental changes that threaten an organization's performance and competitive advantage (Ebrahimpour, Salarifar, & Asiaei, 2012). Changes in business environment and environmental uncertainty have been documented as the key reasons for organizations failure (Hashem & Aboelmaged, 2023). The majority of OA literature relates ADs to the external environmental factors as the main source of uncertainties (Darvishmotevali et al., 2020). They emphasize changes in marketplace, social factors and faster delivery time (Saha et al. 2017), changes in customers' expectations (Gunasekaran et al., 2018), technology changes and Innovation (Silva & Oliveira, 2023), legal/political pressures (Reis, Cabral, & Arvate, 2024)

and intensity of competition (Garrido-Vega et al., 2023). In contrast, another group of OA researchers stress internal drivers of agility, such as differentiation strategy (Garrido-Vega et al., 2023), internal changes (Wankhade & Kundu, 2020), strategy facilitating mergers and acquisitions, and new performance management system (Bhattacharya, 2019), organization structure, management style and internal process changes (Vinodh & Aravindraj, 2012).

This study addresses both internal and external ADs focusing on four dimensions: changes in customers' requirements, technology; competition; and social factors, as developed by Zhang (2011). Here, Gligor, Esmark, & Holcomb (2015) define change in Customer requirements as consumers' evolving expectations regarding product quality and sudden shift in order quantity and specifications. However, change in technology refers to the rate of variation within the technological environment of a given industry, which necessitates increased investments in research and flexible IT infrastructure (Darvishmotevali et al., 2020). The current OA literature demonstrates a strong connection between a company IT capabilities and its ability to respond efficiently to environmental changes (Silva & Oliveira, 2023). On the other hand, Lee and Yang (2014) demonstrated that the competitors constitute the main driving source that motivates the companies to search for new competitive advantages that differentiate themselves in the marketplace. Thus, being agile requires responding to change in competition environment through monitoring the competitors' movements (competitors plans, and strategies) and promptly understand and react to opportunities or threats that may occur in the business environment because of the competitors' actions (Auh & Menguc, 2005). Regarding changes in social Factors, Fernando and Saththasivam (2017) distinguished between two social factors namely environmental performance (EP) and social performance (SP). They defined

Environmental performance as the collaborations (alliances) among an organization's suppliers and customers to reduce environmental effects on workplace environment and production processes. Nevertheless, social performance refers to changes in environmental demand that require urgent organization response through engaging in effective CSR activities to improve internal and external stakeholders' community. OA literature demonstrates that organizations need to possess agility capabilities to incorporate EP & SP into business strategy (Fernando & Saththasivam, 2017).

2.2: Agility Capabilities (ACs):

ACs are defined as the "organizational characteristics which should be created in order to develop the ability of the organization to respond to the changeable situations rapidly" (Arsawan et al., 2022, P.1). According to Koçyiğit, & Akkaya (2020), ACs are certain competences that provide the organization with the capacity to respond swiftly and properly to the ADs. The ACs agreed by the majority of the current OA literature are responsiveness (Jermsittiparsert, Sutduean, Sriyakul, & Khumboon, 2019), flexibility (Ramos et al., 2023), speed (De Smet, Pacthod, Relyea, & Sternfels, 2020), relationship (Vanichchinchai, 2012), service (Edu, 2022), cost and quality (Christopher & Towill, 2001).

This study adopts four agile capabilities components (i.e.: responsiveness, flexibility, relationship, and service) based on Vanichchinchai's (2012) framework. Zhang & Sharif (2000) define "responsiveness" as the organization capability to recognize and react promptly to the environmental changes either reactively or proactively, and take advantage of that changes. However, "flexibility" refers to the capability of adaptation to environmental changes and stabilize operation processes in uncertain environment (Ramos et al., 2023) and carry out different work and achieve different objectives with the same facilities (Sharif & Zhang, 1999). Nevertheless, "relationship" is the capability to

form solid intra-organizational relationships among organization units and inter-organizational relationships with suppliers and partners to reduce environmental uncertainty and dependency (Hillman, Withers, & Collins, 2009). Lastly, "service" is the capability of continuously monitoring the customer feedbacks on service outcomes and responding quickly to changes in customers' satisfaction and expectations (Bambauer-Sachse & Helbling, 2021).

2.3: ADs / ACs interdependencies:

A growing body of the OA literature addresses the relationship between ADs and ACs emphasizing the organization competencies needed to cope-with changes arose from ADs (Arsawan et al., 2022; Ajgaonkar et al., 2022; Aldhaheri & Ahmad, 2023; Rafi et al., 2022; Al-Shboul, 2022; Zhang & Sharifi, 2000). OA studies addressing ADs and ACs interdependencies build their hypothesized framework based on the Process Theory of Change (PTC) and Dynamic Capabilities Theory (DCT) basic assumptions (Walter, 2021). Here, PTC-based literature assumes that OA emerges through the process by which the teams recognize and respond to changes that arise from the interaction among the stakeholders (customer, competitors, suppliers and management). The PTC-based model of Wufka & Ralph (2015) hypothesizes that stakeholders are the main source for changes. They demonstrate that agile organizations need to acquire responsiveness capability for reducing the "sense-response lag"—the time between identifying and responding to changes. Similarly, DCT scholars emphasized the managerial competencies needed to recognize and respond to environmental changes. They assert that "strong and dynamic managerial competencies and capabilities, formed from a collaborative process, served as solid foundation for organizations to be sensitive in sensing, seizing, and shaping internal and external opportunities and threats for

the purpose of the right strategic decisions and reconfigure and reuse all potential and resources" (Arsawan et al., 2022, P.3).

Based on this, an empirical study by Zhang & Sharifi (2000) examined the AD/AC relationship, focusing on AD components (competition, technology, customer requirements, social factors) and AC components (responsiveness, competency, flexibility, and speed), revealing a strong positive correlation between them. Likewise, Aldhaheri & Ahmad (2023) highlighted dynamic internal and external changes in supply chain functions, finding a significant impact of supply chain innovation, visibility, speed, flexibility, relationships, and leadership capabilities on organizational agility and competitiveness. Al-Shboul (2022) also demonstrated a positive impact of delivery reliability, speed, and supply chain responsiveness on manufacturing firms' performance. Furthermore, Rafi, Ahmed, Shafique, & Kalyar (2022) explored knowledge management capabilities (knowledge infrastructure and processing) and found a direct positive impact on organizational agility and business performance, with agility mediating the relationship between knowledge management and performance.

In summary, continuous changes in ADs components increase the need for agile capabilities, leading to the following hypothesis:

$\boldsymbol{H_1}$: A significant positive relationship exists between changes in ADs' components and the required agility capabilities (ACs).

$H_{1.a}$: A significant positive relationship exists between customer requirement and ACs.

$H_{1.b}$: A significant positive relationship exists between competition and ACs.

$H_{1.c}$: A significant positive relationship exists between technology and ACs.

$H_{1.d}$: A significant positive relationship exists between social factors and ACs.

2.4: Agile Human Resources Management Practices (AHRMPs):

In OA literature, *agility enablers* emphasize the methods, tools, and practices that drive and enhance ACs and empower OA (Rasi & Namakavarani, 2020; Walter, 2021). Much of the literature on OA enablers gives more emphasis on information Technology (Gunasekaran et al., 2018), concurrent engineering and knowledge management (Khatri et al., 2018), customized manufacturing, cross-functional integration, and suppliers relations (Sindhwani & Malhotra, 2017). Nevertheless, a little emphasis was given to the role that *people*, as enabler, play in improving organization performance (Pan et al., 2020). limited OA researchers highlight the importance of building people capabilities through human resource management (HRM) practices to achieve successful agility outcomes (Junita, 2021). In this context, Junita (2021) stresses the important shift in the HR professionals' role from operational to strategic partners, which enables an organization to plan and execute its strategy through developing an integrated system of HRM policies and practices that adapt to changing in business environment while building a strategic competencies matrix and ensure the availability of agile workforce. In line with this, the concept of Agile HRM Practices (AHRMPs) has emerged in OA literature (Vázquez- Bustelo et al., 2007). AHRMPs concept applies the *agility methodology* to the HRM functions (Rogiers, Viaene, & Leysen, 2020), which enables the vertical and horizontal fit of the HRM strategies (Ambituuni, Azizsafaei, & Keegan, 2021), enhances employee capabilities and experiences (Alzoubi, Elrehail, Hanaysha, Al-Gasaymeh, & Al-Adaileh, 2022) and creates value and sustainable competitive advantage for an organization operating in turbulent environment (Karman, 2019).

Studies on AHRMPs often base their theoretical framework on main assumptions of the *Resource Dependency Theory* (RDT) (Hillman et al., 2009). RDT-based literature assumes that an organization is dependent on contingencies in the external environment, which threaten its success (Lu, Wu, Goh, & De Souza, 2019). Hence, poor organization performance is a result of the misalignment of organizational behavior with the environment (Jermsittiparsert, Sutduean, Sriyakul, & Khumboon, 2019). In this context, RDT scholars gave more emphasis on characteristics of the Human and social capital and how managers should act effectively to reduce the resources dependencies and uncertainty of external environment through engaging in intra-organizational and inter-organizational relationships (Hillman et al., 2009). The recent empirical research suggested a bundle of agile HRM practices including flexible selection process (Kavitha & Suresh, 2021); agile training need plan (Hammouri et al., 2023); competencies-based performance management and continuous talent review (Harsch & Festing, 2020); organic remuneration system with multiple components (Vázquez- Bustelo et al., 2007); and cross-functional team building (Junita, 2021). The suggested AHRMPs enable creating qualified, highly motivated, T-shaped skills, teamwork oriented workforce, and aligned with an organization HRM and business strategy (Ambituuni et al., 2021; Hammouri et al., 2023). This study adopts dimensions of the AHRMPs suggested by Vázquez-Bustelo et al. (2007) (i.e.: agile teamwork, agile motivation and incentive plan, organic remuneration system, and agile training needs plan).

2.5: AHRMPs, ACs and ADs interdependencies:

OA scholars addressing AHRMPs emphasize the central role that HR professionals play in realizing, shaping and improving people agile competences (ACs) that enables agile organizations to cope with environmental challenges (ADs) (Harsch & Festing, 2020; Agarwal, 2021; Ajgaonkar et al., 2022). In this context, Ajgaonkar et al. (2022)

conducted semi-structured interviews with senior IT professionals and managing directors to examine the relationship between AHRMPs and the workforce competencies in agile organizations. The findings demonstrate that agile HR strategy integrating internal and external resources enables employees to acquire three dynamic capabilities of sensing", "seizing", and "continual renewal". In the same line, Karman (2019) demonstrated a significant positive, strong relationship between the AHRMPs (i.e.: flexible work arrangements; cross-functional training; skill development programs) and employees' agility capabilities (i.e.: adaptability and responsiveness). Likewise, Saha et al. (2017) highlight the central role of HR professionals in sustaining the competitive advantage of organizations operating in a dynamic environment. They demonstrated the crucial impact of HR practices of educating employees about the importance of recognizing and understanding different needs of stakeholders. In the same context, Vanichchinchai (2012) examined the effect of the HRM practices (i.e.: employee involvement and partnership management) on the firm's supply chain agile capabilities (i.e.: cost, flexibility, relationship and responsiveness). The findings revealed that employee involvement and partnership management have significant positive direct effect on ACs. Another study by Kavitha & Suresh (2021) pointed out that human resource is an important enabler of agile culture and in turn agile organization.

In summary, current OA literature linking AD variability with the need for AHRMPs and ACs modifications suggests the following hypotheses.

$\boldsymbol{H_2}$: A significant positive relationship exists between changes in ADs' components and AHRMPs

$H_{2.a}$: A significant positive relationship exists between customer requirement and AHRMPs

$H_{2.b}$: A significant positive relationship exists between competition and AHRMPs.

$H_{2.c}$: A significant positive relationship exists between technology and AHRMPs

$H_{2.d}$: A significant positive relationship exists between social factors and AHRMPs

$\boldsymbol{H_3}$: A significant positive relationship exists between AHRMPs and the required ACs modifications.

Previous OA studies have primarily examined the direct relationships among AHRMPs, ACs, and ADs, often focusing on these relationships independently or in pairs. In this study, AHRMPs are considered a function of ACs, ultimately enhancing responses to ADs. Therefore, this study treats ADs as an independent construct, hypothesizing that AHRMPs serve as a mediator. This approach aims to examine how organizations empower employees to recognize and respond swiftly and effectively to ADs by developing AHRMPs. Based on this, the following hypotheses are proposed.

$\boldsymbol{H_4}$: AHRMPs (as mediators) affect the relationship between changes in AD's components and the required ACs modifications.

$H_{4.a}$: AHRMPs affect the relationship between customer requirement and ACs.

$H_{4.b}$: AHRMPs affect the relationship between competition and ACs.

$H_{4.c}$: AHRMPs affect the relationship between technology and ACs.

$H_{4.d}$: AHRMPs affect the relationship between social factors and ACs.

Referring to Figure (1), continuous changes in agility drivers' components-namely customer requirements, technology, competition, and social factors-necessitate immediate adaptations in workers' agility capabilities of: flexibility, relationship management, responsiveness, and

service. However, enhancing these capabilities requires agile HRM practices, including an agile training needs plan, cross-functional team building, an agile incentive plan, and an organic remuneration system with multiple components. These practices equip workers with the competencies necessary to respond swiftly and effectively to rapid changes in environmental drivers.

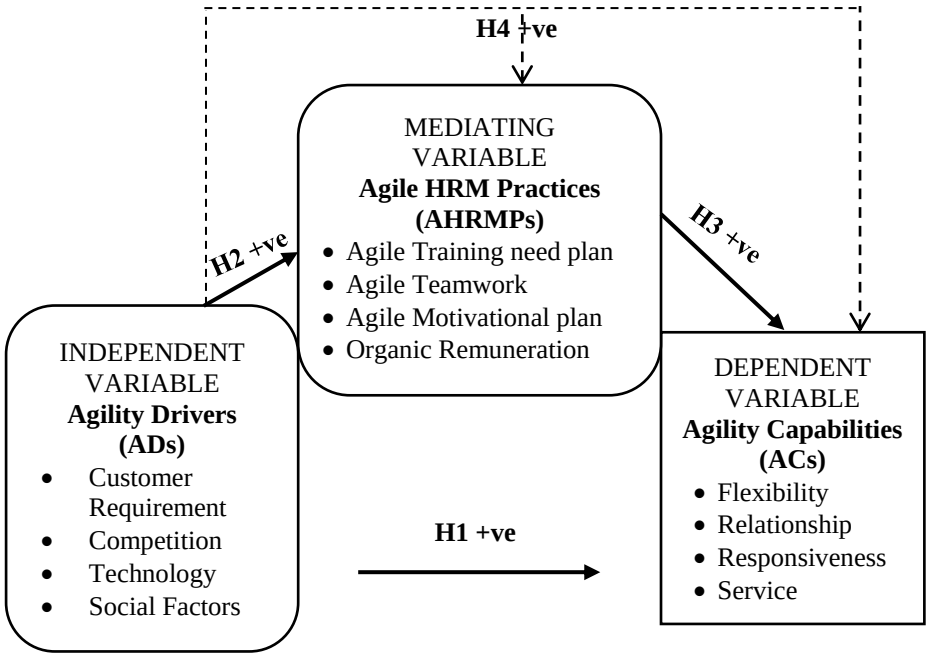

Figure 1: The Hypothesized Framework
Source: *created by authors*

3. Research Methodology:

3.1: Research Population:

This study focuses on crude steel production in Egypt. As noted by worldsteel (2023a), steel is a vital product that underpins the modern world, with substantial economic and social impacts. Every ($1) invested

in the steel industry contributes ($2.5) to steel-dependent sectors, such as construction, automotive, and machinery. Additionally, each job created in steel manufacturing generates (6.5) jobs in related industries (worldsteel, 2023a, b). However, steelmakers operate within a highly dynamic environment, interacting with equipment manufacturers, raw material and energy providers, financial institutions, and climate governance bodies. Steel production alone accounts for (9%) of global CO_2 emissions (Gajdzik & Wolniak, 2021; worldsteel, 2023a, b). Therefore, building an *agile steel companies* that response urgently and effectively to ever-changing in the stakeholders' demand has been considers one of world-steel's key focus areas, and one which the present research takes the opportunity to address (De Smet et al., 2020; worldsteel, 2023b).

Egypt ranks among the world's top (20) crude steel producers, first in Africa and second in the MENA region (worldsteel, 2023a). The Egyptian steel industry directly employs over (50,000) workers, with an additional (150,000) in steel-related industries. Producing (15.6) million tons annually—equating to (36%) of African and (26%) of Arab steel production—Egypt's steel industry contributed (1.6%) to the nation's GDP in FY 2022/23, supported by a total investment of (100) billion EGP (World Bank, 2022). This study focuses on Suez Steel Companies (SSCs), established in 1997 and owned by the National Service Products Organization (NSPO), a military institution. SSCs, one of Egypt's "big four" steel producers, supplies (23%) of the country's steel and employs (3,113) regular employees, producing (2) million tons of crude steel annually (OECD, 2024). Based on this, the study's objective is to identify the agile HRM practices adopted by leading Egyptian steel manufacturers, which enable workers to swiftly adapt to current environmental challenges.

The study population comprises (3,113) regular employees at SSC, including both managerial and non-managerial roles across five non-operational departments (human resources, finance, marketing & sales, security, and administrative affairs), four operational departments (rolling mill plant, steel melting plant, direct reduction plant, and non-core plant), and six operations-support departments (technical office/civil, automation reliability & planning, logistics/inbound, HSE & quality, and warehousing & operations planning) (see Figure 2). SSC workforce includes (190) managerial positions: 11 heads of departments, (29) division chiefs, (71) section heads, (4) plant directors, (17) production line managers, and (58) workshop supervisors. Additionally, there are (2,923) non-managerial roles comprising (296) foremen, (1,890) technicians, (336) engineers and chemists, (89) security personnel, and (312) administrative staff. Both managerial and non-managerial positions are distributed across the (15) departments shown in Figure (2).

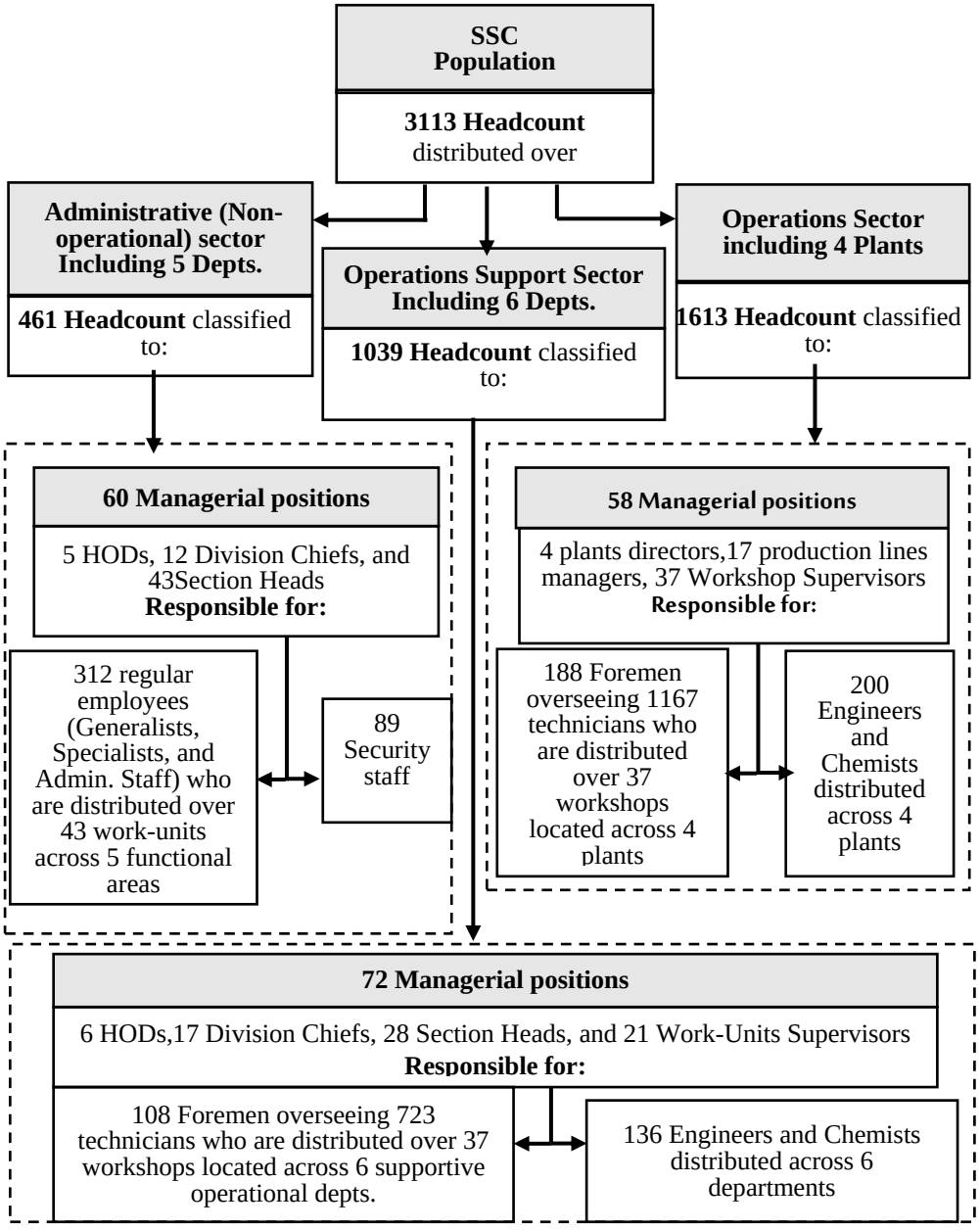
SSC Population
3113 Headcount distributed over
Administrative (Non-operational) sector Including 5 Depts.
461 Headcount classified to:
Operations Support Sector Including 6 Depts.
1039 Headcount classified to:
Operations Sector including 4 Plants
1613 Headcount classified to:
60 Managerial positions
5 HODs, 12 Division Chiefs, and 43Section Heads
Responsible for:
312 regular employees (Generalists, Specialists, and Admin. Staff) who are distributed over 43 work-units across 5 functional areas
89 Security staff
58 Managerial positions
4 plants directors,17 production lines managers, 37 Workshop Supervisors
Responsible for:
188 Foremen overseeing 1167 technicians who are distributed over 37 workshops located across 4 plants
200 Engineers and Chemists distributed across 4 plants
72 Managerial positions
6 HODs,17 Division Chiefs, 28 Section Heads, and 21 Work-Units Supervisors
Responsible for:
108 Foremen overseeing 723 technicians who are distributed over 37 workshops located across 6 supportive operational depts.
136 Engineers and Chemists distributed across 6 departments

Figure 2: Distribution of SSC managerial and non-managerial staff across SSC functional areas

Source: Created by authors

3.2: Sampling methods and data collection techniques:

This study employs multiple data collection methods to offer a comprehensive view of SSC's agility practices, particularly examining how agile HRM practices enhance workers' agility to respond swiftly to unexpected environmental changes (Fàbregues, Hong, Escalante-Barrios, Guetterman, Meneses, & Fetters, 2020; Samuelsen, Chen, & Wasson, 2019). A mixed-methods approach was adopted, incorporating a cross-sectional survey of (346) SSC employees, alongside semi-structured interviews with (27) SSC key managers Noble & Heale, 2019; Fabregues et al., 2020). The study *utilized disproportionate stratified random sampling* (Berndt, 2020). A sample of (346) SSC workers was randomly selected across 15 departments, calculated for a population of 3,113 at a 33% population proportion and a (97%) confidence level (Berndt, 2020). After removing incomplete responses, we obtained a usable sample of 288, resulting in an (83%) response rate. Table 1 details the sample distribution within SSC's population. The survey was conducted on June 2023 during employee break times to capture insights into SSC's business environment, HRM practices, and worker competencies, taking approximately (15) minutes to complete. For sample selection, a *circular systematic sampling technique* was used, allowing each SSC worker from diverse workgroups an equal probability of inclusion (Mostafa & Ahmed, 2018; Subramani, Gupta, & Prabavathy, 2014). Serial codes were assigned to SSC workers across nine workgroups to aid data synthesis and analysis. The first sample unit was selected randomly, with subsequent units chosen systematically according to a predetermined interval (see Figure (2) for workgroups classifications).

SSC Population																	
Administrative /Non-Operational Sector (5 Departments)																	
Dept. Title / Job Title	Human Resources			Finance			Marketing & Sales			Administrative Affairs			Security			Total		
	P	**%**	**S**	**P**	**%**	**S**	**P**	**%**	**S**	**P**	**%**	**S**	**P**	**%**	**S**	**P**	**S**	**R #%**
***Managerial positions**	08	0.3	01	16	0.5	02	17	0.55	02	06	0.2	01	13	0.4	02	60	08	87% 07
****Non-managerial positions**	84	2.7	09	43	1.4	05	77	2.5	08	108	3.5	12	89	2.9	10	401	44	86% 38
Total	92	3	10	59	02	07	94	03	10	114	3.5	13	102	3.3	12	461	52	87% 45

Table 1: Sample Distribution over SSC population

Operations Sector (4 Plants)																				
Dept. Title / Job Title	Technical office/civil			IT; Automation; Reliability & planning			Centralized Services			Logistics /inbound			HSE & Quality			Warehouses & Operations Planning			Total		
	P	**%**	**S**	**P**	**%**	**S**	**P**	**%**	**S**	**P**	**%**	**S**	**P**	**%**	**S**	**P**	**%**	**S**	**P**	**S**	**R # %**
***Managerial positions**	07	0.2	1	03	0.1	1	22	0.7	03	08	0.3	01	09	0.3	01	23	0.7	03	72	10	80% 08
****Non-managerial positions**	26	0.8	3	48	1.5	5	362	12	40	207	6.6	23	186	06	20	138	4.4	15	967	106	84% 89
Total	33	01	4	51	1.6	6	384	12	43	215	07	24	195	6.3	21	161	5.2	18	1039	116	84% 97

Operations Support Sector (6 Departments)															
Dept. Title / Job Title	Non-Core Plants			Direct Reduction Plants (DRPs)			Rolling Mill Plants (RMPs)			Steel Melting Plants (SMPs)			Total		
	P	**%**	**S**	**P**	**%**	**S**	**P**	**%**	**S**	**P**	**%**	**S**	**P**	**S**	**R #%**
***Managerial positions**	02	0.1	01	16	0.5	02	16	0.5	02	24	0.8	03	58	08	87% 07
****Non-managerial positions**	67	02	07	239	7.7	26	657	21	72	592	19	65	1555	170	82% 139
Total	69	2.2	08	255	8.2	28	673	22	74	616	20	68	1613	178	82% 146
												Grand Total	**3113**	**346**	**83 %** **288**

Source: SSC HRM report, June 2023

P. stands for "Population size"; **S**. stands for "Sample size"; and R#% stands for "Response units and percentage".

****Managerial Positions are Heads of Departments; Managing directors; Section Heads; Division chiefs; Work-units' supervisors and foremen.

***Non-Managerial Positons are Engineers, Chemists, Technicians, and Regular Employees.

Additionally, Data from semi-structured interviews, conducted in June 2023 on-site with a sample of (27) key managerial positions selected from SSC's departments using the same sample size calculation and confidence level (Berndt, 2020). *Purposive sampling* method ensured data quality by targeting knowledgeable experts (Ames, Glenton, &

Lewin, 2019). Data from semi-structured interviews provided managers' insights into how agile HRM practices foster workers' agility in responding to sudden environmental changes (Noble & Heale, 2019). Each interview lasted (30–40) minutes, focusing on specific aspects of agility within SSC (see Table 2).

Table 2: Interviewees sample distribution over SSC population

Managerial tile	Population	Sample	Org. Unit title
Head of Departments	11	3	▪ Human resources Dept. ▪ Marketing & sales Dept. ▪ IT-Automation-Relaibility & planning Dept.
Division chiefs	29	5	▪ Customer service Division ▪ Warehousing & Operations Division ▪ Logistics / inbound Division ▪ Employees Relations Division ▪ R&D Divisoin
Section Heads	71	8	▪ Recrutment Planning.Section ▪ Learning & Capability Development Section ▪ Talent and People Capability Section ▪ Compensation & Benefits Section ▪ Financial Planning & Budgeting Section ▪ Product Engineering Section ▪ Internal communication & employee engagement Section ▪ Technical Office/Civil Section
Plants Directors & Production Lines Managers	21	4	▪ Steel melting Plants SMPs ▪ Roling Mill Plants RMPs ▪ Direct Reduction Plants DRP. ▪ Non-Core Plants
Work-unit Supervisors	58	7	▪ Customer Support Unit ▪ Security Unit ▪ Products & Services development Unit ▪ Digital Operation Unit ▪ Big Data Unit ▪ Digital Innovation Unit ▪ HSE & Quality Unit
	190	27	

Source: SSC, HR department

3.3: Research variables and measurement instruments:

Agility Drivers (ADs) (independent variable): According to Ebrahimpour et al. (2012), ADs are the pressures arose from the surrounding environmental changes that would threaten the performance and the competitive advantage of the organizations. The present study addresses both internal and external environmental factors through adopting the ADs' measurement developed by Zhang (2011), which includes the four dimensions of: changes in customers' requirements (6 items); technology (3 items); competition (6 items); and social factors (5 items). The questionnaire measures the degree of change (uncertainty) in SSC internal and external business environments using a five-point Likert scale ranging from (1) (strongly disagree) to (5) (strongly agree). Referring to Zhang (2011), the Cronbach's alpha value for the entire ADs' index was (0.903).

Agile HRM practices (AHRMPs) (intervening variable): According to Junita (2021), AHRMPs refer to an integrated system of HRM policies and practices that adapt to changing in business environment while building a strategic competencies matrix and ensure the availability of agile workforce. AHRMPs measurement instrument is developed based on the research of Vázquez- Bustelo et al. (2007). They suggested the five agile HRM practices of: agile teamwork (3 items); agile motivation & incentive plan (2 items); organic remuneration system (3 items); and agile training needs plan (3 items). The questionnaire measures the degree to which agility methodology is applied to the HRM functions within the SSC using a five-point Likert scale ranging from (1) (strongly disagree) to (5) (strongly agree). Referring to Vázquez- Bustelo et al. (2007), the Cronbach's alpha value for the AHRMPs measurement instrument was over (0.7).

Agility capabilities (ACs) (dependent variable): ACs are defined as the "organizational characteristics which should be created in order to develop the ability of the organization to respond to the changeable situations rapidly" (Arsawan et al., 2022, P.1). The present study adopts the four agile capabilities dimensions suggested by Vanichchinchai (2012), which consist of: responsiveness (4 items); flexibility (3 items); relationship (4 items); and service (4 items). The questionnaire measures the existence of certain competences that provide SSC with the capacity to respond swiftly and properly to the environmental challenges using a five-point Likert scale ranging from (1) (strongly disagree) to (5) (strongly agree). Referring to Vanichchinchai, (2012), the Cronbach's alpha value for the agile capabilities' measurement instrument was (0.823).

4. Presentation and analysis of the result

4.1: Procedural and statistical remedies:

To enhance the rigor of the research and avoid potential biases, the partial least square (PLS) structural equation modeling (SEM) technique has been used to analyze the hypothesized model (Hair et al., 2019), alongside procedural and statistical remedies that deal with missing values and the psychometric properties of the subscales, in addition to examining common method biasness (Fornell & Larcker, 1981; Bagozzi, Yi, & Phillips, 1991). Smart-PLS 3.0 were used to analyze collected data and test research hypotheses. Nevertheless, the *deductive thematic analysis* technique has been employed to analyze the qualitative data collected from the SSC key positions (Braun & Clarke, 2020). Referring to the four stages of the thematic analysis proposed by (Mackieson, Shlonsky, & Connolly, 2018; Braun & Clarke, 2020), in *stage one*, assumed names were given for the carefully selected (27) SSC key positions who are classified into (5) groups (see table 2). In *stage two*, the semi-structured interview transcript was developed. The transcript

includes well-written questions that emphasize research questions and hypotheses. Transcripts extracted from audio recordings of interviews were used to support the process the data collection. In *stage three*, the ideas of the interviewees were coded and listed in a structured codebook, arranging it into main themes for a more rigorous analysis. Table (3) shows codes and sub-codes of the thematic qualitative analysis. In the final stage, agreed initiatives, which helps in developing a preliminary conclusion of the interviewees' viewpoints were identified.

Table 3: Codes and sub-codes of thematic qualitative analysis

Variables	Codes	Sub-codes
ADs	Customer Requirements	▪ Ever-Changes in Consumers' expectations ▪ Product quality ▪ Products innovation ▪ Suden change in order quantity and specifications
	Competition	▪ Degree of Products substitutions ▪ New competitve advantage ▪ Changes in competitors palns and strategies
	Technology	▪ Flexible IT infrastructure ▪ Introduction of new technology
	Social Factors	▪ Environmental pressures ▪ Environmental Performance and business collaborations ▪ changes in social Factors
AHRMPs	Agile Training	▪ Training assessment (on the job - self-development) ▪ Acquire new skills and know-how
	Teamwork	▪ Relationship building ▪ Cross-functional team building
	Motivation	▪ Competencies based performance management ▪ Continuous talent review ▪ Personal opinions encouragemen
	Remuneration system	▪ Rewards and incentives ▪ Extrensic and intrensic reward-based systems
ACs	Flexibility	▪ Adaptation to environmental changes ▪ Stabilize operation processes ▪ Carry out different work with the same facilities
	Relationship	▪ intra-organizational relationships among org. units ▪ inter-organizational relationships with partners
	Responsiveness	▪ Reactiveness ▪ Proactiveness
	Service	▪ New methods to market service ▪ New ways for customer satisfaction ▪ New ways for service promotion ▪ Customer relationship maintenance/sustainability

Source: created by the authors

4.2: Measurement Assessment:

This section presents the purification of the research constructs. The CFA test vis AMOS was elaborated in order to confirm the results obtained from EFA via SPSS. As, EFA output indicates that, the scores of KMO for the constructs range between 0.851 to 0.933 which are perfect scores at Bartlett of sphericity < 0.001 (Bartlett, 1954 and Kaiser, 1974) (Table 4). Further, all score for cumulative variance for eigenvalue of the constructs are > 60% which are acceptable (Hair, Risher, Sarstedt, & Ringle, 2019). Moreover, the average communalities for sample size > 250 is acceptable to be ≥ 0.6 (see table 4). Referring to the CFA results (Table 5); all factor loadings are significant and their values > 0.5, and all t values > 1.645. As, all constructs were found to have AVE values that > 0.5 (Fornell & Larcker,1981; Hair et al., 2019). Thus, based on EFA results and CFA results, the convergent validity for the research constructs is retained.

Table 4: CFA Results & Measurements Estimate

Items	Ads				AHRMPs				ACs				AVE		SD	t-test	P-value
	CR	CP	T	S	M	TW	OR	TR	F	R	RS	SV					
A1	0.58												0.61	0.63	0.112	3.010	0.003**
A2	0.53														0.194	2.665	0.008**
A3	0.68														0.218	2.806	0.005**
A4	0.66														0.212	2.836	0.005**
A5	0.62														0.244	2.524	0.012*
A6	0.68														0.211	3.266	0.001**
A7		0.64												0.64	0.157	3.947	0.000***
A8		0.67													0.146	4.408	0.000***
A9		0.70													0.135	4.953	0.000***
A10		0.64													0.142	4.486	0.000***
A11		0.55													0.176	1.976	0.017*
A12		0.66													0.222	2.982	0.002**
A13			0.59											0.61	0.158	3.241	0.001**
A14			0.64												0.181	3.046	0.002**
A15			0.59												0.168	3.737	0.000***
A16				0.56										0.58	0.171	2.819	0.005**
A17				0.54											0.136	4.368	0.000***
A18				0.60											0.181	2.172	0.030*
A19				0.53											0.160	3.499	0.001**
A20				0.67											0.201	2.160	0.031*
B1					0.74								0.75	0.74	0.062	11.673	0.000***
B2					0.74										0.049	14.957	0.000***
B3						0.74								0.73	0.060	12.456	0.000***
B4						0.75									0.059	12.585	0.000***
B5						0.70									0.075	9.052	0.000***
B6							0.75							0.75	0.063	12.132	0.000***
B7							0.80								0.064	12.526	0.000***
B8							0.79								0.071	11.357	0.000***
B9								0.71						0.74	0.066	10.657	0.000***
B10								0.74							0.063	11.796	0.000***
B11								0.75							0.064	12.000	0.000***
C1									0.71					0.71	0.048	14.632	0.000***
C2									0.73						0.049	15.032	0.000***
C3									0.69						0.048	14.208	0.000***
C4										0.53					0.059	9.050	0.000***
C5										0.70					0.042	16.720	0.000***

C6										0.68			0.72	0.66	0.044	15.597	0.000***
C7										0.72					0.036	20.719	0.000***
C8											0.79			0.73	0.030	26.513	0.000***
C9											0.80				0.028	28.478	0.000***
C10											0.58				0.071	8.015	0.000***
C11											0.74				0.038	19.236	0.000***
C12												0.74		0.75	0.041	18.159	0.000***
C13												0.77			0.038	20.340	0.000***
C14												0.78			0.039	19.490	0.000***
C15												0.74			0.044	16.104	0.000***
Mean	**ADs**				**AHRMPs**				**ACs**								
	4.08				3.48				3.98								
	4.02	4.02	4.22	3.86	3.48	3.77	3.36	3.43	4.07	3.77	4.11	3.96					
CA	**ADs**				**AHRMPs**				**ACs**								
	0.869				0.921				0.931								
	0.81	0.70	0.75	0.75	0.78	0.76	0.84	0.79	0.82	0.78	0.82	0.85					
rho-A	0.932				0.875				0.942								
CA	0.933				0.888				0.940								
SD	0.103				0.086				0.01								
t-test	8.509				10.846				94.491								
Sig.	0.000***				0.000***				0.000***								
KMO	0.851				0.930				0.933								
artlett	0.000***				0.000***				0.000***								
EV %	62.501%				65.354%				75.354%								
Com.%	60.93%				63.02%				79.37%								

* Significant at p < 0.05
** Significant at p < 0.01
*** Significant at p < 0.001

Note: ADs= Agile Drivers, AHRMPs= Agile Human Resources Management Practices, ACs=Agile Competencies, CR=customer requirements, CP=competition, T= technology. S= social factors, M= motivation, TW= teamwork. OR=organic remuneration system, TR= training. F=flexibility, R= relationship, RS=responsiveness, SV- services. Factor Analysis- - SPSS & Bootstrapping- 500 subsamples via SEM-Smart-PLS, AVE= average variance extracted, CA= Cronbach's alpha, CR= Composite Reliability, S.D.= standard deviation. t-value is significant at 1.96, EV%= Eigenvalue cumulative variation %, Com. %= Communalities %.

Regarding discriminant validity, the researchers relied on Fornell & Larcker (1981) criterion. Thus, based on the results shown in Table (5), discriminant validity is established. Additionally, SEM via Smart-PLS 0.3 was run in order to test the constructs` reliability. Hence Composite reliability (CR), Cronbach` alpha (CA), and rho-A were calculated. The results show that all scores of the main research constructs are > 0.7 (Hair et al., 2019), which indicates that, the reliability of the research constructs in this model are retained.

Table 5: Fornell-Larcker Criterion

	Ads	AHRMPs	ACs
ADs	**0.777**	-	-
AHRMPs	0.577	**0.748**	-
ACs	0.543	0.016	**0.716**

Source: Created by authors based on Fornell-Larcker Criterion

4.3: The Goodness of the Model Fit & Testing Hypotheses :

This section demonstrates the results extracted from the software Smart-PLS 3.0. relying on the PLS method, (500) resamples-bootstrapping approach. Specifically, the study employed structural equation modeling to examine the hypothetical framework, considering the model fit criteria (Table 6). Hence, the SEM outputs of the path analysis model for both the main constructs and the research sub-hypotheses are compared to the cut-offs criteria (see Figures 3&4)

Table 6: The Goodness of the Model Fit Criteria

Indices	Interpretation	Recommended Criteria	Sources
Average Variance Extracted (AVE)	Convergent Validity	AVE > 0.50	Henseler (2017)
Criteria of Fornell & Larcker	Discriminant Validity	The square roots of the AVEs > the constructs correlations	Fornell & Larcker (1981)
Cronbach` alpha (CA) & Composite Reliability (CR)	Model Reliability	AC > 0.70 CC > 0.70	Hair et al. (2019)
t- test	Assess the significances of the regression & the correlations	t > 1.96	
Evaluation of the coefficients of Pearson's determination (R^2)	% of variance in the dependent explained by the independent	2% = small effect 13% = moderate effect 26% = large effect.	Cohen (1988)
Size of the effect or Cohen's Indicator (f^2)	Assess how much each variable is useful to the model.	0.02= small 0.15= moderate 0.35= large	Cohen (1988); Hair (2019); Sarstedt, Ringle, & Hair, (2021)
Stone-Geisser indicator- Predictive Validity (Q^2)	Assess the model accuracy	$Q^2 > 0$	
Path Coefficient	Assess the causal relations	Based on theory	
RMESA	Root Mean Square Error of Approximation	< 0.05 Good Fit < 0.08 Acceptable Fit	

Source: Ringle et al. (2015)

Table (7) and Figure (3) show that the values of the path coefficients for SEM- path model, are 0.737, 0.760 and 0.127, which indicate weak to strong values at p- values < 0.001, and t-test values > 1.96, that indicate significant relationships (Hair, et al., 2019). Based on Stone–Geisser (Q^2) indicators, the results show that all Q^2 scores are > 0, indicating accuracy and quality of the model (Hair, 2019). Furthermore,

regarding Cohen indicators (f^2), the values of f^2 are: 0.055,0.593, and 0.393, indicating small, large, and large effects, respectively (Hair, 2019). Finally, the value of SRMR < 0.08 which is acceptable. Accordingly, the results of the SEM- PLS indicate a highly satisfactory model.

Table 7: Goodness of Model Fit Indicators SEM- SmartPLS

H	Structure path	Path coefficient	R^2	Sig.	SD	t-test	Q^2	f^2	Decision	Model fit
Total Effect										
H1+	ADs >ACs	0.737	0.702	0.000***	0.052	14.082	0.467	0.055	Accepted	Good fit
H2+	ADs >AHRMPs	0.760	0.577	0.000***	0.023	32.713	0.187	0.593	Accepted	
H3+	AHRMPs >ACs	0.127	-	0.031*	0.059	2.161		0.393	Accepted	
Specific Indirect Effects										
H4+	ADs>AHRMPs>ACs	0.096	-	0.030*	0.044	2.178	-	-	Accepted	
SRMR		0.07 < 0.08								

t value is significant at 1.96, * Significant at p < 0.05, ** Significant at p < 0.01, *** Significant at p < 0.00, SRMR < 0.08

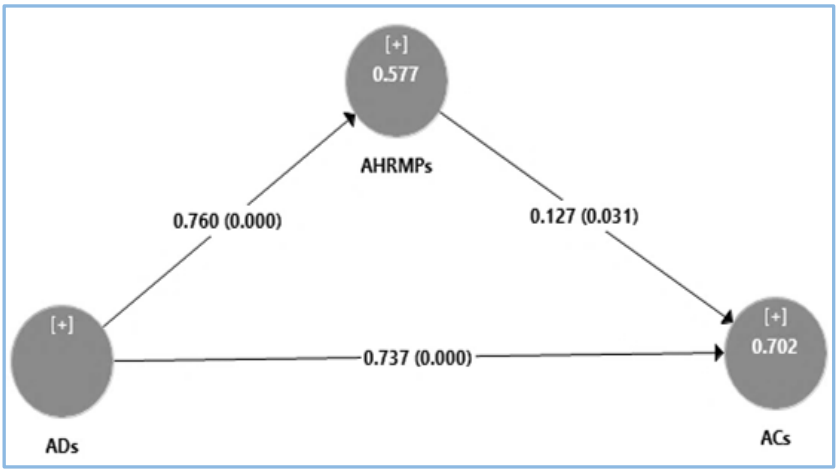

Figure 3: Path coefficients model (the main constructs).

Source: Created by authors

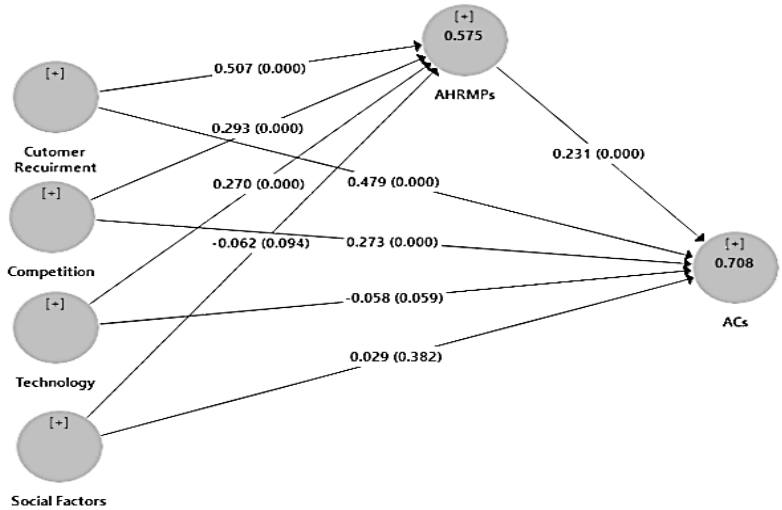

Figure 4: Path coefficients model (Sub-Hypotheses).

Sources: Created by authors.

In the same line, the SEM findings show high R^2 scores. Referring to figure (4), ADs explain 57.5% of the variance in AHRMPs. Furthermore, ADs explain 70.8 % of the variance in ACs via AHRMPs. Thus, ADs (in terms of customer requirement and competition) are *direct* predictors of changes in workers' agile capabilities. however, technology and social factors have *no-direct* effect on changes in workers' agile capabilities. Moreover, ADs affect AHRMPs in terms of (customer requirement, competition and technology), however, social factors have no effect on AHRMPs. Accordingly, the findings support the main hypotheses H1, H2 & H3, however, the sub-hypotheses $H1_c$, $H1_d$, $H2_d$, and $H4_d$ are rejected (See Figures 4 & Table 8).

Table 8: Structural Model Assessments- (PLS-SEM)

H	Structure path	Path coefficient	SD	t-test	P-value	Adj. R^2	Decision
H1	**ADs > ACs**	**0.737**	**0.052**	**14.082**	**0.000*** **		**Accepted**
$H1_a$	**Customer Recruitment > ACs**	**0.479**	**0.063**	**7.642**	**0.000*** **		**Accepted**
$H1_b$	**Competition > ACs**	**0.273**	**0.055**	**4.957**	**0.000*** **		**Accepted**
$H1_c$	**Technology > ACs**	**-0.058**	**0.031**	**1.896**	**0.059**		**Rejected**
$H1_d$	**Social Factors > ACs**	**0.029**	**0.033**	**0.875**	**0.382**		**Rejected**
H2	**ADs > AHRMPs**	**0.760**	**0.023**	**32.713**	**0.000*** **		**Accepted**
$H2_a$	**Customer Recruitment > AHRMPs**	**0.507**	**0.053**	**9.518**	**0.000*** **		**Accepted**
$H2_b$	**Competition > AHRMPs**	**0.293**	**0.054**	**5.467**	**0.000*** **	**0.575**	**Accepted**
$H2_c$	**Technology > AHRMPs**	**0.270**	**0.037**	**7.382**	**0.000*** **		**Accepted**
$H2_d$	**Social Factors > AHRMPs**	**-0.062**	**0.037**	**1.677**	**0.094**		**Rejected**
H3	**AHRMPs > ACs**	**0.231**	**0.059**	**3.901**	**0.000*** **		**Accepted**
H4	**ADs > AHRMPs > ACs**	**0.096**	**0.044**	**2.178**	**0.000*** **		**Accepted**
$H4_a$	**Customer Recruitment > AHRMPs > ACs**	**0.117**	**0.031**	**3.728**	**0.000*** **		**Accepted**
$H4_b$	**Competition > AHRMPs > ACs**	**0.068**	**0.023**	**2.932**	**0.004** **	**0.708**	**Accepted**
$H4_c$	**Technology > AHRMPs > ACs**	**0.062**	**0.017**	**3.633**	**0.000*** **		**Accepted**
$H4_d$	**Social Factors > AHRMPs > ACs**	**-0.014**	**0.010**	**1.467**	**0.143**		**Rejected**

t value is significant at 1.96, * Significant at $p < 0.05$, ** Significant at $p < 0.01$, *** Significant at $p < 0.00$

Concerning the fourth hypothesis (H4) related the indirect effect of ADs on ACs via AHRMPs, the findings in Table (9) and figures (3 and 4), reveal that ADs (in terms of customer requirement, competition, and technology) indirectly influence ACs via AHRMPs at p- value < 0.001, however, social factors have neither direct nor indirect effect on ACs.

Table 9: The Mediating Effect of AHRMPs

H4, H4a, H4b, H4c, H4d	Total effect (direct +indirect)		Direct effect		Indirect effect via AHRMPs		Type of mediation
	Path coef.	*P* value	Path coef.	*P* value	Path coef.	*P* value	
ADs >AHRMPs >ACs	0.833	0.000	0.733	0.000***	0.096	0.000***	Partial mediation
Customer Recruitment >AHRMPs >ACs	0.596	0.000	0.479	0.000***	0.117	0.000***	Partial mediation
Competition >AHRMPs >ACs	0.340	0.000	0.273	0.000***	0.068	0.004**	Partial mediation
Technology >AHRMPs >ACs	0.004	0.892	-0.058	0.059	0.062	0.000***	Full mediation
Social Factors >AHRMPs >ACs	0.014	0.662	0.029	0.382	-0.014	0.143	No mediation

* Significant at $p < 0.05$, ** Significant at $p < 0.01$, *** Significant at $p < 0.001$

Referring to the findings in table (9), the whole AHRMPs construct is partially mediating the linkage between ADs and ACs (Baron & Kenny, 1986). It indicates that a portion of the impact of ADs on ACs is mediated by AHRMPs, while ADs still explain a portion of ACs. Furthermore, the direct effect (0.479) and indirect effect (0.117) of customer requirement on ACs are significant at p- value < 0.001. Moreover, the direct effect (0.273) and indirect effect (0.068) of competition on ACs are significant at p- value < 0.001. Thus, AHRMPs

partially mediate the customer requirement–ACs relationship, and the competition–ACs relationship. However, the direct effect (-0.058) of technology on ACs is not significant at p- value > 0.05, while the indirect effect (0.062) of technology on ACs is significant via AHRMPs at p-value < 0.001. Thus, AHRMPs fully mediate the effect of technology (as a dimension of ADs) on ACs. This demonstrates that technology only influences ACs via the existence of AHRMPs. Accordingly, hypothesis four is supported, however the fourth sub-hypotheses are partially accepted.

5. Discussion

5.1: Reflection on outcomes:

The findings indicate that changes in customer requirements and competition significantly influence the necessary modifications in workers' ACs, aligning with the findings obtained by Auh & Menguc (2005), Lee & Yang (2014), Roberts & Grover (2012), and Karhapää, Behutiye, Rodríguez, Oivo, Costal, Franch, & Abherve, (2021). In this context, Auh & Menguc (2005) demonstrated that agility requires effective responses to competitive changes, necessitating the capability to monitor competitors' actions and swiftly identify opportunities or threats. Similarly, Lee & Yang (2014) identified changes in the competitive environment as a primary driver motivating companies to seek new competitive advantages for differentiation in the marketplace. Furthermore, Roberts & Grover (2012) found that agile organizations, which engage in continuous interaction with customers, significantly enhance their workers' ACs and improve alignment with product/customer needs. Karhapää et al. (2021) also emphasized that linking modifications in workers' ACs to changes in consumer requirements facilitates prompt responses to customer feedback.

Nevertheless, the current research demonstrated that ADs related to changes in social factors dimensions (i.e.: social performance and environmental performance) don't explain changes in workers' ACs. This result is in line with the findings obtained by Porter & Kramer (2006), who prove that firms engage intensively in corporate social responsibilities (CSR) activities (social performance) prefer to achieve ethical objectives and long-term sustainability over responsiveness and flexibility. In the same context, Fernando & Saththasivam (2017) indicate that engaging in CSR activities require intensive resources that could be assigned to other drivers that directly improve organizational agility. In terms of the environmental performance, collaboration with key suppliers may cause dependency, or monopoly, which limits the ability of the organization to be flexible and responsiveness, particularly if their key suppliers are rigid toward changes (Williamson, 1985). In this point, Christopher (2000) noted that complex integrations among suppliers contribute to supply chain complexity, hindering organizational agility due to increased communication and coordination demands. Additionally, Cousins, Handfield, Lawson, & Petersen (2008) pointed out that misalignment between organizations and their suppliers negatively impacts the ability to adapt to changes.

The study also found that the AD dimension related to technological changes does not explain the necessary modifications in workers' ACs. Limited literature supports a direct effect of IT capabilities on enhancing workers' ACs (Martín-Martín, Orduna-Malea, Thelwall, & López-Cózar, 2018). This result is aligned by Khan, Atlas, Ali, Ghani, & Khan (2023), who argued that there is no significant, direct effect of the company IT capabilities on its agility by which IT alone doesn't lead to ACs. Likewise, Jabbouri (2016) has pointed out that IT/ACs complex relationship should be investigated indirectly rather than directly. Consequently, the findings confirm the first hypothesis of the

present study, proposing a significant, direct, and positive correlation between ACs and the AD dimensions of customer requirements and competition. However, ADs dimensions of (changes in technology and social factors) are not associated directly with ACs.

From another perspective, the present research demonstrated a significant, positive relationship between ADs dimensions (i.e., customer requirements, competition, and technology) and AHRMPs. This result is consistent with the study of Prapraite (2022), which highlights the impact of understanding customers' feedbacks on enhancing HRMPs related to customer services and sales people ACs. The study also proves that the continuous changes in competition, and technological capabilities force organizations to embrace HRMPs to react swiftly to the potential changes in the market. Here, organizations rely on agile HRMPs to cope with the rapid environmental changes in order to be differentiate themselves from their competitors (Subramanian & Suresh, 2022). Nevertheless, the relationship between ADs dimension of social factors and AHRMPs isn`t supported in the current study. This result is consistent with the findings obtained by (Jensen et al., 2016) who demonstrated that agile HRMPs enable organizations to quickly respond to market demands and internal changes that often make social factors become less relevant. Though social aspects are vital for organizational success, they have minimal reflection on AHRMPs (Motwani & Katatria, 2024). Consequently, the findings proved the present study second hypothesis that proposes a significant, positive relationship between ADs construct (i.e.: customer requirements, competition and technology) and AHRMPs. However, ADs dimension of changes in social factors has not been associated directly with AHRMPs.

Furthermore, the current research proved a significant, positive relationship between AHRMPs and the required modifications in workers' ACs. This result is consistent with the findings obtained by

Harsch & Festing (2020), Agarwal (2021), Ajgaonkar et al. (2022), and Karman (2019). In this context, Ajgaonkar et al. (2022) demonstrated that agile HR strategies enable employees to acquire dynamic capabilities. Agarwal (2021) emphasized the vital role HR professionals play in realizing, shaping, and improving employees' agile competencies, thereby equipping organizations to handle environmental challenges (ADs). Accordingly, the findings support the third hypothesis of the present study, which proposes a significant, positive relationship between AHRMPs and ACs.

Finally, the current research proved the mediating effect of AHRMPs on the relationship between ADs construct (i.e., customer requirement, competition, and technology) and ACs. The findings show that AHRMPs explain the ACs/ADs interdependency by which agile HRM practices equip workers with the ACs needed to react swiftly and efficiently to the rapid changes in ADs. This finding is supported by Motwani & Katatria (2024), who found that AHRMPs enable organizations to quickly respond to market demands and internal changes, often diminishing the relevance of social factors. Additionally, the results show that AHRMPs fully mediate the relationship between IT capabilities and ACs, suggesting that technology influences ACs only through the presence of AHRMPs. This finding aligns with Khan et al. (2023), who argued for the absence of a direct impact of IT on agility. Further, Martín-Martín et al. (2018) noted that empirical evidence demonstrating a significant impact of IT on enhancing agile capabilities is scarce; therefore, IT alone cannot facilitate agility within an organization. Consequently, the findings support the fourth hypothesis of the present study, which proposes the mediating effect of AHRMPs on the relationship between AD constructs (i.e., customer requirements, competition, and technology) and ACs.

5.2: Theoretical and Practical implications:

A growing body of the OA scholars highlights fundamental assumptions of the process theory of change (PTC), which emphasizes the sense-response cycle alongside the Dynamic capabilities theory (DCT), which underscores the organization agility competencies necessary for recognizing, anticipating and swiftly reacting to the environmental changes (Arsawan et al., 2022; Ajgaonkar et al., 2022; Aldhaheri & Ahmad, 2023; Garrido-Vega et al., 2023; Harsch & Festing, 2020; Koçyiğit & Akkaya, 2020; Rafi et al., 2022; Al-Shboul, 2022). However, our understanding of agility methodology—specifically, the best practices leading to agility competencies (ACs)—remains limited (Walter, 2021). Existing OA studies on agility enablers often adopt a narrow focus, emphasizing information technology (Gunasekaran et al., 2018), concurrent engineering and knowledge management (Khatri et al., 2018), customized manufacturing, cross-functional integration, and suppliers relations (Sindhwani & Malhotra, 2017). Yet, there has been insufficient attention to human-related practices (HRM enablers) that significantly impact the development of people capabilities and the design of agile HR functions necessary for achieving successful agility performance (Hammouri, 2023; Pan et al., 2020; Harsch & Festing, 2020; Agarwal, 2021; Kavitha & Suresh, 2021; Ajgaonkar et al., 2022).

From this perspective, this study contributes new insights to the OA literature by developing a novel agility methodology for managing changes in disruptive markets. Thus, Resource Dependency Theory (RDT) is employed to elaborate on how AHRMPs—such as agile training plans, cross-functional team building, agile incentive systems, and organic remuneration structures—enhance ACs (including responsiveness, relationship management, flexibility, and service) in response to unprecedented changes in ADs (i.e., customer requirements, competition, technology, and social factors).

On the practical side, the study emphasizes the critical shift in HR professionals' roles from operational to strategic partners, facilitating the realization and enhancement of agile competencies that enable organizations to adapt to environmental challenges (Harsch & Festing, 2020; Agarwal, 2021; Ajgaonkar et al., 2022). Data collected through a survey were compared with insights gathered from semi-structured interviews conducted with (27) key positions at SSC, leading to the following results.

Regarding SSC's response to changes in ADs (i.e., customer requirements, competition, and technology), the head of the products and services development unit noted that until early 2019, nearly (90%) of SSC's product mix was directed towards local market, while only (10%) was for export. In response to ongoing economic shocks affecting the real estate market in Egypt, SSC adjusted this ratio to (70%) for exports and 30% for the local market. The head of financial planning and budgeting explained that this shift was driven by the continuous devaluation of the Egyptian pound against foreign currencies. The Chief of Warehousing and Operations pointed out that approximately (95%) of materials used in steel manufacturing, including machinery and tools, are imported in foreign currency (primarily US dollars and euros). Consequently, local sales do not cover manufacturing expenses due to high import costs.

The head of marketing and sales noted that the recession in the Egyptian real estate market in 2019 caused an oversupply of residential units, leading to a significant decline in local steel demand. To address these environmental changes, the Chief of Customer Service Division highlighted the immediate need to pursue a horizontal market expansion strategy, shifting SSC's focus toward foreign markets. This resulted in adjustments to the product mix and manufacturing processes. The marketing and sales team, in collaboration with the products and services

development team, developed a new STP plan aimed at attracting customers in Finland, Germany, the U.S., and Scandinavia, generating foreign currency to cover manufacturing expenses and achieve targeted profit margins. According to the head of IT-Automation, Reliability, and Planning, this shift from local to global competition necessitates leveraging information technology to track changes in customer needs and adjust product design and manufacturing processes accordingly. The head of product engineering confirmed that a strategy of product diversification was adopted, leading to significant modifications to SSC's steel mix to meet foreign market specifications. The customer support head and the product engineering section head noted that changing customer requests required adjustments to product technical specifications, including a shift from traditional water cooling to air cooling technology. The Rolling Mill Plant (RMPs) director supported SSC's decision to establish a new rolling mill to keep adopted with technological advancements in the steel industry. The head of HRM acknowledged the challenges of equipping SSC workers with the competencies required for the new factory.

Regarding AHRMPs that support workers' ACs, the head of HRM emphasized the need for fundamental changes in recruitment, talent pooling, and training programs to adapt to changes in customer needs and manufacturing processes. The recruitment and planning section head mentioned the launch of a vocational training program, "Training for Employability" (T4E), in partnership with El-Sewedy Technical Academy (STA) and the German Chamber of Commerce. This program aims to prepare 150 recent university graduates (ages 20-25) for careers in the steel industry. It consists of four months of practical study followed by two months of hands-on training in the factory, concluding with a practical and oral exam. T4E aims to improve job prospects for recent graduates in Egypt's steel sector. The talent and people capability

section head noted that enabling workers to utilize new manufacturing technologies requires vocational training. Consequently, SSC and STA established a three-year vocational diploma program, after which trainees receive certification as steel production technicians. The Learning and Capability Development section head indicated that SSC has prepared three classrooms for 20 trainees each, aiming to graduate 500 to 700 professional steel production technicians by the end of 2025. However, the Chief of Employee Relations raised concerns among senior SSC workers that training opportunities were disproportionately benefiting the children of SSC employees, contradicting the principle of equal opportunity emphasized by the SSC administration. This discrepancy explains the weak relationship between SSC's social performance and workers' adaptive capacities (ACs).

Lastly, regarding long-term alliances with major steel makers and civil society organizations, the head of products & services development and HSE & Quality head unit mentioned that SSC established long-term alliances with big steel makers (i.e., SMS Group, Danieli & Total) to mitigate the monopoly of steel distributors and spare parts suppliers. This necessitates compliance with international quality standards and operating system requirements, including gender equality, disability inclusion, and ethical codes, aligning with the Sustainable Development Goals (SDGs). SSC's social performance is evaluated by the U.S. company CARES.

5.3: Direction for Future Research:

From the limitations and findings of the present study, we recommend future researchers to investigate the interdependencies among ADs, ACs, and AHRMPs in AI-based service sector to investigate how emerging technologies of internet of things (IoT), and block-chain can enhance ACs, and how HRMPs should adapt to leverage technological advancements. Furthermore, a longitudinal design could be

employed to examine the long-term effects of AHRMPs on ACs. Moreover, the current research recommends to look deeper into how social factors affect ACs taking into account different dimensions of social and environmental performance across various organizational settings. Lastly, future research should investigate how leadership-styles and actions contribute to building a resilient culture and enhancing the effectiveness of AHRMPs, which led to the new leadership-style known as resilient leaders.

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