

A Systematic Literature Review of Performance Management of University Holding Company

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Abstract

Existing research on university holding companies has focused on specific areas of operational and strategic management. However, holistic performance management remains underexplored, despite UHCs' expanding influence within entrepreneurial ecosystems and their critical contributions to institutional sustainability. Therefore, this paper aims to propose a comprehensive performance management framework tailored to ensure the operational effectiveness and long-term viability of university holding companies. A systematic literature review was conducted on 1,216 academic papers published between 1991 and 2024. This review involved a detailed search for terms related to the concept of university venture capital. The analysis identifies three critical components for effective management of university holding companies: governance structure, acceleration, and policy and support. The corporate governance includes a shareholder structure, a board structure, and strategy. The acceleration component comprises service support, training programs, and networks. Lastly, policy and support consist of investment policy, regulation, and performance management.

Keywords

University holding company, University venture capital, Spinoffs, Startups, Literature review

1. Introduction

The commercialization of university research has become an increasingly important issue. Beyond licensing intellectual property (IP) to the market (Bray and Lee 2000; Wright et al. 2004), institutions are now creating environments where faculty and students can transform their research into robust businesses, such as university spinoffs and startups (Chaipongpati et al. 2022; Neves and Brito 2020). These enterprises are potentially significant and increasingly founded for generating income from research commercialization (Vohora et al. 2004; Siegel et al. 2003; Shane 2001). Additionally, they play a significant role in spurring national progression, bolstering economic growth (Wright et al. 2004; Yun 2020), and generating employment opportunities (Yun 2020). However, one of the main challenges faced by university research-based innovations is securing appropriate funding to effectively launch and grow new ventures (Cassar 2004). This issue is particularly critical for deep-tech university spinoffs (USOs) and startups, which often lack marketability as their outputs require further testing, production, and promotion. Consequently, many USOs never reach the stage where they are ready for external investors (Bonini and Capizzi 2019; Thawesaengkulthai et al. 2024). This results in a funding gap at the early stages of development (Munari et al. 2017).

To address this issue, universities have increasingly created venture capital mechanisms to invest in university-incubated businesses by establishing university holding companies (UHCs) (Bengtsson 2017; Ekholm and Landberg 2022; Hussin et al. 2017; Yang and Xu 2004), or university enterprises (Cao et al. 2009; Ma 2004; Xue 2004; Zhang 2003), or university venture capital funds (Fuster et al. 2019; Graham 2014; Lerner 2009; Wright et al. 2006). Serving as a bridge between the private sector and academia, UHCs catalyze co-investment partnerships essential for fostering

the growth of innovation-driven enterprises (Etzkowitz and Leydesdorff 2000). Moreover, UHCs play a critical role in enhancing the long-term sustainability of their parent institutions.

Meanwhile, many universities have established UHCs to increase financial convenience and investments in university spinoffs and startups. However, research related to UHCs is currently limited, particularly concerning performance management and performance indicators. The operations of UHCs involve numerous aspects that must be considered to ensure their effectiveness. Therefore, this research aims to collect systematic and comprehensive information on the factors influencing the operational management of UHCs to enhance their success and sustainability.

1.1 Objectives

This systematic literature review aims to explore the area of performance management within university holding companies (UHCs). The study has three key objectives: This systematic literature review aims to explore the area of performance management within UHCs. The study has three key objectives: 1) comprehensively synthesizing existing scholarly insights pertaining to UHCs; 2) identifying the critical components and performance indicators integral to devising a specific performance management model for UHCs; and 3) creating a performance management framework suitable for such a model.

1.2 University Holding Company

A university holding company (UHC) is an institution established by universities to manage and commercialize intellectual property from their research and to invest in university spinoffs, startups, and innovation-driven enterprises by obtaining equity in these ventures (Bengtsson 2017; Ekholm and Landberg 2022; Hussin et al. 2017; Yang and Xu 2004). UHCs play a pivotal role in driving technology commercialization, particularly by nurturing startups through initial funding and functioning as accelerators, thereby catalyzing the broader commercialization process (Jacob et al. 2003; Mowery et al. 2001; Yun 2020). This construct has become essential because many universities are state-affiliated and thus restricted from directly participating in commercial transactions (Jacob et al. 2003). UHCs facilitate the transfer of technology, knowledge, and innovations from academic research to the marketplace, allowing universities to protect their IP, generate revenue through licensing agreements, and promote the commercialization of research results (Siegel et al. 2003). Moreover, UHCs support the comprehensive process of technology commercialization beyond just investment, aiming for positive social, environmental, and financial returns (Alakent et al. 2020; Yun 2020).

By studying and collecting research related to university venture capital institutions for investing in these ventures, it was found that several specific terms are used. Besides the term UHC, other terms such as university technology holding, and university enterprise are also prevalent. The author has compiled all related terms and their definitions, as shown in Table 1.

Table 1. Related terms and definitions for a university holding company

Related Terms	Definitions	Countries that use this word	References
University holding company (UHC)	A private entity established separately from a university to commercialize knowledge and invest in university spinoffs, startups, and research-based ventures. UHCs receive shares as compensation, assist in the startup process, and provide resources, industry connections, financial services, and business development, aiming to generate income and drive sustainable growth for the university.	China, Sweden, Indonesia, Malaysia, Thailand	Bengtsson (2017), Ekholm and Landberg (2022), Hussin et al. (2017), NXPO, (2023), Yang and Xu (2004)
University technology holding (UTH)	A specialized organization was established to create spinoffs as subsidiaries and commercialize university inventions. It is affiliated with the Industrial and Academic Cooperation Foundation and operates by investing in shares when transferring technology to support the growth of these subsidiaries.	South Korea	Son et al. (2022), Yun (2020)
University venture capital firm (UVC)	UVC is a financial intermediary associated with universities dedicated to investing in new technologies emerging from university research.	Spain, Vietnam	Graham (2014), Huong et al. (2020), Padilla-Meléndez et al. (2021)
University enterprise/ University-affiliated enterprise	An entity owned by universities, often initiated and managed by university staff or alumni. These enterprises act as local intermediaries, venture capital providers, and facilitators of university-industry collaborations, heavily relying on their parent university's research and development. Their goal is to minimize financial risk and enhance decision-making freedom separate from the university, focusing on incubation, external investment, and market-driven expansion.	China, Germany, Kenya	Cao et al. (2009), Ma (2004), Xue, (2004), Zhang (2003)
University Venture funds / University Venture capital funds	University venture funds are designed to support local or regional economic growth by financing early-stage technologies and investing in academic spinoffs from university research. These funds aim to generate profits for the fund owners, which the university can then use to enhance technology transfer and the commercialization of research results.	The United States of America (USA), European Union (EU)	Croce et al. (2014), Munari et al. (2015)
university-affiliated venture capital (UVC) funds	UVC funds are university-affiliated investment funds created to address the funding gap for new ventures emerging from academic research. UVC funds primarily aim to finance and support university spinoffs (USOs), which often involve university stakeholders. They are typically established through collaborations with private and public institutions.	United Kingdom, Belgium, Spain, USA, The Netherlands, Switzerland, Northern Ireland	Lerner, (2009), Magomedova et al. (2023), Wright et al. (2006)

In this research, we adopt the term "University Holding Company" (UHC) to align with terminology used in Thailand. A UHC is a private entity established separately from a university or public research organization and owned by universities. Its primary role is to professionally manage investments in innovation-driven enterprises (IDEs) emerging from university research, such as spinoffs and startups. Additionally, a UHC facilitates commercial research and development, providing access to university resources, industry connections, and financial services (NXPO, 2023). Currently, the National Higher Education, Science, Research and Innovation Policy Council of Thailand has approved universities to establish venture capital units operating independently to invest in research-based businesses. Consequently, universities in Thailand use the term UHC to describe this mechanism.

2. Systematic Literature Review Methodology

This study employed a systematic review methodology for its transparency and repeatability, aiming to delve into the key elements of performance management within UHCs. The research examined the existing body of knowledge on UHCs, and investment institutions affiliated with universities that invest in startups, spinoffs, and innovation-driven enterprises (IDEs). Data collection spanned from 1991 to 2024, utilizing a rigorous search strategy across databases including Scopus, Science Direct, Emerald, EBSCO, and Google Scholar. The main goal of the literature review was

to identify and organize key concepts and frameworks, leading to the creation of a tailored conceptual framework specifically for managing the performance of UHCs. This study was structured around three key phases of the systematic literature review: planning the review, executing the review, and reporting and disseminating the findings (Leesatapornwongsa et al. 2023; Page et al. 2021; Tranfield et al. 2003; Tonjang and Thawesaengskulthai 2020).

2.1 Planning the Review

The scope of the review includes English-language articles from 1991 to 2024. This chosen timeframe ensures that the data were included from the emergence of university venture capital mechanisms to support the growth of startups, spinoffs, and IDEs until recent studies. The following inclusion criteria were applied while choosing articles for this study:

- 1) The article search involved using keywords “university holding company OR university technology holding” AND “performance OR performance management.
- 2) The search criteria were not limited solely to documents about UHCs to ensure comprehensive coverage of university investment mechanisms in companies that commercialize university research (such as spinoffs and startups). We broadened the search terms to include the phrases “university venture capital OR university venture OR joint venture spinouts OR joint venture university OR university investment OR university enterprise OR enterprise university” AND “performance OR performance management.”
- 3) Examination of the definition, framework, and methodology of performance management for UHCs.
- 4) Examination of the problems, success factors, drivers, elements, capabilities, or best practices for the performance management of UHCs.
- 5) A case study or empirical study related to the performance management of UHCs.

2.2 Conducting the Review

The search process was further refined using filters for "peer-reviewed journals" and "full text," based on the criteria and key search words. The search encompassed publications from the last thirty years, specifically covering the period from 1991 to 2024. This time frame was chosen to maintain the contemporary relevance of the journal articles. The search process resulted in a total of 1,216 search results (including Scopus 143 papers, Science Direct 232 papers, Emerald 159 papers, EBSCO 167 papers, and Google Scholar 515 papers).

From an initial pool of 1,216 papers identified through the search results, titles were screened to eliminate duplicates and those not meeting the specified criteria, reducing the count to 363 papers. These papers were then subjected to abstract screening, further reducing the selection to 64 articles. Following this, full-text reviews were conducted, resulting in the inclusion of 19 papers (see Figure 1). Ultimately, a total of 19 papers were selected for summarization and categorization, focusing on key aspects of the UHC performance management.

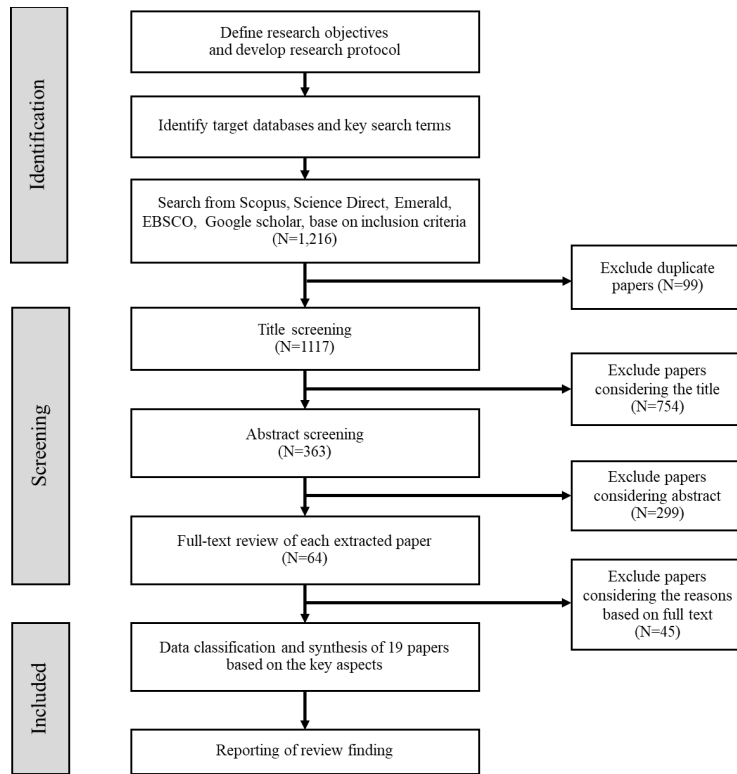


Figure 1. Flow diagram of systematic literature review

3. Result

University holding companies (UHCs) have received significant attention as investment entities within universities globally. Despite their increasing prominence, research on UHCs remains relatively limited, particularly concerning the performance management of these entities. Table 2 provides a comprehensive overview of the existing academic literature on investment institutes within universities, highlighting key focus areas and the number of papers conducted on each search term.

Table 2. Summary of academic research on key search terms for investment institutes of universities

Key Terms	Number of papers	References
University holding company	5	Bengtsson (2017), Ekholm and Landberg (2022), Hjalmarsson (2022), Hussin et al. (2017), Kelly (1992)
University venture capital	3	Etzkowitz (2005), Etzkowitz et al. (2023), Padilla-Meléndez et al. (2016)
University venture capital fund	2	Croce et al. (2014), Huong et al. (2020)
University-affiliated venture capital fund	2	Atkinson (1994), Magomedova et al. (2023)
University venture capital firm	1	Padilla-Meléndez et al. (2021)
University-affiliated enterprise	1	Cao et al. (2009)
University enterprise	1	Thuva and Muturi (2017)
University venture fund	1	Good et al. (2019)
University technology holding	1	Son et al. (2020)
Others	2	Craigue (2003), Wright et al. (2004)

3.1 Corporate Governance

Corporate governance encompasses the mechanisms by which corporations are managed and governed (Doupnik and Perera 2015). It entails a network of relationships among a company's management, board of directors, shareholders, and other stakeholders (OECD 2015). Its primary goal is to create an environment of trust, transparency, and accountability to promote long-term investment, financial stability, and business integrity (Good et al. 2019; OECD 2015). Effective corporate governance is crucial for economic growth, market confidence, and the efficient functioning of capital markets.

3.1.1 Shareholder Structure

Ownership structure is a crucial component of corporate governance and significantly influences the agency relationships within firms (La Porta et al. 1999; Faccio and Lang 2002). UHCs can be solely owned by the university or jointly owned in partnership with other organizations (Croce et al. 2014; Bengtsson 2017; Good et al. 2019). Each ownership structure offers distinct advantages. A UHC owned by the university consistently benefits from the ventures it creates and simultaneously contributes to industry through collaboration and entrepreneurship (Xue 2004). Joint ownership, as described by Good et al. (2019), helps balance the purposes and activities of various components, thereby enhancing their ability to engage with stakeholders or external parties as a cohesive entity (Zhou 2008).

3.1.2 Board Structure

Board structure is one of the vital components of the corporate governance practices of UHCs (Hussin et al. 2017), influencing decision-making through the cognitive processes of board members (Cambrea et al. 2017). In the context of UHCs, directors' personal characteristics and professional backgrounds significantly affect organizational strategy and performance (Rossignoli et al. 2021). Moreover, the key elements of governance that affect the performance of the company include the board of directors (BOD), audit committees, internal auditors, external auditors, and management (Hussin et al. 2017). Specifically, the BOD is a key governing body and a central element of the firm's strategy that plays an important role in initiating and managing innovation projects (Cambrea et al. 2017; Magomedova et al. 2023). Moreover, the composition and diversity of the BOD are pivotal to governance effectiveness, fostering both conflict and collaboration that enhance decision-making and strategic planning. Diverse boards improve information scrutiny and external interactions, serving as a strategic asset for the firm's success (Croce et al. 2014; Hillman and Dalziel 2003; Huong et al. 2020).

3.1.3 Strategy

UHCs should develop a comprehensive strategy and roadmap for supporting startups within the university (Huong et al. 2020), aligning their strategic direction with desired impact outcomes (Ekholm and Landberg 2022). This approach aims to enhance capital-raising capacity and provide robust support for startups and spinoffs (Huong et al., 2020). UHCs should conduct thorough self-assessments of their business operations to foresee outcomes and identify flaws. With advancements in impact measurement methodologies, revising impact goals annually is recommended to maintain relevance and efficacy (Ekholm and Landberg 2022). A well-defined strategy and regular assessment ensure that UHCs can effectively nurture entrepreneurial ventures and facilitate their growth, thereby contributing to the university's broader economic and innovative objectives.

3.2 Acceleration

The UHC carries out all the management activities involved in developing research opportunities (Padilla-Meléndez et al. 2021). This acceleration was led by experienced, accomplished entrepreneurs. Their primary objective was to diminish the traditionally high failure rates by offering mentorship and guidance to budding ventures. While the accelerator paradigm aligns with the contemporary shift towards intangible, knowledge-intensive support within incubation services, it is not without its unique characteristics. Beyond the intangible benefits like mentoring and networking, accelerators incorporate several features that differentiate them from conventional incubation models (Isabelle 2013; Thawesaengskulthai et al. 2020). Accelerators serve as fundamental pillars in the entrepreneurial landscape, primarily aiding startups and entrepreneurs, especially during their initial stages marked by capital and resource challenges (Cohen 2013; Pauwels et al. 2016; Thawesaengskulthai, et al. 2024; Radojevich-Kelley and Hoffman 2012). By providing funding and resources in return for equity, they strive to boost the growth direction of these early-stage ventures (Cohen and Hochberg 2014). These organizations extend diversified support, encompassing services like office space, mentorship, networking avenues, management guidance, and specific expertise (Cohen and Hochberg 2014; Dempwolf et al. 2014; Pauwels et al. 2016).

3.2.1 Service support

UHCs play a critical role in supporting university innovation by providing substantial business development services that facilitate the startup process (Bengtsson 2017). These services go beyond simply offering resources; UHCs act as strategic partners, providing vital mentorship, funding, and management expertise to spinoff and startups emerging from the university (Padilla-Meléndez et al. 2021). UHCs operate in four primary domains:

1) *Personnel Service* who play a critical role in supporting startups across various dimensions, particularly through mentorship and coaching. They provide essential expertise, assist in formulating business plans, and identify potential challenges (Hjalmarsson 2022; Etzkowitz et al. 2023; Hjalmarsson 2022; Thawesaengskulthai et al. 2024). Additionally, they contribute to commercialization efforts (Hjalmarsson, 2022). The presence of mentors is pivotal to the growth trajectory of startups (Huong et al. 2020; Padilla-Meléndez et al. 2021; Son et al. 2020). Startups benefit from continuous guidance throughout their development process, not merely during the initial stages, thereby increasing their likelihood of success.

2) *Legal Services*: UHCs are required to provide comprehensive legal services through specialized units such as the Intellectual Property Unit, Patent Office, and Law and Contracts Office (Laage-Hellman et al. 2020). These services are vital for mitigating legal risks associated with the formation of startup companies by students and professors, particularly when engaging with large corporations (Ghorbani 2020). The provision of expert legal advice and support ensures that the legal frameworks governing participation are properly established (Croce et al. 2014; Good et al. 2019; Thawesaengskulthai et al. 2024), thereby safeguarding the interests of all parties involved and enhancing the viability of these startups.

3) *Place Service* refers to the physical environment where startups gather, fostering idea exchange, community building, and access to incubation support. The capacity of universities to provide business incubators, science parks, and entrepreneurial services significantly enhances startup productivity. Son et al. (2020) highlight the establishment of UHCs as a key factor in successfully scaling research results into startups. This structural choice evolves the physical space, providing the necessary infrastructure to support evolving service operations. These facilities positively impact universities by enhancing their connections with surrogate entrepreneurs and industrial partners (Hjalmarsson 2022; Etzkowitz 2005; Padilla-Meléndez et al. 2021).

4) *Financial support*: financial resources are fundamental to the establishment and growth of startups and spinoffs (Laage-Hellman et al. 2020). Studies have shown a positive correlation between access to venture capital and the growth of new firms (Rodeiro-Pazos et al. 2017). In essence, the availability of funds acts as a critical lifeblood for new companies (Tritoasmoro et al. 2022). This financial ecosystem encompasses a diverse range of funding sources, including venture capital investments, corporate sponsorships, public grants, and the development of alternative revenue streams. However, it is important to acknowledge the investor perspective. Venture capitalists, for instance, typically anticipate returns on their investments contingent upon successful scaling and the achievement of milestones (Dempwolf et al. 2014; Thawesaengskulthai et al. 2024).

3.2.2 Training program

The training program provides a suite of services aimed at equipping startups with essential growth skills and industry-specific insights. It includes various aspects such as business development, marketing, financial management, and product design (Cohen and Hochberg 2014; Miller and Bound 2011; Pauwels et al. 2016). This includes creating meetings, or creative arenas, between different individuals who can contribute to the development of ideas and create good general conditions for commercialization (Hjalmarsson 2022). The training program integrates structured coaching sessions alongside a rigorous selection process. This selection mechanism, a critical part of the startup vetting process for program admission, operates through a phased, criteria-based evaluation system (Dempwolf et al. 2014; Miller and Bound 2011; Pauwels et al. 2016). Evaluation criteria typically include the team's expertise, the innovativeness and scalability of the business concept, and the prospective market scope (Wright and Stigliani 2013).

3.2.3 Network

UHCs play a critical role in fostering network support within the entrepreneurial ecosystem by partnering with various stakeholders. These stakeholders include alumni, entrepreneurs, venture capitalists (VCs), angel investors, corporations, universities, technology transfer offices, governments, and not-for-profit foundations (Etzkowitz et al. 2023; Fuster et al. 2019; Hjalmarsson 2022; Padilla-Meléndez et al. 2021; Tritasmoro et al. 2022). Networking events offer invaluable visibility for startups, paving the way for impactful affiliations in the entrepreneurial ecosystem (Wright and Stigliani 2013). This fosters a vibrant environment for innovation and collaboration (Cohen 2013; Pauwels et al. 2016). Strong networks are essential for entrepreneurial success. Therefore, policies should be designed to facilitate the building of these relationships (Rasmussen et al. 2015).

3.3 Policy and Support

The most critical element of this framework is the policy and support from the university's senior management, which encompasses both administrative and academic leaders. Without this essential backing, the mechanism is unlikely to succeed. Conversely, strong support from senior management holds substantial potential for a wide range of innovative ecosystems that can significantly benefit the university, thereby enhancing its academic vitality and financial sustainability (Kelly 1992). Furthermore, the policy intent, government support system, and UHCs' access to business development capabilities and monitoring are crucial components that support UHCs (Bengtsson 2017).

3.3.1 Investment policy

Investment is crucial for fostering the growth of innovation-driven enterprises (IDEs). Consequently, investment policies in IDEs should include criteria for investment and expected returns, focusing on which IDEs to support (Ekholm and Landberg 2022). Moreover, policies on intellectual property and conflict of interest significantly shape the investment stage in university-based innovation ecosystems. (Etzkowitz et al. 2023; Huong et al. 2020). Investment strategies that offer stable long-term returns are often linked to strong risk management, highlighting the need for improved due diligence processes (Zacharakis and Meyer 2000). In addition, the investment process should encompass three primary steps: fundraising; evaluating, selecting, and investing; and finally, divestment or the sale of shares or enterprises to other investors (Huong et al. 2020).

Furthermore, a professionally managed portfolio of early-stage investments is recommended (Etzkowitz 2005) and should involve co-investors with greater experience to address internal expertise limitations (Good et al. 2019). Additionally, due diligence and prospect follow-up are critical for thorough evaluation and monitoring of investments (Good et al. 2019; Ekholm and Landberg 2022). Evaluating the economic value of technologies is essential for selecting the most promising ones for investment and subsidiary establishment (Son et al. 2020).

3.3.2 Regulation

University regulations should support and foster relationships among UHCs while promoting the creation of IDEs by university researchers at regional and national levels (Bengtsson 2017; Ekholm and Landberg 2022). This framework includes managing intellectual property and university regulations (Geuna and Rossi 2011), and it synergizes with technology transfer infrastructures like science parks, incubators, and seed funds (Jacob et al. 2003). Governance practices within UHCs are also part of this framework. Furthermore, Bengtsson (2017) highlighted the significance of a comprehensive approach to designing university technology transfer systems, which is essential for evaluating each country's system development and effectiveness. Therefore, the regulation is crucial for enabling universities to possess the flexibility and capacity for business-oriented decision-making that enhances competitiveness for universities, companies within the value chain, and the broader economy.

3.3.3 Performance Management

UHCs must conduct self-assessments of their organizational capabilities in integrating potential impact measurement and management and producing annual progress reports (Ekholm and Landberg 2022). This process necessitates regular evaluation and follow-up on the impact generated by investments, particularly during the exit phase for an investor. It is essential to implement robust monitoring and evaluation methods following investment decisions. Continuous monitoring of impact metrics guides businesses toward sustainable development (Ekholm and Landberg 2022; Good et al. 2019; Thuva and Muturi 2017). To further stimulate the growth of subsidiaries, UHCs provide various management support and business monitoring services (Son et al. 2020), which are integral to enhancing sustainability assessment processes (Ekholm and Landberg 2022).

Key elements and key findings for the conceptual framework of the UHC performance management model obtained by systematic literature review. The authors summarize three key components of the UHC performance management model to be studied, as shown in Table 3.

4. Performance Measurement

The performance measurement of UHCs plays a significant role in their operations and investments in IDEs, as they are drivers in assessing the effectiveness and efficiency of outcomes related to university entrepreneurship (Siegel et al. 2007; Colombo et al. 2010; Bigliardi et al. 2013). Kaplan and Stromberg (2003) found that the rights to venture capital returns are contingent on various performance-based results, both financial and non-financial. Non-financial indicators measure success through economic contributions, technological innovation, and UHC development (Smith 2010). Furthermore, the assessment capabilities of UHCs to evaluate sustainability encompass multiple dimensions. An important emerging aspect is the role of key performance indicators (KPIs) in sustainability for UHCs. Various sustainable investment concepts, such as socially responsible investing, environment, social, and governance (ESG) investing, are explored. UHCs must transparently disclose their impact, progression, and intentions, with a significant emphasis on integrating and monitoring customized key sustainability performance indicators (Ekholm and Landberg, 2022). Hegeman and Sørheim (2021) specifically suggest that investment entities should adopt corporate sustainability or ESG practices to guide the due diligence and investment decision process, ensuring that appropriate risks and opportunities are considered.

Financial Dimension: The financial performance of UHC is measured through various metrics such as the amount of startup funding raised, revenue generation, profit margins, license income and market valuation (Carlsson et al. 2003; Etkowitz et al. 2023; Hjalmarsson 2022; Hussin et al. 2017; Thuva and Muturi 2017).

Non-Financial Dimension: The non-financial aspects offer insights into the broader impact of UHC, including the number of startups and spinoffs created, number of patent applications, number of licenses, number of startups, (Carlsson et al. 2003; Rasmussen et al. 2013).

ESG Dimension: This dimension reflects UHC’s commitment to responsible and sustainable business practices. These steps involve defining the purpose and scope, identifying significant environmental issues, selecting appropriate ESG frameworks and indicators, and collecting and analyzing data using reliable methods to ensure accuracy. This process is integral to the continuous improvement and alignment with the organization's strategy and vision (Armstrong 2020; S&P Global 2022).

4.1 The UHC Performance Management Model

The UHC performance management model provides a strategic framework for enhancing, developing, and ensuring the long-term sustainability of operational methods and investment strategies in innovation-driven enterprises (IDEs). This model, derived from a comprehensive study, forms the foundation of this research. The structure of the conceptual framework is visually presented in Figure 2.

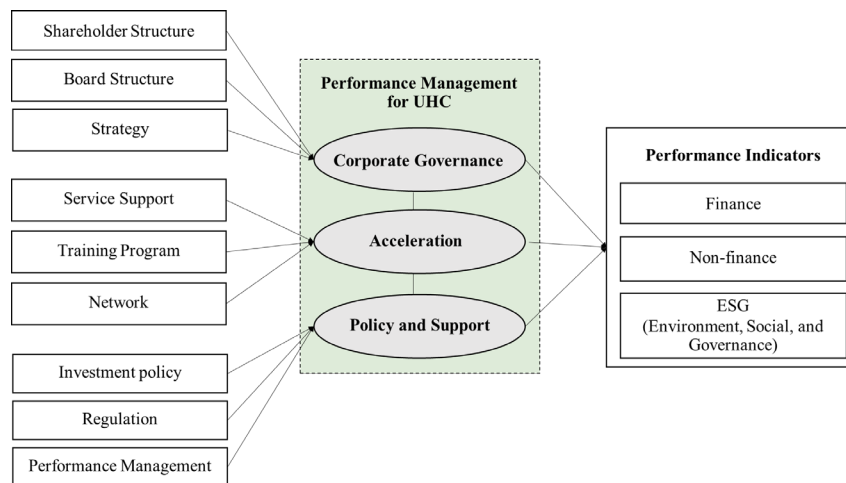


Figure 2. The UHC performance management model

5. Discussion and Future Research

The findings of this study underscore the critical components necessary for the effective management of UHCs. However, an examination of the existing literature reveals that prior research has predominantly focused on specific aspects of UHC operations, lacking a holistic perspective. Moreover, there is a notable gap in studies addressing non-financial performance outcomes. To address these gaps, this research synthesized data from a systematic literature review to propose a comprehensive performance management framework for UHCs. This framework emphasizes key components and multidimensional performance indicators aimed at enhancing operational efficiency and ensuring the long-term sustainability of UHCs.

Based on the findings of this study, future research should examine the performance management model for UHCs, with a particular focus on assessing how each component influences various performance indicators. Such studies will be instrumental in refining and optimizing the performance management framework for UHCs, ensuring its suitability and effectiveness in implementation.

6. Conclusion

This paper explored the performance management of university holding companies (UHCs), entities established by universities to invest in spinoffs and startups, and to manage and commercialize intellectual property (IP). Our review identified key components integral to effective UHC performance management: corporate governance, acceleration, and policy and support. Corporate governance involves analyzing shareholder and board structures, emphasizing diverse, experienced boards and strategic planning. This includes setting operational objectives, targeting specific startup groups, and enhancing capital-raising and support. Acceleration focuses on service support, training programs, and network building, providing essential resources and fostering connections for startups. Policy and support highlight the necessity of robust investment policies, regulatory frameworks, and continuous performance management to ensure sustainable development and enhance UHC operations. Additionally, three key performance indicators including finance, non-finance, and ESG, are used to assess UHC operational efficiency.

Table 3. Key elements and key findings from systematic literature review for conceptual framework of the UHC performance management model

Elements	Evaluation Factors	Key Findings	References
Shareholder Structure	The proportion of university shareholding	Ownership structure is a key element of corporate governance and significantly impacts the agency relationships within firms. Advantages of sole ownership by the university Advantages of joint ownership with other organizations.	Croce et al. (2014), Bengtsson (2017), Faccio and Lang (2002), Good et al. (2019), La Porta et al. (1999), Magomedova et al. (2023), Wright et al. (2004), Xue (2004), Zhou (2008)
Board Structure Board of Directors	The types and role of members on the BOD	Board size, executive and non-executive members, independent directors, and directors of investment analysis expertise. There is the university executive who serves as a board member of the UHC.	Craigie (2003), Croce et al. (2014), Etzkowitz et al. (2023), Hjalmarrsson (2022), Hussin et al. (2017), Kelly (1992) Son et al. (2020)
Executive committee	Experience and expertise of the executive committee	The executive board possesses experience, expertise, commitment, and transparency in corporate governance and venture capital.	Croce et al. (2014), Huong et al. (2020), Hussin et al. (2017), Magomedova et al. (2023)
	Risk management and portfolio management	Managing investment proportions in subsidiary companies, assessing the value of investments, and ensuring efficiency in investment management.	Klier (2009), Porter (1987)
	Audit Committees	Audit committees monitor and control UHC operations to ensure transparency and effectiveness. The company also maintains efficient internal controls and audits, complemented by external audits.	Hussin et al. (2017)
Investment Committee	knowledge and experience	The investment committee is composed of individuals knowledgeable and experienced in analyzing investments in businesses that leverage research and innovation outcomes, business management, project analysis, and accounting.	Croce et al. (2014), Ekholm and Landberg (2022), Huong et al. (2020), Hussin et al. (2017)
	Transparency in investing decisions	The investment committee operates with transparency in its investment deliberations, ensuring it is free from any conflicts of interest or related concerns regarding the projects under consideration.	Etzkowitz et al. (2023), Hussin et al. (2017), Son et al. (2020)
Strategy	Strategic management	A business model and strategy focused on nurturing startups and fostering sustainable growth, such as setting clear operational objectives, targeting specific startup groups, and outlining methods for selecting companies for incubation.	Ekholm and Landberg (2022), Huong et al. (2020), Hussin et al. (2017), Magomedova et al. (2023), Wright et al. (2004)
Service Support	Personnel service	The UHC supports personnel through mentorship services, including guidance from mentors and industry experts for startups, spinoffs, strategic advice, technology, communications, marketing, help commercialize, and subsidiaries to enhance operational efficiency.	Atkinson (1994), Debrulle (2014), Etzkowitz et al. (2023), Hjalmarrsson (2022), Huong et al. (2020), Padilla-Meléndez et al. (2016), Padilla-Meléndez et al. (2021), Son et al. (2020)

Elements	Evaluation Factors	Key Findings	References
	Legal service	The UHC provides assistance and advice with legal matters for startups, such as company registration, tax advice, and intellectual property rights (IP) licensing.	Good et al. (2019), Ghorbani, (2020), Laage-Hellman et al. (2020)
	Place service	The UHC offers essential support for physical spaces that facilitate business operations and various working environments, such as office spaces, co-working space, equipment, laboratory facilities, incubators, and accelerators.	Hjalmarsson (2022). Etkowitz (2005) Padilla-Meléndez et al. (2021) Atkinson (1994)
	Financial service	The UHC provides financial support to startups, encompassing a variety of funding sources such as investor funding, venture capital, angel investors, corporate funding, and public funding. This includes access to a network of investors and funds to ensure adequate financial resources for growth and development.	Atkinson (1994), Craigue (2003), Croce t al. (2014), Ekholm and Landberg (2022), Etkowitz et al. (2023), Hjalmarsson (2022), Huong et al. (2020), Laage-Hellman et al. (2020), Padilla-Meléndez et al. (2016), Padilla-Meléndez et al. (2021), Son et al. (2020), Tritoasmoro et al. (2022)
Training program	Training program	<i>Curriculum-Based Training and Incubation</i> : A structured program for coaching and incubation with regular counseling. <i>Public Pitch Events and Demo Days</i> : Events to showcase startups to potential investors for securing necessary funding. <i>Market Analysis Platform Access</i> : Tools to assist teams in understanding market dynamics and opportunities. <i>Developing Entrepreneurial Skills</i> : Enhancing the entrepreneurial capabilities of faculty, students, and staff.	Dempwolf et al. (2014), Etkowitz et al. (2023), Hjalmarsson, 2022), Huong et al. (2020), Miller and Bound, (2011), Pauwels et al. (2016), Wright and Stigliani (2013)
Network	Network	The UHC has established a robust network to support the growth of startups and to create business opportunities and strategic collaborations for the UHC such as venture capitalists (VCs), angel investors, corporations, universities, government entities, entrepreneurs, alumni, and non-profit foundations.	Atkinson (1994), Etkowitz et al. (2023), Good et al. (2019), Hjalmarsson (2022), Huong et al. (2020), Padilla-Meléndez et al. (2021), Son et al. (2020)
Investment Policy	Investment stage and ecosystem development	Focus on the different stages of investment within the university-based innovation and entrepreneurship ecosystem to effectively support the growth and development of startups.	Craigue (2003), Croce t al. (2014), Ekholm and Landberg, 2022), Etkowitz et al. (2023), Good et al. (2019), Huong et al. (2020), Magomedova et al. (2023), Son et al. (2020)
	Evaluation of economic value of technologies	Implement processes to evaluate the economic value of emerging technologies to identify the most promising ones for investment and the establishment of subsidiaries.	
	Intellectual property and conflict of interest policies	Establish and enforce clear policies on intellectual property and conflict of interest to ensure transparency and fairness in university-based innovation.	
	Deal flow management and due diligence	Develop robust mechanisms to manage deal flow, ensuring a steady pipeline of viable projects for investment.	

Elements	Evaluation Factors	Key Findings	References
Regulation	University regulation	<p>Future regulations will impact sustainability agendas. Regulations should enhance support for UHCs, fostering relationships and promoting startup initiation by university researchers at regional and national levels.</p> <p>Regulations should include universities' roles in managing intellectual property and internal regulations.</p> <p>Regulations should enable universities to possess the flexibility and capacity for business-oriented decision-making that enhances their competitiveness.</p>	Bengtsson (2017), Ekholm and Landberg, (2022), Geuna and Rossi (2011), Huong et al. (2020)
Performance Management	Performance assessment and monitoring	<p>UHCs must conduct self-assessments of their organizational capabilities in integrating potential impact measurement and management, along with producing annual progress reports.</p> <p>Implementing robust monitoring and evaluation methods following investment decisions and managed portfolio companies.</p>	Ekholm and Landberg (2022), Etzkowitz (2005), Good et al. (2019), Son et al. (2020), Thuva and Muturi (2017), Wright et al. (2004)
	Evaluation of investment impact	Continuous monitoring of impact metrics helps businesses toward sustainable development.	

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