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A systematic review of the effects of cybernetic systems theory on innovation management

International business

Master's thesis

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27.03.2024

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This thesis explores the potential benefits of integrating cybernetic systems theory into innovation management processes. It discusses the role of true innovation in disrupting established markets and business models, emphasizing the importance of creating genuine value. The research aims to map the potential of cybernetics systems in benefiting innovation management by using the Viable Systems Model and exploring the link between innovation, cybernetics, and worker rights. The study follows a systematic literature review and thematic analysis to identify key themes in cybernetic management in an innovation context. Key implications include fostering a culture of continuous improvement and adaptability in organizations. The thesis suggests that integrating cybernetic frameworks into innovation tools can enhance organizations' adaptability and continuous improvement culture. Furthermore, it advocates for a human-centric approach within viable systems. The thesis also provides practical implications for different stakeholder groups, addressing the need for humanistic approaches to management and the prioritization of worker well-being in fostering innovativeness within organizations.

Keywords: Innovation processes, Cybernetic systems, Labour rights, Complex systems, Organizational coordination mechanisms, Systematic literature review

Pro gradu - tutkielma

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Tämä pro gradu -tutkielma tutkii kybernetiikan järjestelmäteorian integroimista innovaatiojohtamiseen ja tämän integraation mahdollisia hyötyjä. Tutkielma käsittelee sisäisen innovaation roolia vakiintuneiden liiketoimintamallien häiritsemisessä ja korostaen todellisen arvon luomisen merkitystä. Tutkielman tavoitteena on kartoittaa kuinka innovaatiojohtaminen voi hyödyntää kybernetisiä järjestelmiä kuten Viable Systems -järjestelmä. Lisäksi tutkielma tarkastelee innovaation, kybernetiikan ja työntekijöiden oikeuksien välistä yhteyttä. Aiheen monitieteellisyyden takia tutkielma suoritettiin systemaattisena kirjallisuuskatsauksena. Kirjallisuuskatsaus tarkastelee aihetta temaattisen analyysin kautta. Keskeisiksi teemoiksi nousivat jatkuva parantaminen ja sopeutumiskykyisen kulttuurin edistäminen organisaatioissa. Tutkielma löydökset viittaavat siihen että, kybernetisten järjestelmien integrointi innovaatiojohtamiseen ja innovaatiotyökaluihin voi parantaa organisaatioista sopeutumiskykyä ja auttaa organisaatioita saavuttamaan jatkuvan parantamisen kulttuurin. Lisäksi löydökset kannustavat ihmiskeskeistä lähestymistapaa johtamiseen käyttäen Viable Systems – järjestelmän periaatteita. Tutkielma tarjoaa myös käytännön implikaatioita eri sidosryhmille, jotka käsittelevät humanististen lähestymistapojen tarvetta johtamiseen ja työntekijöiden hyvinvoinnin priorisointiin innovaatioiden edistämisessä organisaatioissa.

Avainsanat: innovaatioprosessit, Kybernetiset järjestelmät, Työoikeudet, Monimutkaiset järjestelmät, Organisaatiokoordinointimekanismit, Systemaattinen kirjallisuuskatsaus.

TURUN YLIOPISTO

Table of contents

TURUN YLIOPISTO

LIST OF FIGURES

LIST OF TABLES

1 Introduction

1.1 Cybernetic innovation

"The computer is incredibly fast, accurate, and stupid. Man is unbelievably slow, inaccurate, and brilliant. The marriage of the two is a force beyond calculation" Leo Cherne[1]

Constant fast paced technological advancements have become the new status quo that is touted as the one and only way to progress both internal processes as well as being one of the leading causes for product innovation (Wolff 2021, 274; Ringel et al. 2015, 1-5; Van Looy, 2021, 1-2). This attitude towards mandatory and fast innovation is leading to both unfulfilling and meaningless jobs as well as the acceleration of planned obsolescence in products. (Graeber 2019, 273; Fishman et al. 1993, 361-362) The drive for companies to be constantly pushing out new products is not only a corporate sustainability crime in the age of attempting to fight global warming but also can limit true innovation as the resources of R&D are pushed towards the machines of barely new features. This phenomenon is not only creating less efficient organizations but also overworked and undervalued employees. (Walo 2023, 1125; Pisano 2019, 65) When applied correctly the adoption of internal innovation in organizations has been shown to be a key capability for success, yet due to the potential faults in the implementation of new technology as well as the potential impact on the workforce remains a source of apprehension for many workers as well as companies themselves (Leonard-Barton 1992, 120; Kaplan & Norton 1992, 72; Tohidi & Jabbari 2012, 51; Acemoglu & Restrepo 2019, 8). Cybernetics, focuses on self-regulating system networks, and due to this has been bestowed to offer a path towards a form of emancipatory coordination of workers, which if applied less radically than previously, could be an answer to the issues brought up when discussing contemporary solutions of innovation cultivation. (Krippendorff 2023, 90-93; Cockshott & Cotrell 1993, 5-7; Espejo1990, 6-7; Ashby 1956, 3) This thesis proposes an exploration into using the theory of cybernetics to fill the gaps in the organizational innovation facilitating a more collaborative, effective and communicatory approach to the innovation process. Issues of lack of authority and guidance due to confusing hierarchies, or demotivated workers are easier to handle or even eliminate from the workflow with a self-regulating system that is not reliant on interpersonal interests of actors in the organizational space. (Garicano 2000, 880; Bunderson et al. 2016, 1265)

[1] Garland, R. (1982) Microcomputers and Children in the Primary School. London; Falmer Press.

To support the aims of this thesis ideas are derived from the literature of innovation management, management cybernetics, and to a certain extent the scholarship of socialism. The seminal works by Ashby (1956) and Schumpeter (1934) on their respective fields, cybernetics and innovation, provide a foundational understanding of the potential of self-regulating system networks being used for real-time information sharing as well as the critical nature of innovation for business success. Though cybernetic systems theory cannot be fully removed from its socialistic influences and was purposely chosen for thesis due to it's holistic and humanistic approach to structuring work, the purpose is to serve organizational innovation processes as well. (Krivý 2019, 2; Crossan & Apaydin 2010, 1155) Employee satisfaction, -well-being, and -autonomy serve a critical role in facilitating organizational innovation (Elsamani & Kajikawa 2023, 5; Voordt & Jensen 2023, 29; Theurer et al. 2018, 2).

Though cybernetic theory does have the potential to offer effective tools for the innovation process, it can tend to get encumbered with its political leaning and the unintuitive nature of the theory (cf. van Aken 2004, 222-223,233; Foerster 1984, 15-17; Beer 1981, 123). Proposed real world applications include high-tech control rooms with swivel chairs, yet practical smaller scale solutions are missing. (Wiener 1950, 56; Medina 2011, 18). Already existing examples of implementing cybernetic principles on a smaller and practical scale can be found in Agile innovation management styles and tools, like for instance Scrum, as those are designed to manage complexity and enhance efficiency in similar ways. (cf. Schwaber & Sutherland 2020) By integrating the cybernetic systems theory into innovation research there can be a more holistic human centric human view on innovation management that could be applied to organizations to manage complexity better. This thesis is built on the basis that true innovation requires the creation of value and a readiness for change, and this imposes that solely creating profit is not creating value (Prahalad & Ramaswamy 2004, 5; Chesbrough 2007, 14; Porter & Kramer 2011, 62).

1.2 Research question and contribution

This thesis aims to map the potential of cybernetics systems benefiting innovation management by looking into the internal innovation process and cybernetic system theory. By approaching cybernetics as more than a strictly binary data input-output system, and combining this with innovation management the thesis will aim to answer the question-

How can cybernetics be integrated to the innovation process?

This question will be addressed with two sub-questions –

A: How can cybernetics be integrated in innovation processes to enhance worker rights and promote sustainable business practices?

B: How is overall innovativeness affected by cybernetics?

The implications and contribution of this research lie in exploring the potential benefits of using cybernetic systems in the innovation process. Cybernetics, an interdisciplinary field that studies the control and communication processes in various systems, has the potential to contribute to the optimization and management of complex systems, including organizational systems, coordination mechanisms and innovation processes.

By integrating management cybernetic theory and innovation this thesis aims to provide a comprehensive understanding of the potential benefits of using cybernetics to manage organizations more efficiently by optimizing the innovation processes. As the integration of these two aspects of management is minimal in current literature it would be challenging to obtain a synthesis on these matters without a systematic literature review. Consequently, the findings and conclusions of this study have managerial implications that can affect the way in which innovation and innovativeness are approached within the context of internal innovation.

2 Innovation management and cybernetics

Innovation is widely recognized as a key driver of business success and survival (Tushman et al. 1996, 8; Chesbrough 2003, 1). Contemporary research on innovation highlights the importance of human capital and worker wellbeing in promoting successful innovation (Cammeraat et al. 2021, 9-12). Despite this, worker rights are often neglected in favour of pursuing capital gains and competitive advantages (Adler et al. 1999, 57; Bresnahan et al. 2002, 339; Schumpeter 1934, 83). While capital gains and competitive advantages are essential for organizations, it is important to consider how they are used and distributed, as they can have significant impacts on worker wellbeing and rights. In this regard, it is critical to recognize that competitive advantages often benefit labour as much as they benefit owners, except for those owners who are only interested in short-term gains without loyalty to the organization. (Roziq et al. 2021, 2)

To address the issue of the balancing between competitiveness and worker's rights, this chapter aims to explore the relationship between innovation and cybernetics. This exploration will be achieved by analysing relevant literature and developing a theoretical framework for integrating cybernetics into innovation management for the benefit of worker's rights. The chapter will provide a critical review of literature on innovation, cybernetics, applied management and internal innovation identifying potential gaps and opportunities for future research in this field. The overall goal is to establish a theoretical basis for the integration of cybernetics into innovation management, which can enhance worker rights and promote sustainable business practices.

2.1 Perspectives on innovation

Innovation in organizations is often viewed as the creation of new products or services to meet market demands. (Alsos et al. 2014, 10; Yongmei et al. 2021, 2) However, it can be argued that "true innovation" involves disrupting established markets and business models to create genuine value (Christensen & Overdorf 2000, 67; Dosi 1982,156; Tushman & Anderson 1986, 439; Schumpeter 1942). "True innovation" is the basis of how innovation is regarded in this thesis and is derived from Schumpeter's theory on creative destruction. (cf. Schumpeter 1942, 81) Creative destruction refers to the process by which new innovations and technologies replace or disrupt existing ones, leading to the destruction of old markets and business models. This concept highlights the idea that true innovation involves not only creating new products or services, but also fundamentally changing the way industries operate. (Tzeng 2009, 373; Appleby 2011,9-10) This is achieved by emphasizing the importance of not only introducing new ideas, but also challenging existing norms and practices within an organization. By embracing this definition of innovation, organizations can strive to achieve sustainable growth and competitive advantage in today's rapidly changing business environment. (Tzeng 2009, 373; Sledzik 2013, 90) This approach is in juxtapose with the perhaps more contemporary business literatures divide of innovation into four or five categories of innovation set into a matrix model - incremental, architectural, disruptive, radical. This matrix approach often encourages a focus on cost reduction rather than innovativeness that could serve the customer or company in meaningful ways. (Bowonder et al. 2010, 21; Kaafarani & Stevenson 2011, 45-46; Giesen et al. 2007, 28)

Following the above, innovation will be defined, in this thesis, as a set of actions and arrangements that allow for an organization to conceive new and novel ways of taking advantage of resources. (Van de Ven 1986, 590) This can take the form of combining resources in a new way to achieve efficiency or acquiring new resources such as human capital or new equipment. (Van de Ven 1986, 590; Van de Ven & Rogers 1988, 633) Efficiency is important in some cases, especially for innovations focused on streamlining production processes (e.g. LEAN types of innovations); however, effectiveness (creating something new) is typically more critical. (Voss 1992, 29; Utterback 1974, 620-23; Van de Ven & Rogers 1988, 633)

Reduction of cost of production can be achieved in various ways, such as economies of scale or scope (Van de Ven 1986, 595; Rothwell 1977, 192). Another historical cost cutting measure has been economizing of labor (Utterback 1974, 620; Utterback & Abernathy 1975, 640; Ray & Ray 2010, 145). The expendable worker is a classic idea that dates to the late 19th and early 20th centuries when Taylorism was a popular management approach to increase productivity in mostly unskilled labor in stereotypical mass production. This approach involved breaking down tasks into smaller, repetitive motions to maximize efficiency and minimize the need for skilled labor. By reducing the reliance on highly skilled workers, companies were able to cut costs and increase output. This method also allowed for easier replacement of workers, as they were seen as interchangeable, expendable, parts in the production process. (Ichniowski et al. 1996, 230-233; Pil & MacDuffie, 1996, 425; Ritter & Ruggero 2017) Overall, the economizing of labor through Taylorism revolutionized the way companies approached workforce management and cost reduction strategies. (Johnson et al. 2005; Acemoglu & Restrepo 2018, 20; Taylor 2016, 100) However, the devaluation of skilled labor under Taylorism led to a decrease in job satisfaction and a lack of opportunities for career advancement (Johnson et al. 2005; Taylor 2016, 101). This ultimately resulted in a shift towards valuing skilled labor and knowledge workers for their unique contributions to innovation and productivity. Following this, skilled labor and knowledge workers were developed to improve society through education and training, as well as through labor laws and regulations. (Crouch et al. 1999, 72; Silver 2021, 3; Steiger & Wardell 1992, 415) Skilled labor and knowledge workers play a crucial role in driving innovation and progress in various industries. They bring expertise, creativity, and problem-solving abilities that are essential for pushing boundaries and achieving sustainable growth. (Taylor 2016; Chalfin et al. 2016, 125-127)

However, these ideas are highly context specific. For example, in industries where automation and technology are rapidly advancing, the role of skilled labor and knowledge workers may shift towards more specialized technical skills. (Autor 2014, 845; Silver 2021, 3) Additionally, the demand for continuous learning and upskilling in these fields is crucial to stay competitive in the ever-evolving job market. Furthermore, the integration of artificial intelligence and machine learning in these industries requires workers to adapt and develop new skills to remain relevant. Embracing technological advancements and staying ahead of the curve is imperative for professionals in these rapidly changing fields. (Autor 2014, 846; Steiger & Wardell 1992, 415) The downside to relying solely on skilled labor and knowledge workers is that it can create a divide between those who have access to education and training and those who do not, leading to social inequality. (Autor 2014, 845; Silver 2021, 3; Steiger & Wardell 1992, 415) Additionally, the rapid pace of technological advancements may require continuous upskilling and reskilling of workers to remain competitive in the workforce. This potentially leading to increased job insecurity and economic disparities. Use of unskilled laborers has been shown to link with abuse of labor rights and exploitation, highlighting the importance of finding a balance between skilled and unskilled labor to promote social equity and economic stability. (Autor 2014, 845; Silver 2021, 3; Steiger & Wardell 1992, 415; Chalfin et al. 2016, 125-127) Emphasizing the need for comprehensive labor policies and regulations to protect workers' rights and ensure fair treatment across all sectors of the economy. This is particularly important in industries that heavily rely on automation and artificial intelligence, where the displacement of workers can be significant. (Autor 2014, 850) By implementing training programs and support systems for workers to adapt to new technologies, companies can mitigate the negative impacts of technological advancements on the workforce (Autor 2014, 845; Silver 2021, 3; Steiger & Wardell 1992, 415). Ultimately, finding a balance between technological progress and human labor is crucial for creating a sustainable and equitable economy (Autor 2014, 845; Silver 2021, 3).

Another famous innovation management theory comes from Schumpeter. Schumpeter (1949, 86) introduced the innovation theory of profit, positioning innovation management as it is often understood today. He argued that entrepreneurs drive economic development through the introduction of new products and processes, creating a competitive advantage in the market (Schumpeter 1949, 81). Schumpeter's theory emphasizes the importance of creative destruction and the role of innovation in shaping capitalist economies (Schumpeter 1949, 81). The innovation theory of profit states that innovation is a function, if not a necessity, of a business to profit from in the form of capital gain (Schumpeter 1934, 84-85, 88-89). Schumpeter believed that innovation was essential for businesses to thrive and remain competitive in a dynamic market environment. He highlighted the significance of constant change and adaptation to achieve long-term success and growth. (Schumpeter 1934, 84-85) This theory is also the basis for the separation of internal and external innovation elaborated on later in this thesis. Although Schumpeter's theory talks about innovativeness in the form of innovative and novel products (Schumpeter 1934, 86), it also lays the foundation for decades of labor exploitation in the name of innovation. Schumpeter's emphasis on innovation as a driving force for economic growth has led to a focus on continuous improvement and advancement in industries worldwide (Frey & Osborne, 2017, 265; Standing, 2011, 93). However, critics argue that this relentless pursuit of innovation has sometimes come at the expense of fair labor practices and ethical considerations. This exploitation is achieved by positioning the reduction of production costs as a pillar of innovativeness, inadvertently contributing to the creation of the image of the expendable worker. (Frey & Osborne, 2017, 265; Standing, 2011, 93; Schumpeter, 1942, 81) In essence, Schumpeter's theory of innovation has sparked both positive economic growth and negative consequences in the workforce (Frey & Osborne 2017, 265; Schumpeter, 1942, 81). However, it is important to note that Schumpeter's theory of innovation encompasses more than just the reduction of production costs. It emphasizes the idea of combination, where existing elements or resources are combined in new ways to drive entrepreneurial articulation and bring about economic change (Lipieta & Lipieta 2022, 3225; Luamba et al. 2021, 334; Sledzik 2016, 227). In contrast to the perspective of cost-cutting and the ever-growing gospel of more lean organizations, there is an opposing argument that challenges the notion that innovation solely focuses on reducing production costs and treating workers as expendable. (Luamba et al. 2021, 334; Sledzik 2016, 227) While it is true that innovation can lead to cost reduction and increased efficiency, it is essential to recognize that innovation goes beyond mere cost-cutting measures. (Lipieta & Lipieta 2022, 3225)

One aspect that is often overlooked is the role of nontechnological innovations in driving organizational outcomes (Asiaei & Jusoh 2015, 669; Volberta et al. 2014, 1250). New management processes and practices are crucial for achieving desirable outcomes and facilitating organizational transformation and renewal. This implies that innovation extends beyond product and process advancements to include the implementation of new strategies. (Asiaei & Jusoh 2015, 669) Incorporating innovative management practices can lead to increased efficiency, employee satisfaction, and overall success for businesses. By prioritizing nontechnological innovations alongside technological advancements, organizations can create a more sustainable and ethical work environment for their employees. (Asiaei & Jusoh 2015, 670-71) This holistic approach to innovation can also result in improved customer satisfaction and loyalty, ultimately driving long-term growth and profitability for the organization. Embracing a culture of innovation can help businesses stay ahead of competitors and adapt to changing market demands more effectively. (Volberta et al. 2014, 1250 ; Litago and Fernandez-Crehuet 2018, 5027)

Recognizing the broader scope of innovation is paramount, especially when considering non-technological aspects. The discussion extends beyond traditional notions, highlighting the pivotal role of internal innovations, such as novel management processes and practices, in steering organizations towards transformative outcomes. (Asiaei & Jusoh 2015, 669; Volberta et al. 2014, 1250 ; Litago and Fernandez-Crehuet 2018, 5027)

2.1.1 External innovation

The thesis will mainly explore internal innovation and the specific strategies and benefits of utilizing cybernetic management tools for it to provide practical insights for organizations seeking to enhance their performance. These tools can also be utilized in external innovation but may not be as effective in promoting organizational performance compared to internal innovation. However, they can still be valuable for expanding a company's reach and staying competitive in the market. This section will shortly elaborate on external innovation and its potential benefits for organizations looking to grow and adapt in a rapidly changing business environment. This is done to achieve a more holistic view of innovation strategies and their impact on organizational success. By understanding the benefits and limitations of both internal and external innovation, companies can make informed decisions on how to best leverage these tools to drive growth and stay ahead of the competition.

With the trend of open innovation being researched, external innovation is seemingly being used as a term for any innovation that uses external sources, but this thesis follows the more traditional divide of internal/external (cf. Anokhin et al. 2015,1434). As previously stated, this thesis is informed by Schumpeter's theory of innovation in which he separates innovation from creation of new products. Creating or producing commodities, be it however inventive or unique, would not be considered innovation in the eyes of Schumpeter as his theory states innovation to only exist in creation of new combinations of existing means. (Anokhin et al. 2015,1434; Schumpeter, 1942, 81)

Though informed by the theory of innovation, this thesis does not follow this strict of a definition of innovation taking into consideration the research and literature coming after Schumpeter. In this thesis, external innovation is referred to as the improvement of goods and services, which directly affects the customer (Anokhin et al. 2015,1434). This may mean introduction or betterment of new product lines to better meet your customers' ever-evolving needs. This might be referred to as product innovation and within organizational structures falls in with research & development (R&D) departments. (Anokhin et al. 2015,1440) This definition does not exclude outside sources of ideas or innovativeness from external innovation as R&D that incorporates external sources is crucial for staying competitive in today's rapidly changing market. By tapping into external ideas and expertise, businesses can access fresh perspectives and insights that may not be available internally. This can lead to the development of new products or services that better meet customer needs and preferences, ultimately driving business growth. (Anokhin et al. 2015,1440; Ramadhan & Farida 2023, 105)

Product innovation is important for companies to stay competitive in the market and meet changing consumer demands. It allows businesses to differentiate themselves from competitors and attract new customers. (Ramadhan & Farida 2023, 111) Innovative products can also help companies increase market share and drive revenue growth. By continuously improving and introducing new products, businesses can stay ahead of trends and maintain relevance in the industry. Additionally, successful product innovation can enhance brand reputation and loyalty among existing customers. (Agustia et al. 2020, 1039; Ramadhan & Farida 2023, 111)

Innovation can also lead to increased efficiency and cost savings, as new technologies and processes are developed to meet the needs of new products. External and internal innovation are not wholly separate entities but interconnected systems. New products often require new production methods or changes to existing production which bleeds into the internal innovation sphere. (Agustia et al. 2020, 1040)

2.1.2 Internal innovation

This thesis defines internal innovation as innovative approaches that focus on human capital and processes internal to the organization. The development of new production and resource management technology is one of the primary objectives of internal innovation. (Vrande, V 2009, 425) Production technology refers to the tools, equipment, and processes employed by an organization to efficiently create goods and services. Internal innovation plays a crucial role in enhancing production technology through the development of new systems and techniques that optimize resource management and boost overall productivity. By focusing on improving human capital and internal processes, organizations can stay competitive in today's rapidly changing business environment. (Vrande, V 2009, 425) The aim of new production technology is to produce more efficiently with less effort than before, resulting in increased productivity and profitability for the organization. However, the introduction and adoption of such measures have been slow at times due to the fear of future unemployment among workers, who perceive new technology as a threat to their jobs (Cockshott & Cottrell 1993, 163; Marx 1883, 74; Acemoglu & Restrepo 2019, 2494). Although there are multiple compensating mechanisms that counterbalance the labor-cutting impact of new technology, the apprehension of the workforce remains, as cutting the workforce and reducing human labor cost remains one of the main reasons for introducing new technology (Somers et al. 2022, 17; Acemoglu & Restrepo 2019, 4; Baldwin et al. 2021, 13).

Efficiency and economizing of time are the primary objectives of internal innovation, as it aims to maximize productivity while minimizing costs (Hargadon & Sutton 2000, 163; Nonaka & Takeuchi 1995, 17; Tidd & Bessant 2018, 32). However, historically there has been little to no incentive for seeking and implementing innovation and modernization when there is little monetary benefit or other incentive to economize labor time (White 1962, 19; Cockshott & Cottrell 1992, 70). On the other hand, the contemporary business environment has been more than willing to adopt measures that economize time via measures pulled straight from Taylorism (Quade et al. 2019, 1158). These measures are mostly not for the sake the employee but for the sake of the bottom-line s seen in the practices of Amazon. Amazon has been known to implementing innovative technologies and processes to streamline their operations and increase efficiency, often at the expense of their employees' well-being. (Quade et al. 2019, 1158; Briken & Taylor 2018, 439-340) This focus on maximizing profits through labor time economization reflects a larger trend in the modern business world, where time is seen as a valuable resource to be optimized for financial gain. The conditions of employees under these strategies fuel the fear of becoming irrelevant that is a common concern among workers, although historically, these fears have been unfounded, as new technologies have generally increased overall wealth in the long run. (Quade et al. 2019, 1161; Callard 2022,200) However, the rapid pace of technological advancement and automation in recent years has raised concerns about job displacement and the widening wealth gap. It is crucial for businesses to prioritize the well-being of their employees while embracing innovation to ensure a sustainable and equitable future for all. Nevertheless, the introduction and implementation of innovation and modernization require workers' involvement and participation. (Quade et al. 2019, 1158; Callard 2022, 200; Briken & Taylor 2018, 439-340)

The provision of goods and services in many societies cannot be satisfied by labor alone, necessitating the introduction of innovation and other policies to maintain the standard of living or promote migration and integration (cf. White 1962, 19; Cockshott & Cottrell 1992, 70). Labor laws and regulations that limit the total amount of available labor on the market and increase the cost of additional labor hours have become an important instrument for labor unions to negotiate. In a profit function, labor laws and regulations are essentially associated factors that affect the organization's cost and profitability. Nonetheless, the promise of innovation is uncertain and contains risk, while cost is certain. (Botero et al. 2004, 13381) Therefore, it is important to understand where internal innovation comes from, as it is not something that just drops on the organization but is created or implemented by workers. (Botero et al. 2004, 13381)

In addition to effective resource allocation, internal innovation is also a key aspect of innovation management. Internal innovation involves developing new ideas and products within an organization, rather than relying solely on external sources of innovation such as mergers and acquisitions. (Chesbrough 2006, 20-21, Lichtenhaler 2011, 76; Van de Vrande et al. 2010, 227) This approach can help organizations to better leverage their existing resources and capabilities, and to create a culture of innovation that supports ongoing creativity and experimentation. (Gupta et al. 2007, 886-887; Kanter 1983, 69-71)

Internal innovation can be a powerful driver of organizational success when implemented correctly and efficiently. Organizations with strong internal innovation capabilities have been found to be more likely to achieve higher levels of innovation performance, as well as greater market and financial success. This suggests that organizations that invest in developing their internal innovation capabilities are likely to see significant benefits in terms of innovation outcomes and overall business performance. (Hazem et al. 2020, 959, 962, 965; He & Wong 2004, 482; Arora et al. 2001,1-2)

2.2 Innovation management

Innovation management, process of strategically managing the development and implementation of new ideas, products, processes, and services within an organization (Tidd & Bessant 2013, 2), is a heavily studied field with a multitude of theories and models about innovation within organization (see for example Schumpeter1949; Bower & Christensen 1995; Duncan 1976). Often there is a focus on the profit increasing aspect of innovation and how to profit from innovation – Tidd and Bessant, (2014, 32-41) suggest that innovation management can help organizations to achieve competitive advantage and increase profits by continuously generating and implementing new ideas. This profit driven viewpoint follows the ideas laid by Schumpeter (1949) and, to the credit of the scholarship, seems to be owing to the demand for practical managerial applications and reasoning. Yet this viewpoint, where not an unjust one due to the nature of business, is missing a large segment of the phenomenon of innovativeness by boiling it down to a mere tool for more profit. (cf. Schumpeter 1949; Davila et al. 2016, 2; Hult et al. 2004, 438) The importance of human capital and culture management in innovation should not be forgotten and therefore, to fully understand the phenomenon of innovativeness, it is crucial to consider both the practical and human aspects of innovation management. (Edmondson & Nembhard 2009, 130-131; Hirst et al. 2011, 625-626; Amabile & Kramer 2011, 40-41)

2.2.1 Human capital in innovation management

The human capital and culture management discussed until this point can be termed as humanistic approaches to management and will be referred to as such from here on out in this section. Humanistic approaches in innovation management and worker well-being are essential in recognizing the fundamental role of human creativity and individual participation in innovation activities (Nonaka & Takeuchi 1995, 17). These approaches acknowledge that human creativity is the principal factor in organizational innovation and is both the spark and the fuel in innovation processes. Encouraging individual creativity is crucial for organizations to develop and innovate, and recognizing and encouraging individual creativity is essential for managing innovation at the organizational level. (Nonaka & Takeuchi 1995, 17) Humanistic approaches foster innovativeness and worker well-being by emphasizing people-centric processes, human interaction, and the role of knowledge workers in embedding knowledge within the organization. This approach acknowledges that human creativity is the principal factor in organizational innovation and is both the spark and the fuel in innovation processes. Encouraging individual creativity is crucial for organizations to develop and innovate, and recognizing and encouraging individual creativity is essential for managing innovation at the organizational level. (Martinez-Conesa et al. 2017, 560) Additionally, a human-centric approach to knowledge creation and innovation, emphasizes the significance of human creativity and organizational innovation. The literature calls for a move towards a human-centric innovation theory and highlights the importance of human interaction, dialogue, and practice as the basis for knowledge creation. This approach focuses on valuing human creativity, encouraging continuous and holistic learning, and promoting transformational and distributed leadership, all of which are essential for fostering innovativeness and worker well-being within organizations. (Pirson et al. 2019, 56; Martinez-Conesa et al. 2017, 555)

Critics might argue that prioritizing worker well-being and individual creativity could potentially hinder productivity and the feasibility of implementing such approaches within organizations. (Karwowski & Lebuda 2016, 216) However, the research suggest that humanistic approaches not only contribute to worker well-being but also foster innovativeness within organizations (Nonaka & Takeuchi 1995, 17; Karwowski & Lebuda 2016, 216). The emphasis on human creativity, individual innovation, and dynamic human resource management indicates that humanistic management can enhance productivity by creating a supportive and inclusive work environment (Nonaka & Takeuchi 1995, 17). The literature on human-centric approaches to knowledge creation and innovation underscore the significance of human creativity and organizational innovation, providing evidence that humanistic approaches can indeed contribute to organizational success and innovativeness. Therefore, while concerns about productivity and feasibility may arise, the evidence presented in the documents supports the notion that humanistic management and approaches in innovation management can yield positive outcomes for both workers and organizations. (Nonaka & Takeuchi 1995, 17)

As shown, humanistic management can improve productivity and feasibility by fostering a work environment that values individual creativity and well-being. This approach acknowledges the fundamental role of human creativity in innovation activities, which can lead to increased productivity through the generation of new knowledge and valuable ideas. (Nonaka & Takeuchi 1995, 20; Karwowski & Lebuda 2016, 216) Additionally, humanistic management emphasizes the importance of knowledge workers in embedding knowledge within the organization, contributing to sustained competitive advantage and long-term organizational success. By recognizing and addressing dignity gaps in organizations, humanistic management fosters a work environment that values and respects employees, leading to increased job satisfaction, motivation, and overall well-being. This, in turn, can enhance organizational innovativeness by creating a supportive and inclusive culture that encourages creativity, collaboration, and the pursuit of innovative solutions. (Pirson & Lawrence 2009, 560; Tidd & Bessant 2013, 181) The long-term benefits of humanistic management for organizational success and worker well-being are evident in the research and insights provided in the documents.

Innovation management is at large part human capital and culture management (Shahnaei & Long 215, 52). Creating a culture of innovation is essential to foster a work environment that encourages and supports innovative thinking and practices. (Tidd & Bessant 2013, 181; Davila & Shelton 2016, 24; Hult et al. 2004, 433, 435) A positive work environment that values employee wellbeing has been found to be positively associated with innovation. (Pirson & Lawrence 2009, 560; Baer & Frese 2003, 53-54; Amabile & Kramer 2011, 105) This is because workers who are happy and healthy are more likely to engage in proactive behaviors, such as problem-solving and idea generation. (Baer & Frese 2003, 53-54; Amabile & Kramer 2011, 105) The concept of job autonomy, which refers to workers' ability to have control over their work tasks and decisions, has been found to be positively associated with employee wellbeing and innovation. Job autonomy requires appropriate resources to be afforded to the worker and as such resource management has a key role in innovation management. (Fernandes et al. 2018, 96-97; Amabile & Kramer 2011, 105)

2.2.2 Resource management in innovation management

Resource management is a critical component of successful innovation management, as it involves allocating resources such as funding, personnel, and technology to support innovation initiatives. (Fernandes et al. 2018, 97) Effective resource allocation is critical for successful innovation, and that organizations should focus on allocating resources strategically based on their innovation goals and objectives. This involves balancing short-term resource needs with longer-term innovation goals, as well as prioritizing resources based on their potential impact on innovation outcomes. (Klingebiel & Rammer 2014, 264, 265-266; Hafkesbrink & Schroll 2014, 4-7, 11-12) In order to effectively manage resources, especially for internal innovation, organizations must develop robust processes and structures to support innovation initiatives. This includes creating clear innovation goals and objectives, establishing dedicated innovation teams or departments, and providing training and support to employees to foster a culture of innovation. (Tidd & Bessant 2013, X; Vanhaverbeke & Grimpe 2016, 527-537)

Such factors help to fully realize the potential of job autonomy for driving innovation. Additionally, organizations may need to invest in new technologies or infrastructure to support internal innovation initiatives, such as innovation labs, internal software's, or digital platforms for collaboration and ideation. (Den Spiegelaere et al. 2014, 4-6) Overall, effective resource management and internal innovation are critical components of successful innovation management. By allocating resources strategically and developing strong internal innovation capabilities, organizations can foster a culture of innovation and drive ongoing growth and success in their industries. (Crossan & Apaydin 2010, 1155; Den Spiegelaere et al. 2014, 4-6)

2.3 Defining Cybernetics

The thesis follows the definition of cybernetics set by Wiener (1947) and expanded by Ashby (1956) and later Beer (1972) as it is the foundational definition for cybernetics in the context of organizational management. According to Wiener (1948, 19), the founder of cybernetics, the field is concerned with the study of feedback and its control in machines and living organisms. The application of cybernetic to the design of machines and systems can help to improve their performance, reliability, and efficiency. (Wiener 1948) Similarly, Ashby (1956, 3) defines cybernetics as the study of the behavior of systems that can receive, processing, and transmitting information. Cybernetic theory aims to handle complexity through the concepts and principles of variety, circularity, process, and observation. (Wiener 1947, 19; Beer 1981, 2; Ashby 1956, 3)

Variety in relation to cybernetics is a term used to describe the information available to us about the state of a system. The variety of a system must be understood to control the system. Variety is a key concept in cybernetics as it relates to Ashby’s Law of Requisite variety which informs the cybernetic approach to managing complexity. The law states that complexity can only be managed with a requisite variety of equivalent complexity. The implication of which is that a system will fail unless the variability matches the of its environment. (Heylighen 2001, 157)

Circularity means the simple feedback loop at the core of cybernetics; A feedback loop is a closed system where the output of said system is routed back as inputs creating a causal loop. (Wiener 1947, 19; Beer 1981, 2; Ashby 1956, 3) For a system to be considered cybernetic it must have the components of a sensor, controller, and activator (Fig.1). The Sensors detect environmental or system conditions. The comparator determines whether a system change is necessary based on sensor readings, and the activator initiates the change. These three factors work together to regulate how a system functions and changes throughout time. (Squara & Journois 2009, p.4)

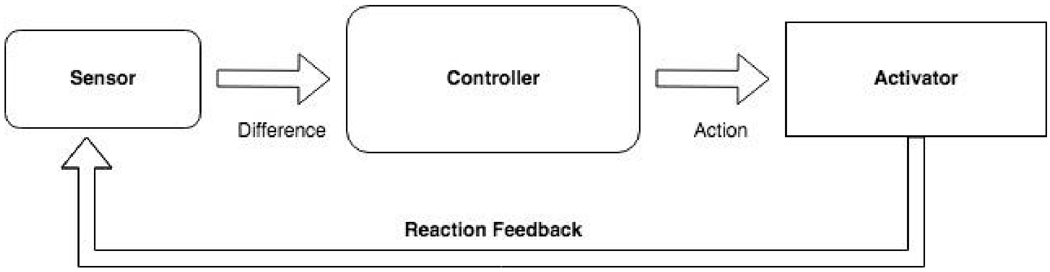

Figure 1 Cybernetic feedback loop

A popular example of this is the feedback loop of a self-adjusting thermostat. The thermostats sensor monitors the temperature of the room and compares this to the pre-set temperature (controller). If a difference is detected between the room temperature and the controller this prompting the thermostat to cool or heat the room until it matches the pre-set temperature. As with any feedback loop output or result of action is sent back into the system for the system to be able to continue adjusting. A positive feedback loop is created when the data causes the system to continue cumulatively moving forward – In the case of the thermostat this would mean the continuous rise of the room temperature. Compared to this to a negative feedback loop in which the data produces a result in an action in the opposing direction. The effects of a negative feedback are stabilizing such as a thermostat trying to keep a hot room cool. (Salen & Zimmerman 2003, p 1-2)

In cybernetics communication is information processing, with a goal of getting the most amount of information with the least number of disturbances. In other terms the purpose of cybernetic systems is to share information within its networks the most effectively it can. (Oberiri 2018, 21) The application of feedback systems and variety management rely on this effective and non-disturbed communication (Kripperndorff 1986) In short, Cybernetics is the interdisciplinary study of complex systems and the development of methods and tools for controlling and regulating them. It is based on the principles of feedback, control, and communication, and can be applied to a wide range of fields to optimize their performance and improve their efficiency. (Wiener 1948, 19; Ashby 1956, 3; Francois 1974, 5; Wallis 2009, 5, 7-10)

2.4 Cybernetic management

2.4.1 Viable Systems model

Where cybernetics can be applied to any field of study, it found its place in management theory after Beer (1972) wrote about it in his book "*The brain of the firm".* This landmark book brought the idea of an organization as systems that handle variety in an ever-changing environment. Beer states that though firms aim for stability, they often must adapt to said environmental changes which leads to an internal conflict. To solve this conflict, he created the viable systems model which boils down to balancing these two inevitabilities – stability and adaptation – of practicing business. (Beer 1972, 12-15, 63-65) Viable Systems model can be applied to any organization as long it meets the criteria to be considered a viable system – any system that is capable of self-regulation and adapting to environmental complexity while still maintaining internal stability aka a system capable of handling variety. Variety is the number of possible states of a system and what this looks like is determined by the purpose of the organization. (Beer 1972, 39, 63-65) The VSM offers different systems to balance the different types of variety of operation, environment, and meta-systematic management. (Ashby 1956, 65, 67; Beer 1972, 39, 63-65 & 1979; Lowe, Espinosa & Yeaworth 2020, 65, 118)

Viable systems model proposes the idea of organizations being a system composed out of interdependent sub-systems participating in a circular relationship with one another and to measure the performance of such systems the input of all actors must be taken into accounts including the true hours worked and performance of workers. (Beer 1959, 23, 25; Beer 1972, 27, 30; Espejo 1989, 1,3; Espejo 2020, 1432) These sub-systems are presented below.

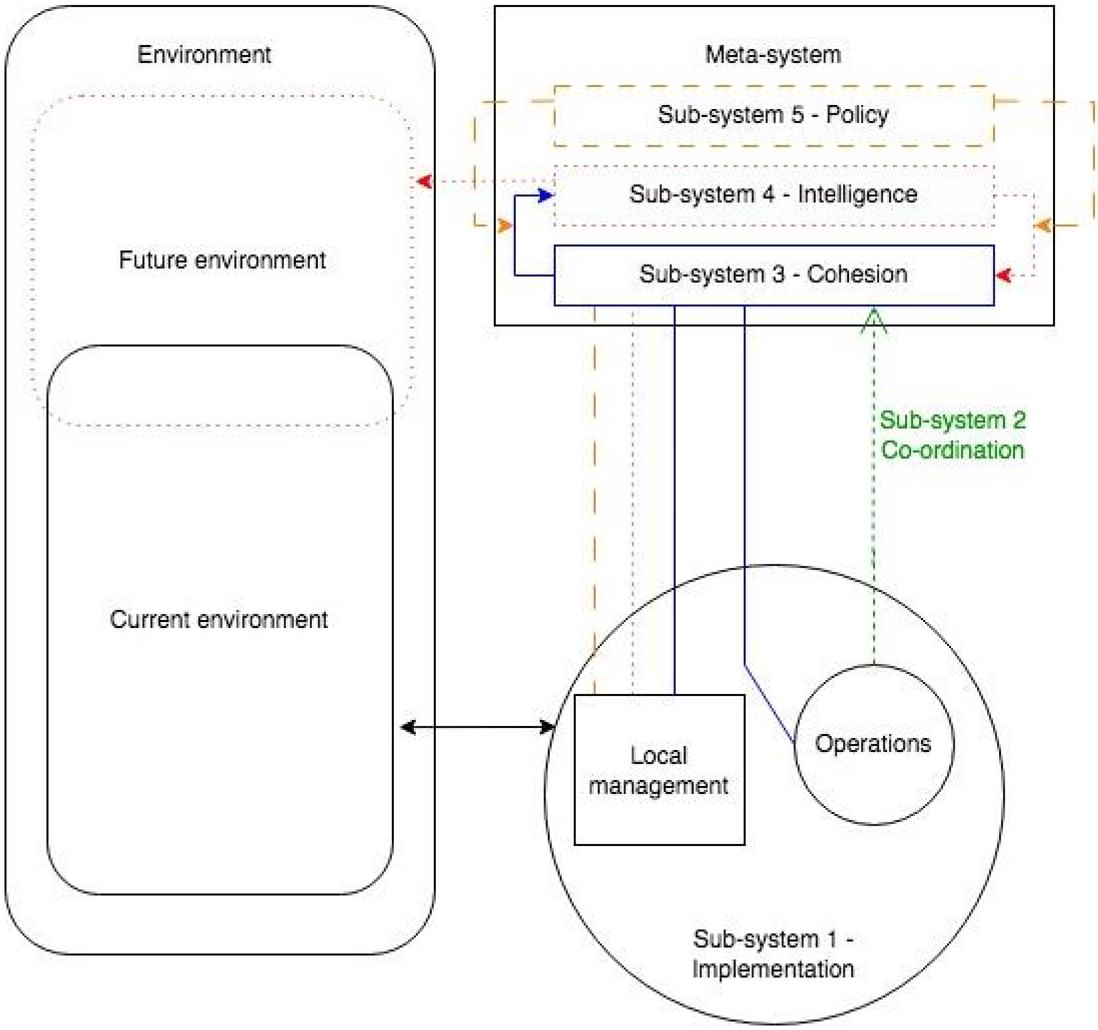

Figure 2 Viable System Model diagram modified from Dominici & Palumbo 2012, 158)

These sub-systems include implementation, coordination, cohesion, intelligence, and policy. The implementation sub-system (sub-system 1) involves primary units responsible for daily operations, while the co-ordination sub-system (sub-system 2) facilitates communication and coordination between different parts of the organization. The cohesion sub-system (sub-system 3) collects external data and transforms it into plans for the entire organization, and the intelligence sub-system (sub-system 4) defines objectives based on the plans developed by the intelligence subsystem. The policy sub-system (sub-system 5) focuses on the overall management style and continuous improvement within the organization. Sub-systems 4,3, and 5 make up a smaller feedback loop, a meta-system, within the bigger system. This thesis will mainly be using the numerical names of these sub-systems going forward as the names of the sub-systems do vary across research and articles. The most common varieties are sub-system 4 being called policy or strategy and sub-system 5 being called management or governance. It does need to be mentioned that though the terms and names given to these sub-systems vary, the purpose within the model does not. When discussing the viable systems model it needs to be emphasized that these sub-systems are not chronological steps but systems of their own existing and acting simultaneously in an environment. (Zlatanović & Mulej 2015, 498; Espejo & Harnden 1989, 3,7-8)

The VSM's design emphasizes the integration of these sub-systems to create a holistic and adaptable organizational structure. This interconnectedness allows the model to address the complexity of organizational management by providing a clear system for diagnosing and developing organizational structure. The model's design aims to ensure that the organization can effectively adapt and evolve to meet the changing demands of the environment, ultimately contributing to its long-term viability. (Beer 1972, 27, 30, 63-65; Espejo 1989, 1,3)

This provided framework for analyzing and designing organizations is capable of meeting the needs of both the workers and the organization as a whole and as such the adoption of these systems of control could also makes the position of management, as it is performed in most current organizational structures, obsolete (Beer 1981, 135,238; Espejo & Reyes 2011, 88; Lowe et al. 2020, 23, 233). These characteristics of the model have allowed it to be used to forward a socialistic management and economy, however it is to be noted that as cybernetics is an interdisciplinary theory and as such it can be applied to a range of ideologies and management styles. (cf. Cockshott & Cottrell, 1993; Lavanderos, 2020)

The Viable System Model exhibits a link to socialism through its emphasis on balancing internal operations with external demands, aligning with socialist principles of collective organization and adaptability. (Espejo & Reyes 2011, 88; Lowe et al. 2020, 23, 233; Cockshot & Cottrel 1993, 60) The VSM's focus on maintaining organizational viability and managing complexity resonates with the socialist ideology of collective organization, where the emphasis is on the collective well-being of the organization as a whole. The model's interconnected subsystems, which work together to ensure the organization's adaptability and survival, reflect the socialist principle of collective coordination and cooperation to achieve common goals. (Espejo & Reyes 2011, 88; Lowe et al. 2020, 23, 233; Cockshot & Cottrel 1993, 60; Zlatanović & Mulej 2015) Additionally, the VSM's emphasis on adaptability aligns with the socialist principle of being responsive to changing external conditions and the needs of the collective. This connection underscores the compatibility of the VSM with the principles of socialism, highlighting its potential applicability in organizational settings that value collective organization and adaptability. This relationship between cybernetics and socialism is complex and debated but the development of the largest cybernetic project – Cybersyn – was deeply influenced by socialist ideals and political commitments. (Joseph 2014) The Cybersyn project, initiated in the early 1970s under the government of Salvador Allende, aimed to create a real-time computer network to manage the national economy under the guidance of Stafford Beer. Beer, though not a Marxist himself, oversaw the deployment of the viable systems for and by the socialist regime of Chile in project Cybersyn (cf. Beer 1972; Medina 2011, 18). He believed in innate laws of organization that should and could be harnessed with development of new processes and systems that create abundance through efficiency. Being abstract and general, this abundance on a macro state level could look like free energy usage or on a micro-organizational level only working for two days but being paid for seven. For Beer these ideas of creating abundance are not idealistic nor political but what he perceived to be the best and logical state of matters. (Joseph, 2023) As this is the groundwork of management cybernetics it is easy to see how Cockshott and Cotrell (1993) built a more political and grounded in Marxism take on management cybernetics. These works, and many more (see for example Edmondson & Nembhard 2009; Tidd & Bessant 2013; Lowe, Espinosa & Yeaworth 2020) surrounding the themes, have contributed to ongoing discussions about the relationship between technology, innovation, and social organization.

2.4.2 Agile Viable Systems Model

Viable system model has an aim to manage complexity and use resources to create efficiency (Espejo 1990, 6-7). This same aim and principles are already present in very common management methods such as the agile method, especially Scrum. The general aim of Scrum is to focus on accumulating value and managing capacity (Schwaber & Sutherland 2020, 3) Viable systems model and Scrum are not identical in processes, yet there is a coherence existing between the models as Scrum does encompass major parts of VSM such as communication, feedback and circularity (Bogner & Wiesinger 2014, 167-169).Scrum as a framework is intentionally incomplete and is meant to be built on the collective intelligence of its users which is as much a benefit of the lightweight tool as it is a liability concerning reliability (Schwaber & Sutherland 2020, 3-4; Bogner & Wiesinger 2014, 167-169). The reasoning for this comparison is to demonstrate the viability of VSM as a management model for innovation management. Cybernetics as a functional science can be made relevant to the agile process model. By applying basic cybernetic principles, the process can be controlled and organized, and these deficiencies can be compensated to achieve the necessary reliability, especially in critical situations. (Bogner & Wiesinger 2014, 167-169; Iskanius et al. 2005, 50)

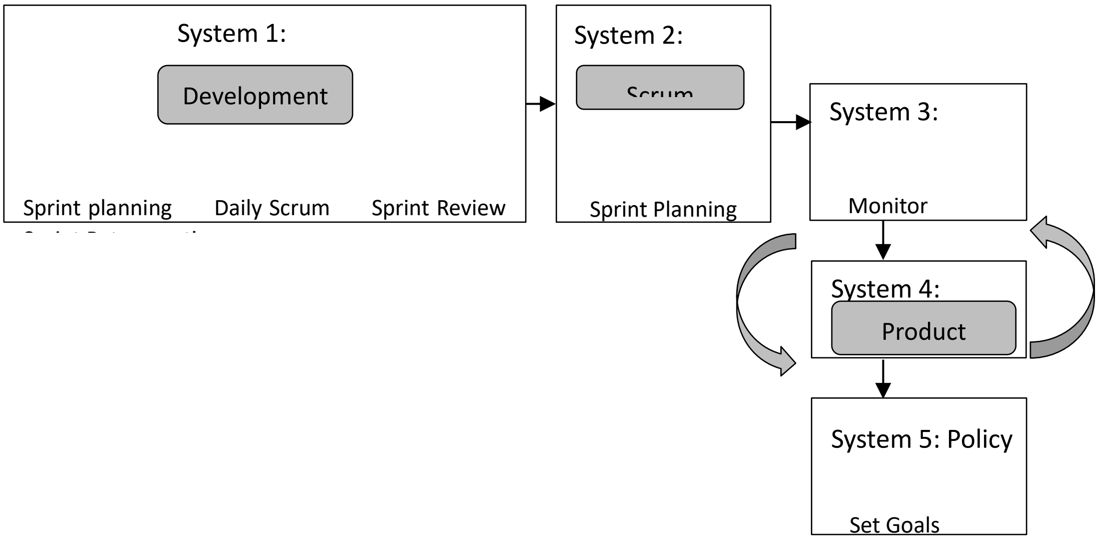

Figure 3 Example of Scrum within Viable System Model

The above figure is one example of how an existing agile system, Scrum, can be shown to not only demonstrate the viability of VSM as a management tool but also be integrated into VSM as is. The diagram represents a rough integration of the Scrum framework within the skeleton of Cybernetic Viable Systems Model. Each Scrum role and event is mapped to the corresponding subsystem in the Viable Systems Model. The figure is not to demonstrate exact application but the possibility of such.

As previously explained, sub-system 1 is concerned with the daily operations of an organization. In a Scrum setting, this would be the role of the development team. The tasks of the development team include sprint planning, the daily scrum meetings, sprint reviews, and retrospectives. During a sprint (completion of a set amount of work within a fixed timeframe) the development team works on a set of tasks determined during sprint planning. The team meets daily for scrum meetings to discuss progress and any obstacles. At the end of each sprint, the team presents their work during a sprint review and reflects on their process in a retrospective meeting. These tasks are essential for ensuring that the team is working efficiently and effectively towards achieving the goals of each sprint. The development team is responsible for delivering a potentially shippable product increment at the end of each sprint. (Schwaber & Sutherland 2020, 5-7; Zlatanović & Mulej 2015, 498; Espejo & Harnden 1989, 3,7-8; Bogner & Wiesinger 2014, 167-169)

Sub-system 2 is concerned with facilitating communication and coordination between different parts of the organization which in Scrum is the role of the Scrum master. The Scrum master plays a crucial role in removing any obstacles that may hinder the development team's progress and ensuring that the team is following the Scrum framework effectively. By facilitating communication and coordination, the Scrum master helps to create a collaborative environment where the team can work together seamlessly towards achieving their sprint goals. Sub-system 3 and 4 form a meta-system of a continuous feedback loop within the larger system. Via monitoring processes and the product owner data is collected to be analyzed and used for future development. The product owner is responsible for defining and prioritizing the features of the product based on the data collected. They act as a liaison between stakeholders and the development team, ensuring that the product meets the needs of the users and aligns with the overall goals of the organization. (Schwaber & Sutherland 2020, 6-7; Zlatanović & Mulej 2015, 498; Espejo & Harnden 1989, 3,7-8; Bogner & Wiesinger 2014, 167-169)

Within the viable systems model, sub-system 5 focuses on management styles and overseeing the overall systems functions on a broader level. Scrum does not explicitly have a set role or characteristic for this sub-system as it is a tool not a management style. Setting goals tends to come from beyond the scrum system, shareholders, or management. However, within the scrum framework, the Product Owner often takes on the responsibility of setting goals and priorities for the development team based on stakeholder input and organizational objectives. (Schwaber & Sutherland 2020, 5-7, 9; Zlatanović & Mulej 2015, 498; Espejo & Harnden 1989, 3,7-8; Bogner & Wiesinger 2014, 167-169)

As previously stated Scrum is not a one-to-one match to the viable systems model in form as Scrum is a specific methodology meant to be agile and adaptive while the viable systems model is a framework with specific roles and tasks. Yet, as shown here, VSM can be used as a lens for organizations to better grasp the functions within a Scrum and how to improve on them. (;Bogner & Wiesinger 2014, 167-169)

2.4.3 Cybernetic Socialism

As demonstrated above, cybernetics isn't exclusive to the socialistic agenda, however, the autonomic systems of control are seen by some as the 21st century solution to the Marxist goal of returning the means of production to the worker or at least balancing the power imbalances of the worker and management. (cf. Srnicek 2017, 157; Lavanderos 2020, 26; Baiocco et a. 2022, 28) A key scholar advocating for this type of cybernetic socialism is Paul Cockshott who introduced the use of VSM as a tool for socialism in his book Towards a New Socialism (Cockshott & Cotrell, 1993). Their work takes the ideas of worker exploitation, working off of the previous works of Marx, and proposes the implementation of cybernetic systems to eliminate it (Cockshott & Cottrell, 1993, 5-7). "Towards a New Socialism" does not discuss individual businesses or internal practices of such instead focusing on the larger economic landscape. It argues that traditional market-based approaches to managing the economy are inefficient and wasteful, and that a cybernetic approach could be more effective in allocating resources and meeting the needs of society as a whole. (Cockshott & Cottrell 1993, 5-6, 12, 127)

This vision of cybernetic socialism is based on the principles of the Viable Systems Model (VSM). In Cockshott's (1993) proposal, the economy would be divided into functional systems that mirror the VSM sub-systems. The functional systems would be coordinated and controlled through a central planning agency, which would use a combination of computer-based modeling and decision-making algorithms to allocate resources and make decisions about production and distribution. The planning agency would be responsible for setting production targets, determining the allocation of resources, and monitoring and adjusting the performance of the functional systems. (Cockshott & Cottrell 1993, 69-72) This macro environment proposal of "Towards a new socialism" (Cockshott & Cottrell, 1993) guides the thesis' take on how to introduce cybernetic management and VSM into the microenvironment. Cockshott (1993, 1-2, 5-6, 127) argues that a cybernetic approach to economic planning would be more efficient and effective than traditional market-based approaches, as it would allow for more accurate forecasting and planning of resource allocation and would eliminate the waste and inefficiencies associated with market competition. Though Cockshott's arguments are focusing on the economic system as whole these same arguments in theory are applicable in a smaller scale as the foundational ideas of Beer state, VSM can be applied to any system regardless of size or mode. (Beer 1972, 40; Cockshott & Cottrell 1993, 69-72) Additionally, Cockshott argues that a cybernetic approach would allow for greater democratic participation in economic decision-making, as decisions about resource allocation and production targets would be made through a transparent and participatory process. (Cockshott & Cottrell 1993, 9, 56, 99) The viable systems model serves to improve worker's rights through the implementation of transparent communication channels, participatory decision-making processes, and fair labor practices. By emphasizing the importance of autonomy, self-regulation, and accountability within organizations, this model aims to create a more equitable and empowering work environment for all employees. The sub-system structure enables the implementation of a system for grading labor, which can be used to gear rewards to effort. This system could involve grading labor into different categories based on productivity, with corresponding rates of pay. (Cockshott & Cottrell 1993, 33-35; Zlatanović & Mulej 2015, 498; Espejo & Harnden 1989, 3,7-8) Additionally, cybernetics can facilitate real-time decentralized control of the economy, providing up-to-date information to decision-makers and allowing for immediate appropriate action to be taken. This can help ensure that workers are compensated fairly based on their productivity and contributions to the economy. Additionally, the model encourages continuous feedback and adaptation to ensure that labor practices remain ethical and effective in meeting the needs of both employees and the organization as a whole. (Cockshott & Cottrell 1993, 54-56; Zlatanović & Mulej 2015, 498; Espejo & Harnden 1989, 3,7-8)

By taking the visions of these scholars into small-scale we can deduce that VSM has the potential to improve efficiency through worker participation, better resource allocation and planning-based economics. These procedures and strategies are also present in the innovation management literature as accelerators of innovativeness. It must be said that though the link of management cybernetic to socialism and workers benefit is undeniable it is not without its criticism. When studying companies that have applied algorithmic work controls that are tangential to the cybernetic ideas and models, these controls are seen as dehumanizing and violating by the workers. (Mahnkopf 2020, 49-53) This apparent contradiction of cybernetic-like solutions with worker satisfaction could be seen as a result of the solutions being put in place with the intent only to serve the company's interest. These technological work controls can be classified as Neo-Taylorism over cybernetic management as they focus on the pure measurements and surveillance of performance more than truly aiming for efficient and better working conditions. (cf. Zuboff, 2019; Delfanti, 2019, p.4-5, 6-7)

2.5 Synthesis

In order to establish the foundation for a systematic review and integrate the various components that have been discussed, it is essential to amalgamate the theoretical discourse into a unified framework. This will enable the creation of a cohesive whole from the preceding elements. The below figure 4 represent this framework.

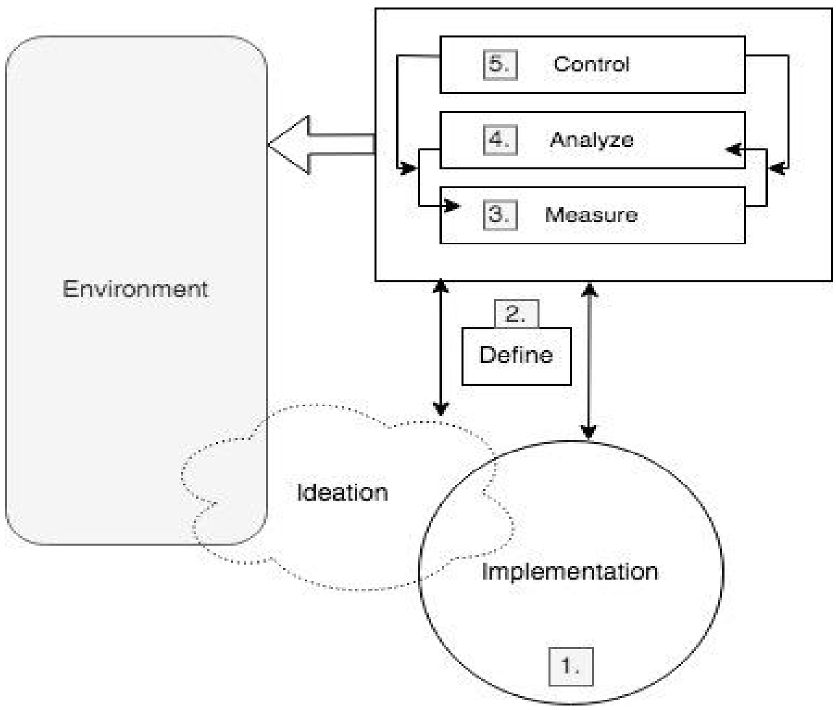

Figure 4 Theoretical framework.

The framework represents the integrate of the viable systems model and an innovation process model. For the purposes of formulating the framework, an innovation model has been chosen to act as proxy to innovation management. The chosen innovation model is an innovation process model derived from the prevalent 5 phase/stage model commonly used in innovation studies and articles (see for example Desouza et al. 2009, Sahin 2006; Cooper 2015). The model has five phases that will be termed as ideation, define, measure, analyze, implementation, and control. Usually, these phases are presented linearly as steps or gates that come after each other.

Even when the representation has cyclical elements it tends to remain quite iterative. The model is followed from point 1 to 5 and then repeated as is in the same order until desired results are achieved. This process type model represents the outlook on innovation that this thesis seeks to change. Figure 4 shows the phases of the innovation process model plotted into what is a modified viable systems model.

Ideation exists in the relational space between environment and sub-system 1. The indication is that though traditionally ideation is presented as the first step of the innovation process developing from the environment, innovation doesn't exist in a void. Ideation can and does arise from the day-to-day operations. Define is serving the same function as sub-system 2 in that it acts as the coordinator between all sub-systems. Where ideation is an important phase of the innovation process, defining the ideas serves arguably just as an important role in ensuring that the ideas are clear, feasible, and aligned with the overall goals of the organization. Without a clear definition of the ideas generated during ideation, the innovation process may lack direction and purpose. Serving as sub-system 2, Define plays a crucial role in translating abstract ideas into actionable plans that can be implemented within the organization. By providing clarity and structure to the innovative concepts, define helps to bridge the gap between creativity and execution, ultimately driving successful innovation outcomes.

Within the innovation process model Measure, Analyze and Control serve as key components to ensure that the desired outcomes are achieved. These steps involve collecting data, evaluating results, and making necessary adjustments to improve performance and meet objectives. The components makeup the same meta-system as sub-systems 3, 4, and 5. Similarly to the meta-system, the components are interconnected and form a feedback loop of their own within the bigger cybernetic system itself. The interconnected nature of these components allows for continuous improvement and adaptation to changing circumstances. The purpose it to closely monitor performance metrics and analyze data in order for organizations to identify areas for improvement and make informed decisions to drive innovation forward. Environment exists as the plane on to which innovation gets released into as well as the influence from which innovation can be born from. The framework establishes the theoretical foundation for how this thesis explores the integration of innovation management and cybernetic management. Where previous literature has introduced cybernetic and systems thinking principles into innovation management, this thesis seeks to do the opposite and bring innovation management into the set parameters of cybernetics through plotting innovation theory into the viable systems model.

3 Research design

3.1 Research approach

In conducting a study, it is crucial to select the most appropriate research approach for said study to obtain valid and reliable findings. The research approach chosen should be in line with the research question and objectives of the study. (Johnson & Onwuegbuzie 2004, 17; Sandelowski 2000, 334-335) For this thesis, a systematic literature review approach was chosen due to its suitability for analyzing and synthesizing existing literature. When aiming for fundamental knowledge advancement it is necessary for this to happen from prior existing knowledge (Xiao & Watson 2017, 93-94).

Systematic literature review is a rigorous and systematic approach to reviewing existing literature that is increasingly being utilized in various research fields (Fisch & Block 2018, 103-104). This approach provides a comprehensive summary of the current state of knowledge on a particular research topic and identifies research gaps and future research avenues (Fisch & Block 2018, 103). By systematically examining a vast body of literature, systematic literature review can provide an objective and unbiased analysis of the literature, leading to more reliable conclusions (Pittaway 2008, 4-5). Given the interdisciplinary nature of this study and the need to obtain a comprehensive understanding of the potential benefits of cybernetics in the innovation process, a systematic literature review is a suitable research approach. With the significant amount of literature available on the topic of cybernetics and innovation, a systematic review will allow the researcher to identify and synthesize existing knowledge, as well as identify gaps in research that need to be addressed. The approach will enable the researcher to analyze and synthesize the information gathered to identify patterns and themes in the literature, answering the sub-questions. (cf. Tranfield, Denyer & Smart 2003, 209-210) By conducting a systematic literature review, the researcher will be able to make valid conclusions and recommendations based on the analysis of the available literature (Tranfield, Denyer & Smart 2003, 209-210) Furthermore, a systematic literature review approach is valuable for the current study because it ensures the research process is conducted in a systematic and transparent manner. The approach follows a set of explicit, systematic principles and methodologies, which helps minimize bias in the selection and analysis of the literature. (Denyer & Tranfield 2009, 673) Thus, the systematic literature review approach guarantees the study's transparency, replicability, and validity which make it an ideal research method for this study (Denyer & Tranfield 2009, 685-686). By following this approach, the study can provide an objective and comprehensive summary of the current state of knowledge on the subjects of study, identify research gaps, and offer recommendations for future research

Following Xiao and Watson (2017, p.103) the process of a systematic review can be divided into three phases. (Fig 5.)

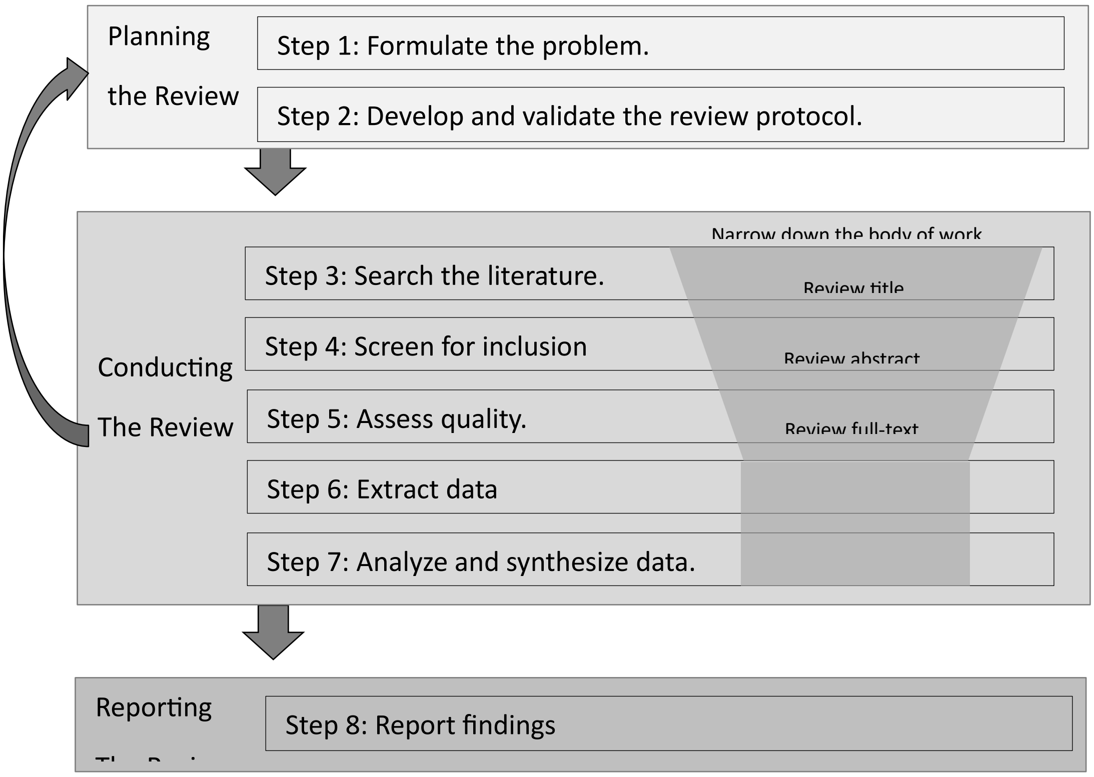

Figure 5 Process of systematic literature review (Xiao & Watson, 2017, p.103)

The first phase of planning the review involves developing an appropriate research question to establish a clear focus for the study the significance of which cannot be overstated (Xiao & Watson 2017, 102-103). The research question drives the entire systematic review process and acts as a guiding framework directing the selection and analysis of relevant studies (Xiao & Watson 2017, 103). To ensure a focused and answerable research question consideration of the topic should be given in order to align it with the objectives of the study. The research question needs to posse's explicit motivations that justify its significance (Aslam & Emmanuel 2010, 49)

A common problem that is made at this point is selecting a question that is too broad (Xiao & Watson 2017, 103; Cronin et al. 2008, 39). The first draft of the research question “How could cybernetics be used to better worker's rights in an innovation management context?" for this study was not necessarily too broad but contained too many variables making it unfeasible. However, during the initial scoping, it became evident that the scope of the study would balloon too large for a thesis. After the pre-reviews of the papers the initial research question was narrowed down to focus on the integration of cybernetics and innovation management leaving out worker’s rights aspect for future or follow-up research. Consequently, multiple modifications are made to refine the research question, ultimately leading to a revised final version.

Second in this phase is development and validation of the review protocol (Xiao & Watson 2017, 103). The review protocol is a preset plan specifying methods utilized in conducting the review (Xiao & Watson 2017, 103). This is crucial in order to conduct a rigorous and reliable systematic review (Xiao & Watson 2017, 103). A review protocol mitigates and aims to reduces possibility of researcher bias in data selection and analysis. It also allows for better cross-check and verification of the study as well as a reproduction studies. The protocol should consist of purpose of the study, research questions, inclusion and exclusion criteria, search strategies, quality assessment criteria and screening procedures, data extraction strategies, synthesis, and finally reporting. (Xiao & Watson, 2017, p.103)

Inclusion and exclusion criteria are established to determine the eligibility of studies for the review. For this study these criteria were based on the research question and applied consistently during the screening process. The initial eligibility criteria were broad to begin with and during initial scoping of data were refined to include only studies directly related to the research question. These criteria consist of key terms that must be present in the title or abstract of reviewed studies. The studies are also required to be available online in-full, in English, and no more than ten years old.

Once the fundamental core of the review has been set, the study is able to progress conducting it through search for literature and screening.

3.2 Methods

This chapter outlines the methods and methodology employed in conducting a systematic literature review utilizing qualitative methods. It begins with a justification for the choice of qualitative methods, acknowledging potential criticisms and limitations, followed by a description of the systematic approach used in the review process.

Originally the systematic literature review was to be conducted by employing a mixed methodology. The key justification for adopting a mixed methods approach was that the research question for this thesis is such a complex and multifaceted one, that it would be difficult to solely use quantitative or qualitative methods to conduct the review. From the initial scoping, it was also recognized that the data requires a mixed approach as to not limit it in a way that might affect the comprehensiveness and validity of the study. The approach of mixed methods enables extraction of rich qualitative data including diverse perspectives, interpretations, and experiences on top of the more objective and representative quantitative data (Popay et al. 2006, 11-14). However, the initial scoping was misdirecting as once the data collection started mainly conceptual papers were identified together with a couple of qualitative papers. Due to the conceptual nature of the dataset, it was decided that a qualitative methodology was more fitting for this thesis instead.

Qualitative methods were selected for this review due to their suitability for exploring complex and nuanced concepts within the subject matter of this thesis. As the focus of the review is on conceptual papers, qualitative methods offer the flexibility to delve into the underlying theories, frameworks, and perspectives present in the literature. By employing techniques such as thematic coding and analysis, qualitative methods allow for a rich understanding of the diverse viewpoints and theoretical contributions within the field. (Braun & Clarke 2006, 78; Jaakkola 2020,20) Conceptual papers often propose novel ideas, theories, or frameworks without relying on empirical data. (Jaakkola 2020,20) Qualitative methods are well-suited for synthesizing and interpreting such conceptual contributions, as they enable researchers to identify common themes, theoretical constructs, and theoretical gaps across a body of literature. Through a qualitative lens, this review aims to uncover the underlying conceptual underpinnings of innovation management and cybernetics, providing insights into the theoretical landscape of these domains. (Attride-Stirling 2001, 390-391; Braun & Clarke 2006, 92)

While qualitative methods offer numerous advantages for conducting a systematic literature review, there are also potential criticisms that warrant acknowledgment. One such criticism is the subjectivity inherent in qualitative analysis, which may lead to biases in data interpretation. To mitigate this risk, a rigorous and transparent protocol was followed. Attride-Stirling 2001, 401)

Another criticism is the potential difficulty in generalizing findings from qualitative studies. As the focus of this review is on conceptual papers rather than empirical research, the goal is not to generalize findings to a specific population but rather to synthesize and interpret the theoretical insights present in the literature. (Attride-Stirling 2001, 401) By contextualizing the findings within the broader theoretical framework of innovation management and cybernetics, the review aims to contribute to theoretical advancements these fields rather than making empirical generalizations. Qualitative data can act as hypothesis or framework generator of which can be further tested or refined using quantitative methods. (Attride-Stirling 2001, 390; Braun & Clarke 2006, 97)

3.3 Data collection

After the research protocol has been finalized, comes identifying relevant studies, Step 3 – Search the Literature (Xiao & Watson 2017, 103). The protocol needs to be set before this step as it is the systematic strategy that ensures a broad and unbiased review (Denver & Tranfield 2009, 682). The eligibility criteria for this study includes that studies have to be available online, meaning that solely electronic databases were utilized to search for relevant literature. The databases used for this thesis were Scopus and Volter. Web of Science was intended to be used but at the start of conducting the data collection it was deemed an unsuitable database for the research. This was due to the much higher percentage of unrelated data that the intended keywords included in the initial searcher when compared to the other two databases. The concept of "cybernetics" was identified to be the problem as Web of Science did not successfully exclude the non-business studies from the pool of data. In order to further obtain a complete list of literature, a backward search was performed. In this method the list of references of identified studies are searched for other relevant studies. To ensure that the search captures the key concepts of the research question, keywords were carefully selected and further refined. These keywords and search terms were broadly laid out in the study protocol but during this phase some discrepancies with the use of terms within the studies was found, such as "cybernetic management", which did not have one singular definition across all the studies and was excluded for the potential of distorting data. The keywords are a mixture of broad concepts and specific terms in order to balance exhaustiveness and precision (Wanden-Berghe & Sanz-Valero 2012, 84). The studies identified through keyword searches, have gone through a screening procedure, to see if the studies should be included for data extraction. These screening criteria for exclusion and inclusion have been previously set out in the research protocol, but some refinements did happen along the way as more of the topic was explored further. This keyword search was performed with a Boolean search function (Fig. 6). The Boolean function was formed by Scopus after an initial keyword string search. Initial screening was done at this phase to limit the number of search results done by using the database filters. The filters used in both databases were "publishing year >2012" and the limitation of subject area to "Business, Management, and Accounting"

cybernetics AND innovation, AND (innovation AND management) AND (cybernetic AND management) AND ((cybernetic AND management) AND NOT (organizational AND cybernetics)) AND viable AND systems AND (model OR variety AND management)

Figure 6 Boolean search function

The final step before setting out to extract and analyze data was to do an appraisal of the selected studies (Xiao & Watson 2017, 103-104). The included studies were critically evaluated by doing a quality assessment on them. The appraisal process involved assessing the relevance to the research question, the study's research design and methodology (Xiao & Watson 2017, 104). Various tools for this are available of which the Joanna Briggs Institute Critical Appraisal Checklist was employed for the quality assessment of the data in this study. This specific checklist was chosen as a tool due to its simple form and ease of use. The used checklist for appraisal is documented in the appendix of the thesis in order to provide transparency and enhance rigor of the study (Booth et al. 2012, 130).

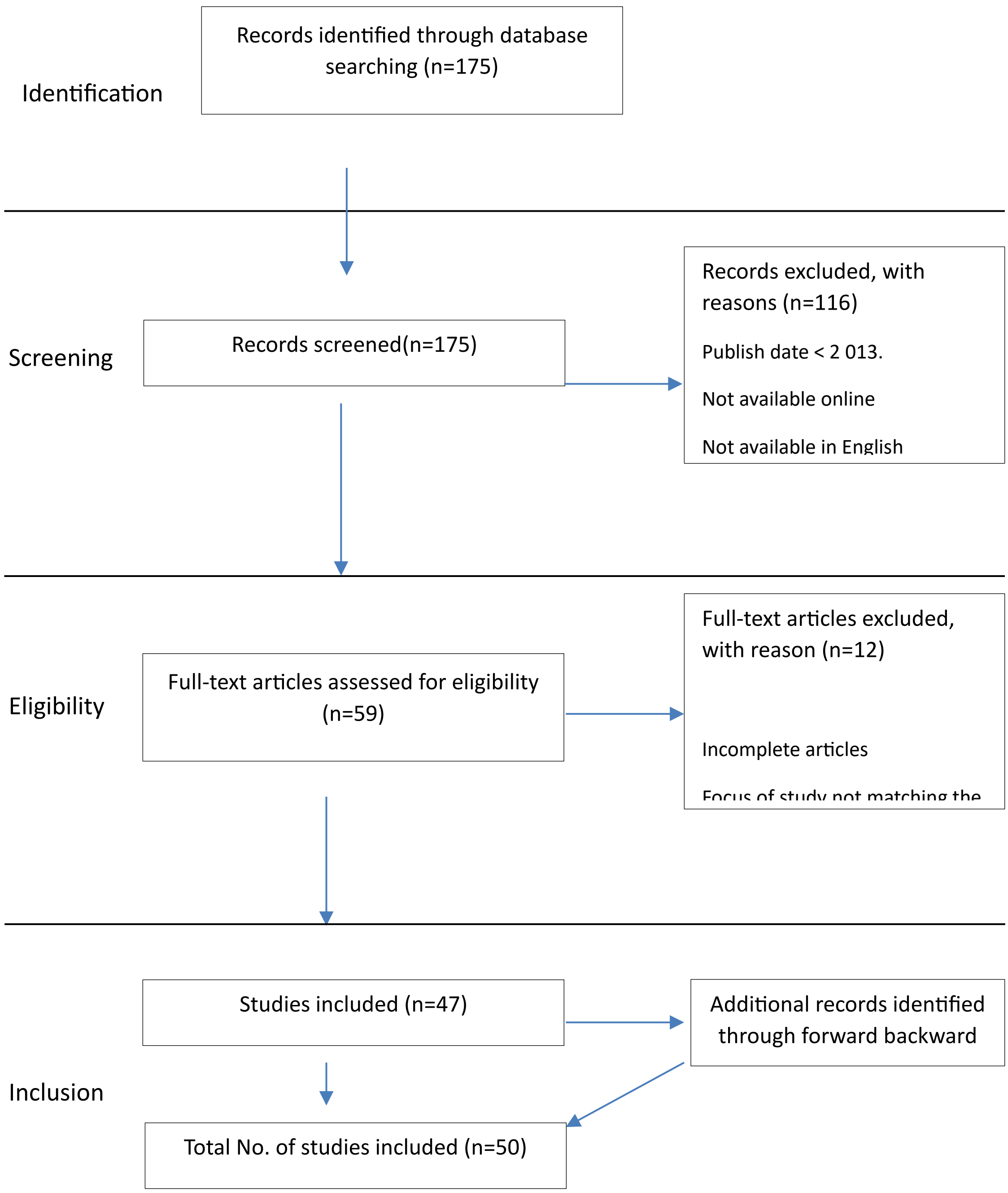

Figure 7 Modified from Example of literature search and evaluation for inclusion (Xiao & Watson 2017, 108)

Though the identification of records involved using filters for initial exclusion of studies that were published over 10 years ago, the extracted records were mainly too old for this thesis. The bulk of the identified articles were published between 1990 and 2012 with the largest spike in 2012. Extending the inclusion criteria by one year could have been justified with the larger pool of data that it would have created. The decision to not do this was done based on the want to stay true to the initial protocol and not skew the findings towards any direction based on later on findings. It was also due to the subject matter on innovation development being contextual to the time and place it is set in.

Once the data extraction was completed, the data was organized accordingly and analyzed. This analysis took the form of thematic analysis.

3.4 Data analysis

Data analysis plays a crucial role within the research process, allowing researchers to derive meaningful insights and draw valid conclusions from the collected data. The data analysis for this review involves a thematic synthesis following the critical realist approach drawing from Fryer (2022) who builds on Wiltshire and Ronkainen (2021). (Table. 6) This approach is data-led and ultimately seeks to find causality between factors. The data-led nature of this approach encourages the challenging of pre-existing ideas and theories that might lead a researcher to find preferable data that fits in. Thematic analysis involves identifying and examining patterns within datasets which in turn allows for a deeper understanding of the research question. By employing a critical realist lens to this, researcher can go below surface-level descriptions and identify underlying causal mechanisms and explanations that contribute to observed patterns.

Table 1 Summary of the five-step critical realist approach to Thematic Analysis (Fryer 2022, 3)

Step 1: Develop your research question	• Identify the experiences and/or events of interest, and develop one or more causal research question
Step 2: Familiarize yourself with the data	• Skim read a substantial portion of the data. • Make notes on initial thoughts and questions

Step 3: Apply, develop, and review codes	• Apply descriptive codes to the data using data-led approach. • Develop these codes by processes of standardisation and consolidating. • Review codes by assessing their validity
Step 4: Develop and review codes	• Develop themes. • Review themes by assessing their validity
Step 5: Generate conclusions and reports	• Reflect on the overall analysis and review validity of conclusions. • Consider how to best communicate the conclusions

3.4.1 Data preparation and Coding

The extracted studies that have gone through the identification and screening process were collected in an Excel sheet for the purposes of data preparation. Accordingly, the studies from the Excel sheet then were uploaded to NVivo for further coding. After this familiarization of the data and skimming of it was performed in order to form initial thoughts and ideas. The Excel file has the basic information of the studies as well as the main findings, and, key issues. (Appendix 1.) The main findings and key issues are from researcher's discretion.

The articles were carefully read through and coded for relevant information using NVIvo to identify important aspects from each study. These codes of relevant and crucial aspects were categorized into nodes of descriptive data describing key issues. These nodes were then consolidated into themes encompassing the key issues in order to align them with the research question. Following the Fryer framework (2022) to the review, coding began in NVIvo with a descriptive approach, relatively long and descriptive codes were created rather than using singular words (Fryer 2022, 6). Examples of such descriptive codes are "improved performance through development strategies" and "machine enabled systems thinking". The aim of this approach is to capture nuance within the data and attempt to describe data as it appears rather than pigeonholing them into abstract theories and concepts (Fryer 2022, 6). A snapshot of the thematic coding process including consolidation can be seen in figure 8. The decision to go with this approach came from wanting to capture the complexity of the research scope without the researchers incomplete understanding on the subject matter limiting the analysis. The benefit of this approach is that the data is allowed to surprise the reviewer and challenge bias rather than be used to strengthen pre-conceived notions that theory-led coding can do (Fryer 2022, 7). Though a data-lead approach encourages openness and challenges, it is important to understand that all research is affected by the ones before it and as such it inevitable that theory informs codes (Fryer 2022, 7). The descriptive codes naturally got more succinct as the initial coding progressed due to heuristic shortcuts started being formed around the subject matters and more theory was read.

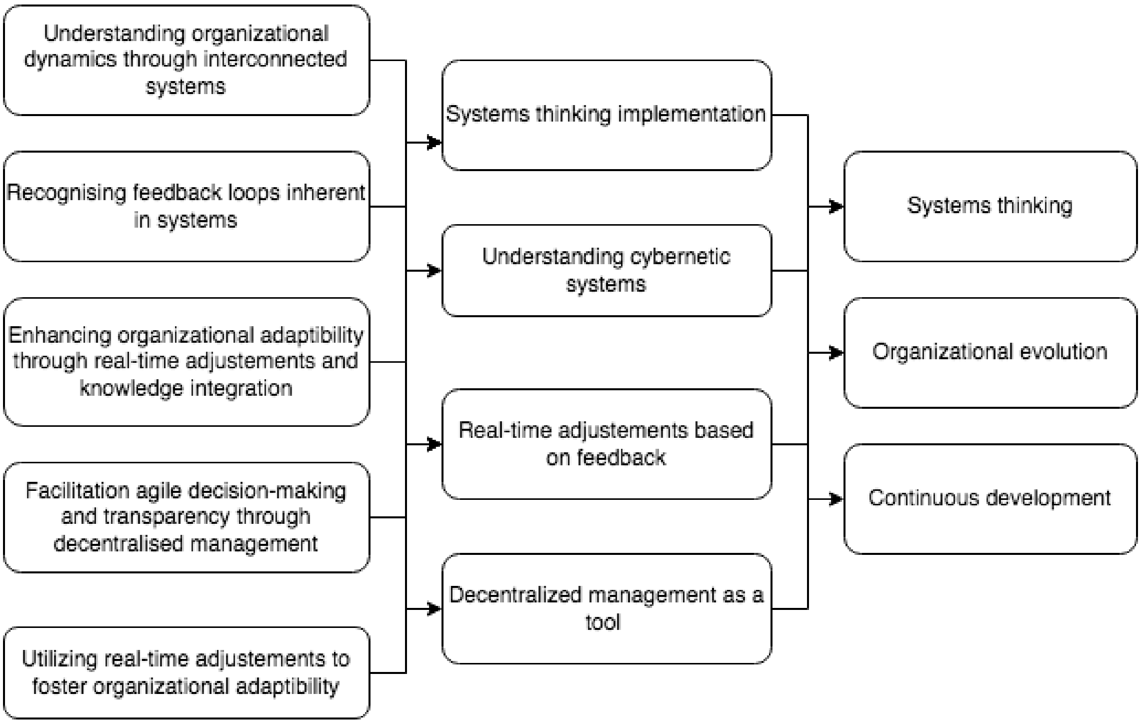

Figure 8 A snapshot of thematic analysis process

The coding was followed by two processes of categorization – standardization and consolidation (Fryer 2022, 7-8). During standardization, similar slightly differently worded codes are brought together as one code. Originally the idea was to give each code a number correlating to the research questions but in standardizing the codes the themes and concepts revealed themselves to be so interrelated that it would have been obsolete to try and separate them. All of the codes could be used to answer to all of the questions. During this standardization process is it key to reflect on the validity of the newly born codes by asking if the code accurately describes the data.

After standardization came consolidation. (Fryer, 2022, p.7-8) This is in reference to the procedure of matching the meanings of codes to general or theoretical terms and applying these as per identified. As with standardization, the validity of consolidated codes should be considered. (Fryer 2022, 7-8) The purpose of standardization is the remove near-duplicates and to serve to make further analysis easier, but the standardization of the descriptive codes served to be harder than expected. Many of the key concepts were descriptively coded using similar or identical language yet had dissimilar meanings and contexts. The term “system” served to create most challenges as it is used to refer to a multitude of concepts across the various articles. Consolidation of the codes followed suit by posing a challenge to the researcher. The over generalization of terms poses a danger of no longer reflect the data in a nuanced way (Fryer 2022, 7-8) and due to the interrelated nature of the key ideas represented by the codes maintaining needed nuance was challenging. The consolidation process resulted in the following six key themes.

- Systems thinking
- Organizational evolution
- Continuous development
- Human-centrism
- Sustainability strategies
- Risk readiness

3.4.2 Thematic Analysis

Various considerations were given and explored for managing the key issues and how these are connectable to the finalized key issues. The aim was to uncover implicit and hidden findings within the data, which can be done via careful contemplation and consideration to the structure and reasons behind the data (Xiao & Watson 2017, 101; Nowell et al. 2017, 2) In the approach followed for this review, a theme is defined as an overarching key idea or concept within the article (Fryer 2022, 10). These themes and the analysis of them aim to “outline how particular causal mechanisms produce the experience and events found in codes” (Fryer 2022, 10). As this is a critical realism thematic analysis, the nature of this step is to scrutinize causal claims existing within the identified codes and looking at the underlying experiences and events (Fryer 2022, 10; Nowell et al. 2017, 2). Previous works can act as a starting point for development of our explanations but should not as limiting factors for findings (Fryer 2022, 11). As long as the conclusions can be justified by reflection of validity it is okay for them to not be present in existing literature (Fryer 2022, 10). This reflection of themes and explanations should be performed all throughout the development and analysis. The researcher should consider the validity of themes and explanations developed to check if they are plausible and appropriate. (Fryer 2022, 11-12) Summarizing should be done while being careful to avoid losing essential insights in the synthesis process.

The coded data was analyzed and synthesized in order to create one coherent whole that encompasses and presents the most crucial aspects of the literature. This was done by generating conclusions and reporting findings appropriately. (Xiao & Watson 2017, 108; Coughlan 2008, 42-43). Firstly, the researcher should consider how these findings relate to the wider literature – points of agreement, disagreement, and extension on knowledge. Here the potential limitations of the research can be identified and reported. At this point gaps can be identified and recommendations for future studies are given. (Fryer 2022, 12). Secondly this is the change to reflect on the implications of the study beyond contribution to academia (Fryer 2022, 12).

3.5 Evaluation of the research

A bad quality study is not worth much and as such the evaluation of research quality is an integral part of the research process. In order to enhance transparency and rigor of the study, specific evaluation criteria can be used. For this study the criteria used is trustworthiness as proposed by Lincoln and Guba (1985) Trustworthiness is a guiding principle in assessing the rigor and reliability of, especially qualitative, studies. (Lincoln & Guba 1985, as cited in Loh 2013, 4) The idea of trustworthiness encompasses multiple component that make up the overall quality of the study (Loh 2013, 4). As posed by Lincoln and Guba (1985) these components are: Credibility, transferability, dependability, and conformability (Lincoln & Guba 1985, as cited in Loh 2013, 4)

Credibility is in reference to the extent to which the findings of the study are plausible and can be considered valid (Lincoln & Guba 1985, as cited in Loh 2013, 5). To establish credibility in this study various strategies were employed, such as triangulation of the data from multiple sources as well as throughout evaluation of this data through screening for accuracy, authority, objectivity, currency and coverage, and review rounds to validate findings. These measures help to ensure that the interpretations and conclusions accurately reflect the data. For this thesis the credibility of data was established by screening the journals in which the articles are published. Initially, the thesis was going to include grey-literature but as the subject matter has political connections to socialism which is a divisive subject matter, established journals that require peer-review were deemed to be the least time-consuming way to try and ensure academic rigor and credibility. The implications of the political connections in the subject being studied are that it can be highly polarizing and subjective, making it difficult to gather unbiased and reliable data. By focusing on established journals with peer-review processes, the credibility of the data used in this thesis was prioritized to mitigate potential biases and ensure academic rigor. Though grey-literature is not included in the study as a whole there are exceptions to this. Three conference papers are included in this thesis, as they meet the inclusion criteria set in the research protocol. The conference papers included are published through associations that require peer-review beforehand.

Transferability refers to the degree to which the findings can be applicable to other contexts or settings (Lincoln & Guba 1985, as cited in Loh 2013, 5). To enhance this, the research context is detailed, and data collection methods provided. The initial research question was also narrowed down as to not make sweeping generalizations within a highly contextual setting of workers' rights. The clear and detailed information of the context and methods enable readers to assess the applicability of the findings to their own contexts and determine the transferability of the results. However, weaknesses in transferability may arise as the context of the study is highly specific one, making it difficult for others to apply the findings to their own situations.

Dependability refers to the stability and consistency of the research findings over time. In order to establish dependability, the research process needs to be clearly documented. This will allow for replication and verification of the study. (Lincoln & Guba 1985, as cited in Loh 2013, 5) For this study the systematic literature review protocol serves the purpose of documenting the steps of data collection, coding, analysis, and interpretation, ensuring the replicability and transparency of the research process. The Boolean function that was used in data collection in order to establish replication. Yet, the Boolean function is highly contextual to the used databases and seems to not give identical results when used in other databases. The data collection also relied on filters outside of the function that can vary in results. Therefore, researchers should exercise caution when applying the same Boolean function across different databases and consider adjusting filters accordingly to ensure comprehensive data collection. Documenting these variations in data collection methods can enhance the transparency and reproducibility of future studies

Confirmability refers to the neutrality and objectivity of the research findings. This is to ensure that there is no undue influence by researcher bias or perception. To promote confirmability a researcher should maintain reflexivity and critically examine their own perspectives, assumptions, and potential bias. (Lincoln & Guba 1985, as cited in Loh 2013, 5) In this study the choice of a data-led coding was done for to mitigate bias and as such promote confirmability of the study. It does need to be stated that though the coding was data-led, the established theoretical base and the political bias affecting the sensemaking of the researcher will inevitably have had an influence on the creation of codes. Not only are the codes affected by researcher's bias and prior assumptions but also the prior mentioned Boolean function. The concepts and terms picked for the Boolean function were derived from scoping that was mainly informed by the researcher's previous knowledge and ideas on the subject matter.

Therefore, despite efforts to reduce bias through data-led coding, the researcher's own perspectives and assumptions may still impact the confirmability of the study.

4 Cybernetic innovation management

This section is built upon the initial framework proposed earlier. The purpose is to answer the research question by introducing, analyzing, and integrating the existing knowledge on cybernetic management in an innovation management setting.

In this section the findings of the review are described first in order to later discuss and synthesize the results of the qualitative synthesis. Through these steps the section aims to answer the research question.

4.1 Descriptive results from the systematic literature review

The 50 articles included for the review were published in 31 different scientific journals and 2 different conference papers. Table 1 presents the journals and the number of analyzed articles from each journal from most to least common.

Table 2 Sources of the reviewed articles

Systematic Practice and Action Research	10
Systems Research and Behavioral science	4
Technological Forecasting and Social change	2
Management Decision	2
Kybernetes	2
Futures	2
International Journal Business Communication	2
International Journal of Information Management	1
Culture and Organization	1
International Journal of Management Practice	1
International Journal of Procurement Management	1
International Journal of Stress Management	1
Journal of Economic Behavior & amp; Organization	1
Journal of Global Information Management	1
Journal of Global Scholars of Marketing Science	1
Journal of Knowledge Management	1
Library Management	1
Academy of Management Review	1
Bulletin of the American Meteorological Society	1
Business & Society	1
Business History Review	1
Construction Management and Economics	1
Culture and Organization	1
Human Systems Management	1
Humanistic Management Journal	1
Knowledge Management Research & Practice	1

Journal of Construction Project Management and Innovation	1
Procedia - Social and Behavioral Sciences	1
Strategic Direction	1
Organizational theory	1
Organization	1
Conference papers	
Conference: 32nd IBIMA International Conference	1
2013 IEEE International Conference on Systems, Man, and Cybernetics	2

As demonstrated in the above table 2 the most common journal was Systematic practice and action research with 9 papers from the journal. Systems Research and Behavior science has the second most papers with 4. These journals focus on the transdisciplinary systems sciences, systems thinking as well as the application and understanding of complexity. The majority of the papers are from a variety of journals with focuses varying from behavioral sciences and management to technology and cybernetics.

The articles, in accordance with the preset protocol, are from the past ten years with the oldest being from 2013 and the newest from 2023. Figure 2 shows that the papers published each year varies with a maximum of 7 papers published in 2018 and a minimum of 2 papers in 2017. The distribution of papers per year is not uniform, with a higher number of papers from 2018 and 2021.

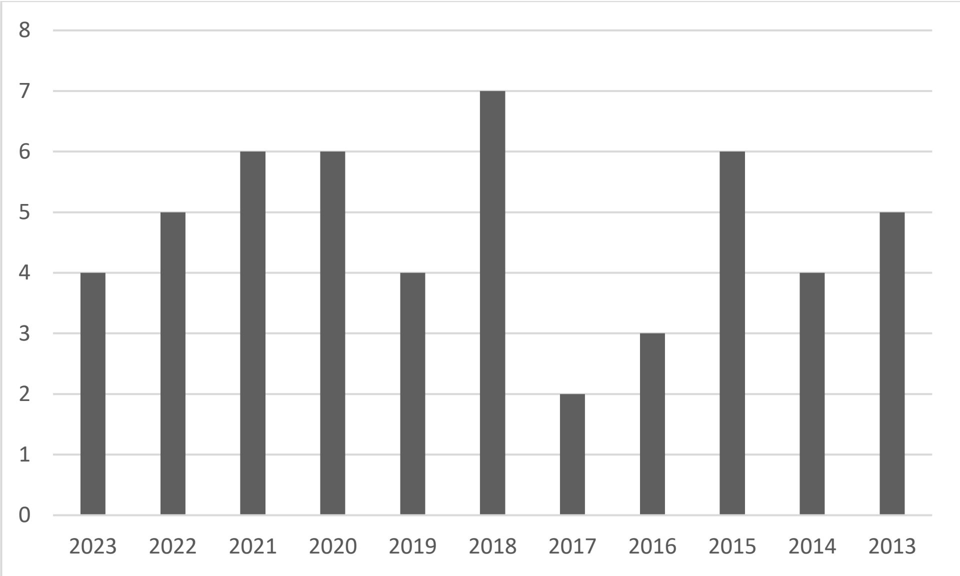

Figure 9 Yearly distribution of the reviewed articles

The papers are mainly conceptual with only 5 empirical studies out of the 50 reviewed being empirical. The empirical studies are divided further into 4 qualitative and 1 multi-methodology study. Questionnaires and interviews were the method of choice for these studies.

Conceptual papers being most represented in the dataset is illustrative of the nature of cybernetic management. The contextual setting of the papers varies from management and HR to technology and education. The issues within these phenomenon and themes are developed and answered through cybernetic methodologies which are conceptual.

4.2 Key themes in cybernetic management in an innovation management context

From the data collected, several key themes were identified across the articles that serve to answer the two sub-questions of this thesis as well as set the foundation for further development of the issues. Overall, 6 key themes were identified which can be seen in Table 3.

Table 3 Key themes in cybernetic innovation management

Key themes	Description
Systems thinking	Knowledge integration Hard system integration Real-time adjustments

	Resource optimization
Organizational evolution	Decentralized processes Non-hierarchical leadership Bottom-up management. Blockchain
Human-centrism	Work-life balance. Mitigation of work-stressors Employee empowerment Development and training Division of labor
Continuous improvement	Kaizen Participatory, multi-viewpoint methods Communication flows
Sustainability strategies	CSR
Risk readiness	Handling extreme complexity Balancing efficiency with decentralized processes Mitigation of change resistance

4.2.1 Systems thinking

The first theme is *systems thinking.* An idea present in the data is that moving forward there needs to be more integration of knowledge from various disciplines to address complex systems and foster a holistic approach to management.) Systems thinking is a way of approaching and handling complexity by viewing it in terms of wholes and relationships rather than breaking it down into individual components. It can be used to investigate and develop effective action in complex environments, enabling systemic change. (Vergne 2020, 2, 20; Medvedeva & Umpleby 2023, 1-2; Swann 2022, 196-197; Marsal-Llacuna 2020, 1-2) The articles analyzed focus on the importance of decentralized and “bottom-up” management practices and models as a way to ensure adaptive and participatory network-based systems. (Vergne 2020, 13; Davis et al. 2015, 335)

Table 4 Practices of systems thinking leadership (Davis et al. 2015, 345)

Practices	Description
Discovery	Explore and justify boundaries for inclusion of stakeholders and issues.
	Uncover values and assumptions of stakeholders through participatory practices.
	Identifying marginalized groups
Framing	Map patterns of behavior and model feedback loops
	Diagram relationships and identify points of leverage.
	Structure interventions, design frameworks for change

One such proposed model is *systems thinking leadership*. This model derives its benefits from the practices of discovering underlying values, framing problems as patters and systematic action when implementing change. These practices, shown in Table 2 are termed as Discovery, Framing, and Action respectively. (Davis et al. 2015, 345-348) The systems thinking leadership model can effectively be swapped in for the first step of another framework identified – 5X method (Table 5.). The 5X method's stage one is concerned with systematically broadening general knowledge and translating this into more effective process and teams of stakeholders. (Hassannezhad et al. 2023, 7)

Table 5 Modified overview of 5X methodology (Hassannezhad et al. 2023)

Exposing *problem complexity*	*Step 1 – Evidence synthesis and goal setting* *Step 2 – Mind-mapping and resource planning* *Step 3 – Participants' selection and planning* *Step 4 – Baseline map development*
Exploring *system structure*	Step 5 – Pre-workshop online polling Step 6 – Participant-driven prioritization scheme Step 7 – Designing scripts and prompts Step 8 – Eliciting data and aggregating maps
Exploiting *stakeholder's knowledge*	Step 9 – Network centrality analysis Step 10 – Network propagation analysis (computational modelling)
Explaining *system behavior*	Step 11 – Map sharing & individual / group appraisal Step 12 – Post-workshop valuation and feedback Step 13 – virtual scrutinizing meetings
Expanding *learning & application*	Step 14 – Reconciling the map Step 15 – Data integration (system level, component level)

The practice of discovery is building on the proposed idea that system's boundaries are not based in structural realities but on the interpersonal constructs of social systems. (Davis et al. 2015, 344) This practice is aimed at minimizing any marginalization of stakeholders. The article looked at multiple research studies analyzing participatory exercises of one of which underscored was appreciative inquiry. This is a strategy relying on a collaborative process of reciprocal interviews. The key principles within this approach are treating the organization as a whole system. (Davis et al. 2015, 344) Similar ideas are presented across the articles with the focus on participatory practices directed towards varied stakeholders. (Hassannezhad et al. 2023, 5-7). While the data shows that integration of multiple sources of knowledge and a multitude of viewpoints is beneficial to an organization there is a major challenge within collecting and acting on stakeholder boundaries. (Medvedeva & Umpleby 2023, 4-6; Swann 2022, 5, 11; Marsal-Llacuna 2020, 2-3; Davis et al. 2015, 346) The boundaries of various stakeholders are pluralistic and often competing which can create additional perceived complexity to systems. This challenge however is proposed to have a solution built-in to the model of systems thinking. (Davies et al. 2015, 346-347; Awuzie & Mcdermot 2013, 9; MacNamara & Pembrey 2022, 2) The 5X method recognizes the principle of balancing adequate representation of the breath of the system with the granularity of information. By engaging in the practices systematically, and explicitly the complexity, perceived or otherwise, will be minimized. (Hassannezhad et al. 2023, 7)

Moreover, discovery practices can be extremely time and resource intensive, but they are crucial, and it is shown to result in significant buy-in from stakeholders. The article shows that leaders that systematically commit the needed time and resources to the discovery practices will benefit from clarity of purpose and ultimately be more successful in implementing change. (Davis et al. 2015, 348-349)

The next practice type is framing which encompasses pattern recognition, identification of interconnection and interrelationships, and structuring frameworks for change. The highlighted framing methodology is systems dynamics. Systematic dynamics uses standard symbols created to represent complex systems like feedback loops in simpler terms. (Davis et al. 2015, 348-349) Framing practices draw upon the qualitative data collected from stakeholders. In common terms the practice of framing can be called and understood as sensemaking. (Davis et al. 2015, 349) The cybernetic participatory approach describes these actions as a creation of a shared representation of reality (Hassannezhad et al. 2023, 7). The issue is that complex systems are often counterintuitive, and the perceived expected outcomes of actions might be false.

(Hassannezhad et al. 2023, 9; Vergne 2020, 6-8) The practices of framing are highly influenced by the heuristic models and cognition of the leaders which can lead to false causalities being identified. This weakness of the practice is proposed to be mitigated with the utilization of structured cognitive teams that can ensure a wide variety of perspectives. (Hassannezhad et al. 2023, 6; Davis et al. 2015, 350) A key principle in mitigating these challenges is balancing perceived reality of the system with the abstracted model of it (Hassannezhad et al. 2023, 8).

The final phase of the systems thinking leadership model is the implementation phase or action practices. These are approaches taken to implement systematic interventions and change based on identified patterns. Systematic action practices involve promoting coordination, collaboration, and communication of networks. (Davies et al. 2015, 8) This phase of the systematic models is about building trust and engaging the participants in the modeling process enabling improved understanding among the actors of the environment and system map (Hassannezhad et al. 2023, 7). This shared understanding can be used to allocate resources and integrate change into existing structures more seamlessly. (Davis et al. 2015, 350) The actual methods used are dependent on the organizational context and setting. (Hassannezhad et al. 2023, 8; Davis et al. 2015, 350) The application of systems thinking leadership is emphasized to foster autonomous teams and mitigate issues arising from hierarchies. Moving away from traditional hierarchical patterns of decision-making encourages adaptive and participatory forms of leadership. (Davies et al. 2015, 2; Vergne 2020, 6-8; Medvedeva & Umpleby 2023, 5)

4.2.2 Organizational evolution

Following from this the second concept is *organizational evolutio*n. The articles present a significant evolution in organizational management in the form of more decentralized processes. This transition has implications for the way organizations operate, internal decision making, and how organizations adapt to changing environments. (Vergne 2020, 2-3; Pirson & Turnbul 2016, 930-931 ; McKenna 2016, 692 ;Turnbull 2017, 169-170 ; Marsal-Llacuna 2020, 3-5) The reviewed articles emphasize the need for more adaptive, participatory, and diffused forms of leadership. The complexity and uncertainty within organizational systems is increasing and it is these complex environments that are highlighted to be key drivers for the shift. Decentralized management is seen as a response to the ever-growing complexities, accordingly with the law of requisite variety, within organizations that necessitate departure from traditional hierarchical and bureaucratic models. (Awuzie & McDermott 2013, 543-544; Vergne 2020, 2 ;Pirson & Turnbul 2016, 931 ;Turnbull 2017, 166 ; Marsal-Llacuna 2020, 5) The laws of requisite variety states that complexity can only be managed with a requisite variety of equivalent complexity. The division of power that is inherent in decentralized management, complexifies organizational structures and allows for better complexity absorption. (Pirson & Turnbull 2016, 932)

Up until this point the thesis has used the term "decentralized" when referring to non-centralized power and management structures, as this is the term used in majority of the articles. However, there is a discussion to be had about the relationship of the terms "decentralized" and "distributed" and the usage of these to refer to management structures. (Vergne 2020, 4) As shown in figure 10 "decentralized" is illustrated to be the in-between phase moving from centralized to distributed. The differentiation is based on the number of nodes that need to fail to break communication within the system. (Vergne 2020, 3)

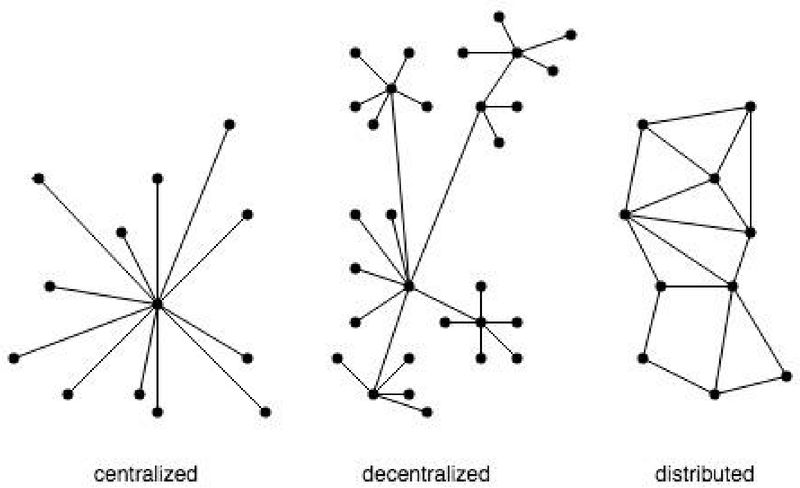

Figure 10 Baran's typology of communication networks (Vergne 2020, 4 originally Baran 1964, 2)

Distributed systems are considered to be more flexible and robust against failing as all nodes are interconnected and allow for agility under adverse conditions. However, this network structure is not optimized for efficiency as it doesn't limit redundancies. Decentralized systems in turn have a broader dispersion of the ability to exchange data and information. Decentralization has had ties to political notions since the French revolution. Later on, it has been adopted by the libertarian axis and the "cyberpunks" when discussing weakening the individuals' reliance on governments and corporate entities via the dispersion of data. (Vergne 2020, 4) Decentralized system networks seek to maximize the number of available information integrators. In practical terms this requires a defined non-hierarchical organizational structure. (Vergne 2020, 8; Pirson & Turnbull 2016, 953; Turnbull 2017, 168-169 ; Arghand 2022, 749 ; Bieraugel 2015, 356) The discussion of decentralized vs. distributed has to brought up in order to introduce Blockchain technology as a tool for the structural evolution within organizations.

A blockchain is a decentralized and distributed digital ledger that securely maintains organized, authenticated transaction data and uses public keys as identities (Vergne 2020, 10). The concept of using blockchain as a tool for cybernetic management came up in multiple of the articles looked at for this thesis. (Marsal-Llacuna 2020, 1-2; Vergne 2020, 3 ; Davidson 2023, 142-143 ; Saxena et al. 2020, 9-11) A blockchain ledger shows a history of each transactions, the chains, that cannot be altered without it leaving a mark. Blocks are created as a large number on transactions waiting to be processed being grouped together and recorded jointly. As a result of this blockchains allow for searching through vast amounts of data and can provide independently verifiable proof of transactions. (Davidson 2023, 143.; Saxena et al. 2020, 9-11) The main usage for blockchains resembles traditional shared databases with added authentication but when used as a core technology for organizations it decentralizes communication. Each organizational member gets a tamper-proof copy of everything that is knowable of the organization. In addition to this blockchains distribute decision-making by designating a decision-maker via an automated lottery system when operational decisions are needed. (Marsal-Llacuna 2020, 2; Vergne 2020, 3; Davidson 2023, 148; Saxena et al. 2020, 9-11; Swann 2022, p.) The nature of blockchain is community-led and collaborative, in addition to not needing a central authority to function. These aspects making it ideal for the non-traditional, decentralized management structures that the research is calling for. (Vergne 2020, 10; Saxena et al. 2020, 9-11) Blockchain technology ensures transparency and immutability, providing a secure and efficient way to manage organizational data which is vital for a decentralized management structure. Moreover, blockchain technology has the potential to streamline operations and reduce costs by eliminating intermediaries. Implementing blockchain technology can revolutionize the way organizations operate and manage their data. (Vergne 2020, 10; Saxena et al. 2020, 9-11; Marsal-Llacuna 2020, 2)

While blockchain streamlines operations and reduces costs by eliminating intermediaries, it also opens up new opportunities for collaboration and innovation among individuals and teams. (Marsal-Llacuna 2020, 2; Vergne 2020, 10)

4.2.3 Human-centric work

Following this is the third theme of *human-centric work.* This theme is at the center of the fore mentioned cybernetic systems thinking. The importance of work-life balance and the impact of psychological states of employees on innovation implementation was a significant subject in many of the articles. Work demands have been found to have a positive effect on innovation, while role-based stressors, such as role ambiguity and professional compromise, are negatively related to subsequent innovation implementation. One key subject in this theme was training and development of the employees in decreasing stressors and mitigating negative aspect of work demands. By providing employees with development opportunities, it allows for better workplace involvement and empowerment of employees. (Heriyati et al. 2023, 7-8; Al-Ansari & Alshare 2019, 67; Dominici & Palumbo 2013, 170; Bieraugel 2015, 356 ; Gaeta et al. 2013, 1426 ; Davis et al. 2015, p. ; Fay et al. 2019, 14-15) The empowerment of the worker leading to autonomous self-controlled work is also shown to reduce cost and enhance productivity. (Dominici & Palumbo 2013, 158-159) Another identified factor in the mitigation of stressors was work-life balance. It has been observed that work-life balance can reduce the impact of role-based stressors, such as role ambiguity and professional conflict, by providing employees with the resources and support needed. When employees have a healthy work-life balance it allows them to recover and recharge from work-related stress, which in turn can have a positive impact on their ability to engage in innovative behaviors. (Heriyati et al. 2023, 8-9; Turnbull 2015, 180)

The integration of humanizing strategies, as described above, within the workplace is the key factor for creative thinking and innovation (Dominici & Palumbo 2013, 169-170). Following this there is an overall need for a more holistic and human-centered approach to innovation management. The literature suggests that this could be achieved by the ideas presented in concepts one and two - decentralized governance, informed by systems theory, can contribute to employee involvement and empowerment by allowing for higher levels of engagement and creating a structure that facilitates the participation of a wide variety of stakeholders. (Heriyati et al. 2023, 2-3, 8-9; Al-Ansari & Alshare 2019, 79-80; Dominici & Palumbo 2013, ,170)

Integration of management with governance activities allows for the integration of corporate social responsibility (CSR) with corporate governance. The division of power and labor within the governance structure reduces the complexity of data processing for actors involved providing opportunities for employees to participate in decision-making processes. (Heriyati et al. 2023, 8-9.; Al-Ansari & Alshare 2019, 79; 24-25; Dominici & Palumbo 2013,162-163,170, ; Bieraugel 2015, 355-356 ; Gaeta et al. 2013, 1430 ; Davis et al. 2015, 930-932 ; Fay et al. 2019, 12 ; Marsal-Llacuna 2020, 2,5) The improved division of power and participatory decision-making serves to better the conditions within the labor market systems. The Japanese lean product system can serve as one example of how labor considerations can be wholly integrated into the organizational structure. Each company has its own internal company union that negotiates wages and work conditions with no differentiation between worker rank or job category. This is not a separate entity but an integral part of the enterprises. (Dominici & Palumbo 2013, 66)

4.2.4 Continuous improvement

Moving to the fourth key theme *continuous improvement* which encompasses the use of dynamic, network-based approaches and adaptive production systems. (Bieraugel, 2015, 352; Dominici & Palumbo 2013, 160; Fay et al. 2019, 11) One research introduces the idea of a cybernetic participatory approach for participatory systems modeling. Participatory systems modeling (PMS) is the term for any process of engaging stakeholders in issue mapping processes. The cybernetic participatory approach emphasizes the potential for more confident and comprehensive systems mapping, promoting knowledge across policy areas, while addressing the limitations of traditional participatory modeling methods. This is facilitated by a holistic approach where the focus is on the whole-system and the circular causality of its parts and the tacit knowledge existing within and of the system. (Hassannezhad et al. 2023, 2-4) While the cybernetic participatory approach introduces a framework to handling continuous improvement it is still quite a flexible and at times fuzzy system consisting of multiple tools that rely on their user’s discretion.

In contrast, a more structured viewpoint to fostering continuous improvement is inclusive growth analysis. Inclusive growth analysis can be utilized when the aim is to identify growth constraint variables and understand their interrelationships. The article presenting this model focusses exclusively on the use of cybernetic analysis as it aims to not only identify but to establish control of the variables. The proposed six-step procedure is akin to an outlined research plan including mixed methods data collection and analysis to produce a list of binding constraint variables that is then modeled into a circular structure. These circular interrelationships of variables are to be based on hard evidence from various data sources as well as contextual insights and knowledge of the environment. These variables can be integrated when there are changes in the system or its environment. This allowing for identification of changes overtime and leads way to potential interventions if there is a persistent issue within a system. (Abham et al. 2015, 596; Hassannezhad et al. 2023, 2-4: Fay et al. 2019, 11)

Though the cybernetic inclusive growth analysis is a more structured model it can be hindered by the same challenge that cybernetic participatory approach is. Both these approaches rely on the user's insights and existing knowledge. While the participatory model approach is more reliant on existing interrelationships of employees and management due to its workshop reliant structure, the inclusive growth analysis does rely on the user or researcher having contextual insights and understanding of research methods and ethics. (Adham et al. 2015, 596; Kasimin et al. 2015, 598)

Opposed to the step-by-step approaches to *continuous improvement,* the conceptual idea of Kaizen is introduced. Kaizen is a Japanese business philosophy that can be considered to be at the heart of the Japanese lean production system. This philosophy focuses on efficient resource allocation and usage, improving productivity, and achieving sustainable continuous improvement of activities and processes. Kaizen allows for a higher level of agility and capability to adapt in complex environments. (Dominici & Palumbo 2013, 159) This concept and approach introduces a cultural dichotomy to the understanding of innovation management and the cybernetic approach. As described in themes *organizational evolution* and *human-centric work,* the more holistic, dynamic, and decentralized approaches to innovation processes are considered to be revolutionary in nature as it is deviating from the traditional western management styles. (Dominici & Palumbo 2013, 169; Vergne 2020, 2-3) Yet, for the Japanese the concept of kaizen corresponds with the preservation of harmony and tradition. Disruptions to the establishment and "revolutionary" action are to be avoided as they are seen to destroy informal relations and disturb the harmony. (Dominici & Palumbo 2013, 169) Without the context of Japanese cultural values and tradition, it might be hard to convince that a decentralized and autonomous work is a more harmonious and stable organizational model. Yet, what could be learned and taken away from the concept of kaizen is the approaches less disruptive nature and how it allows for smoother transitions and integration of ideas into the existing structures and relationships. (Dominici & Palumbo 2013, 169-170)

4.2.5 Sustainability strategies

The fifth key theme is *Sustainability strategies.* Corporate Social Responsibility (CSR) was an overarching concept in the data as the studies show improved CSR to help in creating a healthy and productive environment. CSR is shown to have a relationship with Sustainability development (SD). (Pirson & Turnbull 2016, 931; Basavaraj et al. 2018, 290) In turn, the development of sustainable management practiced is shown to be a contributor to organizational learning which was demonstrated by many of the papers to promote innovation. (Basavaraj et al. 2018, 290; Pirson & Turnbull 2016, 939-940) CSR can be defined as the organizations obligation to maximize its positive impacts while minimizing its negative effects on the environment surrounding by committing organizations to partake in society as corporate citizens. Corporate social responsibility considers the actions on an organizational level while sustainable development is a macro concept encompassing a holistic view that is concerns country-level activities. The relationship between these two concepts leads to the distinction between weak and strong sustainability. Claimed sustainability development consisting of business efforts aimed at solely minimizing environmental impact via minor management systems is considered to be weak sustainability. In contrast, strong sustainability utilizes systematic strategies and tools at various levels. (Basavaraj et al. 2018, 286-287, 290; Hassannezhad et al. 2023, 13; Davidson 2023, 146) The key sustainability strategies proposed in the articles are the same strategies that have been outlined in this section previously – network strategy, power distribution, efficient communication, and coordination. Fostering a culture of continuous improvement is stated to be contributing to the development of sustainable management. (Basavaraj et al. 2018, 302; Pirson & Turnbull 2016, 938) Similar to the systems models elaborated previously, there sustainable development and corporate social responsibility can be modeled using a cybernetic approach (Fig. 11). The cybernetic model to organizing CSR can provide a holistic overview and more insightful explanations than the most often used stakeholder model (Basavaraj et al. 2018, 286)

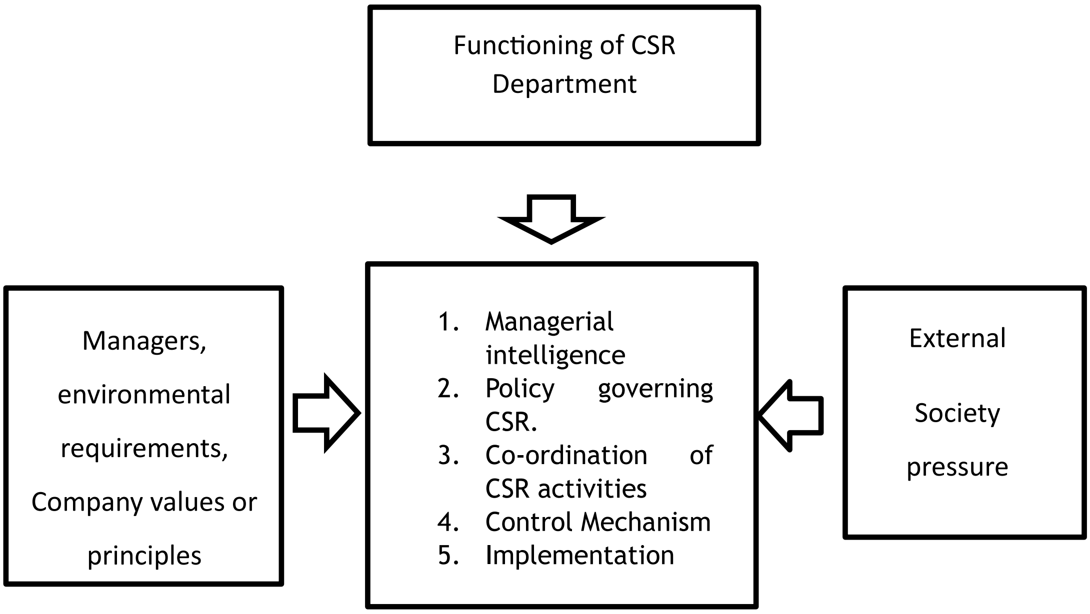

Figure 11 Five components of the cybernetic CSR model adapted from Basavaraj et al. 2018, 286

The components in the cybernetic CSR model are managerial intelligence, policy governing CSR, co-ordination of CSR activities, control mechanism, and implementation. Intelligence involves the knowledge and adaptability of a firm's managers. It focuses on the ability to recognize and respond to dynamic situations, including understanding the past, present, and future implications of decisions. Policy encompasses the guidelines and strategies that steer a company's actions, including its vision, strategy, and intent. Coordination acts as the processor of the system model, ensuring that all units and sub-units are interconnected within the organizational setup, fostering quality communication. Control involves providing instructions to various sub-units to ensure accountability for tasks and actions, often in the form of management control systems. Implementation focuses on executing actions that add value to the system, emphasizing the creation and addition of value through cohesive activities. (Basavaraj et al. 2018, 296-298; Pirson & Turnbull 2016, 948-949)

The cybernetic CSR model (Fig 11.) includes five components that are derived from the viable systems model sub-systems but the model itself cannot be called a viable system as it isn't all contained within one self-sustaining loop. The components in this model are not considered nor treated as separate entities with inherent power but more akin to steps to perform. The order of the components differs from the viable systems model and the power structure reads top-down rather than the decentralized structure inherent in a viable systems model (cf. Basavaraj et al. 2018, 299). This characteristic of the model might be due to it being an illustrative analysis of a company's actions mapped onto the framework rather than an existing cybernetic process within the organization. The cybernetic CSR model can be useful in introducing and encouraging the development of more holistic CSR practices within organizations. The model is designed to provide insights to an even more holistic approach to CSR beyond the more familiar stakeholder models for the sake of promoting stronger sustainability. Using a cybernetic model serves to deepen the understanding of the interconnectedness of factors within sustainability management as well as fostering continuous improvement and adaptability rather than treating CSR as a game of reaching preset benchmarks (Basavaraj et al. 2018, 296-298; Pirson & Turnbull 2016, 948-949; Hassannezhad et al. 2023, 13; Davidson 2023, 146)

Table 6 Sustainability aspects of the Viable systems model

Sub-system	*Sustainability aspect*
Implementation	Focus on executing actions that add values to the system, emphasizing the creation and additions value through cohesive activities Contributing to organization's long-term viability through daily operations Foundation for decentralized and bottom-up structures
Co-ordination	Ensuring interconnectedness Fostering quality communication Fostering healthy organizational culture
Cohesion	Providing instructions to various sub-systems to ensure accountability for tasks and actions Control mechanisms to ensure that activities align with sustainability goals and ethical standards
Intelligence	Involves the knowledge and adaptability of a firm's managers to recognize and respond to dynamic environmental and social situations. Interacts with the environment - emphasizing the need for organizations to understand and address their impacts on the environment and society.
Policy	Setting and steering guidelines and strategies – Vision, strategy, and intent

In contrast to the CSR model that looks at CSR tasks as its own system, department, within a larger system, the viable systems model does not divide sustainability into a separate department. Rather the concepts and principles in CSR are imbedded into each sub-system as sustainability is not a task to be finished but seen as a requirement of viability. (Pirson & Turnbull 2016, 948-949; Hassannezhad et al. 2023, 13; Davidson 2023, 146) VSM emphasizes the need for organizations to adapt and thrive in a changing and interconnected world and view sustainability as a core component of their overall strategy and operations. By integrating sustainability into every aspect of the organization, VSM can help organizations become more resilient and responsive to external challenges. (cf. Pirson & Turnbull 2016, 948-949; Hassannezhad et al. 2023, 13; Davidson 2023, 146; Basavaraj et al. 2018, 296-300)

4.2.6 Risk readiness

The final and sixth theme *Risk Readiness* serves as a reasoning for many of the actions that the other key issues bring up and propose. The cybernetic models do not consider risk to be an external force to combat, but an inherent part of the system that can be planned for and mitigated. (Arghand 2022, 747-748; Bieraugel 2015, 353; Pirson & Turnbull 2016, 931; Hassannezhad 2023, 13,15) All parts of the Viable Systems model aim at controlling and managing complexity via co-ordination of multiple actors which results in a system that is robust against risk factors. (Orengo 2018, 266; Vahidi et al. 2019, 748-749; Arghand 2022, 749)

The articles do acknowledge a need within companies to effectively control risk by the use of management tools that allow for effective handling of extreme uncertainty. (Arghand 2022, 747-478; Bieraugel 2015, 353; Pirson & Turnbull 2016, 931, 937; Hassannezhad 2023, 15) Yet opposed to the other themes discussed, risk readiness does not come up as individual frameworks or models as much as an overarching concept encompassed within the structures and ideas analyzed (Arghand 2022, 747 ; Bieraugel 2015, 353, 358. ; Pirson & Turnbull 2016, 931, 937 ; Hassannezhad 2023, 15). There is intrinsic risk in the challenges and opportunities posed by the application of management cybernetics and the viable system model in an organizational context. Handling extreme uncertainty includes the complexity of real-world systems, the need for interdisciplinary collaboration, and the difficulty in predicting and managing dynamic changes. (Arghand 2022, 749; Dominici & Palumbo 2013, 154)

One article discusses the management of IT risk through a VSM framework. The article finds VSM to be a good framework for this task due to its systems science approach. The use of the viable systems model ensures adaptability and forecasting to be systematically integrated into risk management and creates a more comprehensive approach to mitigation of uncertainty. (Arghand 2022, 748) The creation of autonomous sub-systems within an organization is deemed increase the quality of risk management as it brings the risk management to each part of the organization, most importantly to the front-lines with sub-system 1. (Pirson & Turnbull 2016, 931; Orengo 2018, 266; Dominici & Palumbo 2013, 169)

The VSM framework and its application in risk management demonstrate the interplay between risk readiness with innovativeness in organizations. (Arghand 2022, 749; Orengo 2018, 266; Dominici & Palumbo 2013, 169) By providing a structured and adaptable approach to managing risks, the VSM framework creates a conducive environment for fostering innovativeness within organizations. It ensures that organizations are prepared to handle risks effectively, thereby allowing them to focus on innovative initiatives without being hindered by potential threats. This interplay contributes to the overall resilience and adaptability of organizations in the face of uncertainty, ultimately supporting their capacity for innovation and growth. (Arghand 2022, 749; Orengo 2018, 266; Dominici & Palumbo 2013, 169)

4.3 Viable Systems model as a context of analysis

The key themes identified and presented above seek to answer the sub-questions of this thesis. The following analysis aims to investigate the data from the point of view of the main research question. As the themes are so interconnected and share much of the same grounding theory this section does not follow the same categorization as section 4.2. This is done in order to reduce repetition and improve readability. This section will be borrowing from the articles identified and the theoretical setting of this thesis in that the themes from Section 4.2 are analyzed further by setting them into the viable systems model.

As shown in Figure 2. the Viable Systems model consists of five subsystems that make up the system. The principle of viability states that for a system to be considered viable it needs to have the capability to exist independently – this applies to the individual subsystems as well (Mouhib et al. 2019, 4,11-12). This structure of independent yet interrelated subsystems allow them to recognize internal disturbances and changes and to react accordingly in real-time. The sub-systems making up this structure are as follows – Sub-system 1: Management, Sub-system 2: Coordination, Sub-system 3: Cohesion, Sub-system 4: Intelligence, and Sub-system 5: Policy. (Mouhib et al. 2019, 4,11-12; Dominici & Palumbo 2013, 157)

4.3.1 Implementation

Sub-system one can be understood as the muscle of the system. This sub-system encompasses all the primary operative functions and actions of any given system. (Arghand 2022, 750-751; Dominici & Palumbo 2013, 157) The focus of this sub-system is to maintain the viability of the organization's operational functions (Dominici & Palumbo 2013, 157).

As previously stated in the thesis agile and lean structures resemble the viable systems model as is. Especially ean production methods such as, the reduction of lead times, standardization of tasks, multifunctional workers, and smoothing of production, can be set into this sub-system. The reduction of lead times and standardization of tasks contribute to the elimination of waste and the achievement of one-piece production and conveyance, which are in line with the stated objectives and aims of this sub-system. (Dominici & Palumbo 2013, 159; Orengo 2018, 267)

Following is a short description of each method. Reduction of lead times involves minimizing the time it takes to complete a process, from the initiation to the final delivery of a product or service. This method aims to eliminate unnecessary delays and optimize the flow of work, ultimately leading to improved productivity and customer satisfaction. (Dominici & Palumbo 2013, 159) Standardization of tasks involves establishing uniform procedures and processes for performing specific activities within the organization. By standardizing tasks, organizations can reduce variability, enhance quality, and streamline operations, leading to greater consistency and predictability in outcomes. (Dominici & Palumbo 2013, 160) Multifunctional workers refer to employees who possess diverse skills and are capable of performing various tasks across different functional areas within the organization. This approach allows for greater flexibility in resource allocation, improved cross-functional collaboration, and the ability to adapt to changing demands and priorities. (Dominici & Palumbo 2013, 160; Davidson 2023, 144)

Smoothing of production focuses on maintaining a consistent and balanced flow of work throughout the production process. By minimizing fluctuations and disruptions, organizations can achieve a more stable and predictable production environment, leading to reduced waste, improved resource utilization, and enhanced overall efficiency. (Dominici & Palumbo 2013, 159) These lean production methods align with the objectives of VSM Sub-system one by contributing to the optimization of operational processes, the effective utilization of resources, and the achievement of greater adaptability and responsiveness within the organization. (Dominici & Palumbo 2013, 160; Davidson 2023, 144; Orengo 2018, 267; Arghand 2022, 750-751)

The foundation for these methods comes from analysis of the Japanese lean production system (LPS) and the reasoning behind why these methods are easy to place into a sub-system is because the LPS interacts with the business environment from a Viable System Model (VSM) perspective through osmotic interactions with the Japanese business system. The LPS is depicted as a viable system in homeostatic interaction with the Japanese business environment, maintaining viability through exchanges of information, resources, and raw materials. The LPS is open and self-regulating, with interactions between subsystems and the environment essential for maintaining viability. (Dominici & Palumbo, 2013; 156)

The LPS is a whole framework, with various sub-systems with individual tasks, that can be implemented as a structure for an organization (Dominici & Palumbo, 2013; 155). In contrast, the 5X methodology is a systematic approach used to identify and address inefficiencies in the lean production system. It involves five steps: sort, set in order, shine, standardize, and sustain. The methodology aims to streamline processes, eliminate waste, and improve overall efficiency by organizing the workplace, standardizing procedures, and sustaining the improvements made. In the context of VSM sub-system 1, the 5X methodology can be integrated to enhance the operational structure and contribute to the achievement of one-piece production and conveyance, aligning with the objectives of VSM sub-system 1. (Hassannezhad et al. 2023, 7)

The Viable System Model (VSM) can be integrated with models like the stochastic network approach and 5X methodology into VSM sub-system 1 by utilizing the Viplan computer-based learning system. (Hardwood 2022, 589) Viplan computer systems help in the integration and application of VSM by adopting VSM as a demonstrative apparatus and ensuring that the system in the center is resolved accurately to achieve optimum utilization of the model. (Hardwood

2022, 603; Hardwood 2021, 636) The current and future developments in management cybernetics that are relevant sub-system 1 include the emergence of second-order cybernetics, the combination of VSM with other systemic methodologies. Additionally, the incorporation of artificial intelligence and machine learning algorithms in VSM sub-system 1 can further enhance the efficiency and effectiveness of the system. These advancements in management cybernetics are crucial for staying competitive in today's rapidly evolving business environment. (Hardwood 2022, 603; Hardwood 2021, 636)

The proposed suggestions for improving the application of the Viable System Model (VSM) in real-world scenarios include positioning the VSM as a sub-theory in the broader field of organization theory and practice, conducting a comparative study of commonly known system-oriented approaches to organizational problems, closing theoretical gaps in the VSM to enhance its practical applicability, and cultivating an open community of practice focused on resolving complex organization problems, with strong links to other communities dealing with organization issues. (Orengo 2018, 270; Davis et al. 2015,340) These suggestions aim to refocus the VSM on abstract balancing of varieties, integrate it with classic organization theories and methods, and create a more enjoyable and satisfactory experience for managers and organization developers when applying the VSM. (Hardwood 2022, 603; Hardwood 2021, 636)

The structure of the viable systems model has the inherent characteristic of autonomous teams and the mitigation of hierarchies of command within an organization. However, implementation of autonomous teams within sub-system 1 has most affect on the organization. As sub-system 1 encompasses the daily operations and management of the product, any changes to this system will have a direct impact on the overall efficiency and effectiveness of the organization. (Awuzie & Mcdermott 2013, 5; Davis et al. 2015, 336,339; Dominici & Palumbo 2013, 157-159) Autonomous teams on the ground level can foster a sense of ownership and accountability among employees, leading to increased productivity and innovation. This shift towards decentralized decision-making can also result in quicker responses to challenges and opportunities in the market, ultimately improving the organization's adaptability and competitiveness. (Davis et al. 2015, 336,339; Dominici & Palumbo 2013, 157-159)

The challenges in integrating innovation theories sub-system 1, including the need to balance short-term operational efficiency with long-term strategic goals, can be addressed by focusing on a smaller number of better-trained experts to support a larger number of workers with a more generic know-how. Additionally, ensuring that the innovation process is aligned with the overall organizational structure and culture can be a significant challenge. Additionally, a more focused but broader application of the VSM may lead to better societal organizations and a more efficient solution to societal problems. (Hassannezhad et al. 2023, 7; Arghand 2022, 750-751; Dominici & Palumbo 2013, 157) It is also suggested to tighten the focus of the VSM to the abstract topic of judging variety balances and better connect the model with established methods and tools in management.

4.3.2 Co-ordination

Sub-system 2 is concerned with regulating the operational activities. It serves as the communicatory channel between 1 and 3 allowing sub-system 3 to monitor and coordinate all the activities in sub-system 1. (Dominici & Palumbo 2013, 156; Arghand 2022, 750-751) Key concepts and models from the previous section that can be integrated as a part of the sub-system 2 are dynamic growth analysis, Kanban, and Critical path analysis.

Dynamic growth analysis provides insights into the evolving nature of innovation networks, allowing for a better understanding of the changing dynamics within the system (Adham et al. 2015, 596). Kanban, on the other hand, offers a visual and structured approach to managing workflow, which is essential for coordinating and optimizing innovation processes (Dominici & Palumbo 2013, 159). Critical path analysis aids in identifying critical tasks and dependencies, enabling effective management and prioritization of activities within sub-system 2 (Chwastyk & Pisz 2018, 1). Integration of these concepts into subsystem 2 provides a structured approach to measuring and managing the performance of the system, addressing barriers associated with decentralized innovation network management, shift to systems thinking leadership, and implementing CSR. (cf. Adham et al. 2015, 596; Dominici & Palumbo 2013, 159; Chwastyk & Pisz 2018, 1; Arghand 2022, 750-751)

Dynamic growth analysis focuses on understanding the evolving nature of innovation networks. It aids in identifying the growth patterns, trends, and changes within the network, providing valuable insights into the dynamics of innovation processes. (Adham et al. 2015, 596) By incorporating dynamic growth analysis into sub-system 2, organizations can gain a comprehensive understanding of the development and evolution of their innovation networks, enabling them to adapt and respond effectively to changes in the environment. (Adham et al. 2015, 596; Arghand 2022, 750-751) On the other hand, Critical path analysis aids in identifying the most critical tasks for successful innovation within the network. By determining the sequence of activities that are crucial for achieving innovation objectives, critical path analysis enables organizations to prioritize and allocate resources effectively. When applied within subsystem 2, critical path analysis contributes to the systematic and strategic management of innovation processes, ensuring that key tasks are given the necessary attention and resources. (Chwastyk & Pisz 2018, 1; Arghand 2022, 750-751; Dominici & Palumbo 2013, 156)

Whereas the previous two are analyses, Kanban is a more concrete visual management tool. It facilitates the visualization and management of workflow within the innovation network. It allows for the efficient allocation of resources, identification of bottlenecks, and optimization of processes. (Dominici & Palumbo 2013, 159) When integrated into subsystem 2, Kanban enhances the coordination and management of innovation processes, ensuring a streamlined and efficient workflow that aligns with the goals of the organization. (Dominici & Palumbo 2013, 156, 159)

The relevance of these concepts in subsystem 2 is underscored by their potential to address key barriers associated with decentralized innovation network management, the shift to systems thinking leadership, and the implementation of Corporate Social Responsibility (CSR). By integrating these tools into subsystem 2, organizations can adopt a holistic and integrated approach to measuring and managing the performance of the system, thereby contributing to effective innovation network management, and addressing the identified barriers. (Basavaraj et al. 2018, 291; Dominici & Palumbo 2013, 156)

The key barriers associated with the key ideas identified from the data, decentralized innovation network management, shift to systems thinking leadership, and implementing Corporate Social Responsibility (CSR), pose challenges within organizations. (Pirson & Turnbull 2016, 948-949; Hassannezhad et al. 2023, 13; Davidson 2023, 146) The integration of sub-system 2 can help address these barriers by providing a holistic and integrated approach to measuring and managing the performance of systems. This approach acknowledges that actions, whether individual or collective, must be measured holistically, considering all subsystems involved and not just the main subsystem. This can help in overcoming the siloed and dominance-biased measurement that is often associated with traditional methods. (Basavaraj et al. 2018, 291; Pirson & Turnbull 2016, 948-949; Hassannezhad et al. 2023, 13; Davidson 2023, 146)

In the healthcare sector, the integration of sub-system 2 was shown to potentially help manage the complexity of decentralized networks, enhance leadership decision-making through systems thinking, and ensure that CSR initiatives are implemented efficiently. The integration can facilitate the identification of bottlenecks, optimize resource allocation, and improve the coordination of activities, thereby enhancing the overall innovation process and organizational effectiveness. (Davis et al. 2015, 336) Similarly, in library services, sub-system 2 contributed to addressing the barriers associated with decentralized innovation network management by providing a structured approach to innovation, which can reduce uncertainty and fear surrounding innovation. It can also align with the shift to systems thinking leadership by focusing on rigorous testing and assessment of innovative services, rather than relying solely on visionary leadership. Furthermore, it can contribute to implementing CSR by enabling libraries to develop and launch new services that are customer-focused and efficient, thus meeting the needs of the community in a sustainable manner. (Bieraugel, 2015, 360)

4.3.3 Cohesion

Sub-system 3 represents the structures in place to dictate rights, resources, and responsibilities within subsystem 1. This is the subsystem with the least variety. (Arghand 2022, 749-750; Dominici & Palumbo 2013, 156) This sub-system plays a crucial role in maintaining the integrity and stability of the organization. It is responsible for coordinating and integrating the activities of various organizational units to ensure coherence and adaptability. Sub-system 3 focuses on managing the interactions and interdependencies within the organization, contributing to its overall cohesion and effectiveness. (Arghand 2022, 749-750; Dominici & Palumbo 2013, 156)

The relevance of VSM and sub-system 3 lies in their capacity to provide a holistic understanding of organizational dynamics and to offer a structured approach to managing complexity and ensuring organizational viability. By utilizing the sub-system organizations can enhance their ability to maintain cohesion, adapt to change, and improve overall performance. (Arghand 2022, 749-750; Dominici & Palumbo 2013, 157)

The concepts of the integration of Total Quality Management (TQM) and Statistical Quality Control (SQC) were identified to serve the purposes of sub-system 3. TQM and SQC are principles to ensure optimal quality and efficiency within the organizational systems. TQM emphasizes continuous improvement, customer satisfaction, and data-driven decision-making, aligning with VSM's focus on adaptability and resilience in complex systems. SQC provides accountability for resource allocation and ensures that quality standards are met, contributing to the adaptability and efficiency of the production system. By integrating TQM and SQC into VSM, organizations can maintain the viability of their systems and processes, ensuring that they operate at optimal levels of quality and efficiency. This integration allows for a more comprehensive and systematic approach to organizational management and improvement. (Heriyati et al. 2023;5,8; Dominici & Palumbo 2013, 162)

The concept of resource allocation to the level that viable systems model suggests brings to mind the functions of planned economics and in this the debate of the socialist Calculation Debate (Davidson 2023,142-246) The socialist calculation debate is a theoretical and ideological dispute that took place in the early to mid-20th century. It centers around the feasibility and efficiency of economic planning in a socialist system compared to a market-based capitalist system. At one side of the argument is idea that in the absence of private ownership of the means of production and a functioning price system, socialist economies would lack the necessary information and incentives for efficient resource allocation and production decisions. They contended that without market prices and profit-and-loss signals, socialist planners would be unable to rationally allocate resources and coordinate economic activities. On the other side of the debate, proponents of socialist planning, argued that through the use of simulated or "market-like" mechanisms, socialist economies could replicate the efficiency of market economies. They proposed that socialist planners could use various forms of trial-and-error, computer simulations, and decentralized decision-making to mimic the functions of a market economy. (Davidson 2023,142-146) The later sider arguments against economic planning can be addressed within the context of the Viable System Model as the purpose and function is to enhance decision-making and resource allocation in organizations (cf. Davidson 2023,146; Arghand 2022, 749-750; Dominici & Palumbo 2013, 157).

The integration of the VSM with more classic organization theories and methods allows organizations to better address the challenges. The VSM provides a framework for understanding and managing the complexity of resource allocation in organizations, which is a key aspect of the debate. (Dominici & Palumbo 2013, 155; Davidson 2023,146) By focusing on managing variety balances, the VSM can help organizations make more informed decisions about resource allocation and improve the efficiency of their operations. Additionally, the VSM emphasizes adaptability and viability, which are essential for addressing the challenges posed by the Socialist Calculation Debate. (cf. Davidson 2023,146; Arghand 2022, 749-750)

Complexity Theory, on the other hand, emphasizes the abstract balancing of varieties, providing a more comprehensive understanding of the variety balances within the sub-system. (Pirson & Turnbull 2016, 932; Davis et al. 2015, 337) By applying Complexity Theory within sub-system 3, it can be used to analyze and manage the intricate relationships and interactions within the sub-system and the system as a whole leading to more effective solutions for organizational problems. This integration can contribute to a more efficient and effective management of organizational cohesion, aligning with the VSM's focus on adaptability and resilience in complex systems. (Pirson & Turnbull 2016, 932; Davis et al. 2015, 337; Turnbul 2017, 163)

Another conceptual aspect of cohesion is management of workplace stressors. The management involves understanding how stressors such as work demands, and role-based stressors can influence the organization's ability to maintain stability and coherence. By considering the impact of stressors on cohesion within the organization, potential benefits can be derived in several aspects. (Fay et al. 2019, 13-15; Al-Ansari & Alshare 2019, 68) Firstly, understanding the differential effects of workplace stressors on innovation can lead to enhanced team dynamics. Organizations can develop strategies to minimize negative stressors and promote positive ones, leading to improved team cohesion and collaboration. (Fay et al. 2019, 13-15; Al-Ansari & Alshare 2019, 68) Additionally, identifying stressors that positively impact innovation can help teams leverage these stressors to enhance problem-solving and creativity within the organization. Recognizing the impact of stressors on innovation can contribute to reduced turnover within the organization.By addressing negative stressors and promoting positive ones, organizations can potentially reduce employee turnover and enhance overall cohesion within the workforce. (Fay et al. 2019, 13-15; Al-Ansari & Alshare 2019, 68

Moreover, this understanding can inform targeted interventions to mitigate negative stressors and promote positive ones, ultimately fostering a more cohesive and innovative work environment. By addressing stressors that hinder innovation and leveraging those that promote it, organizations can improve overall performance and productivity, contributing to greater cohesion within the organization. (Fay et al. 2019, 13-15; Al-Ansari & Alshare 2019, 68; Dominici & Palumbo 2013, 156)

4.3.4 Intelligence

Sub-system 4 is responsible for looking externally at the environment in which the system operates in order to establish how it need to adapt (Dominici & Palumbo 2013, 157). The sub-system collects data from their external environment, to transform them into plans for the whole firm. Any necessary changes must be implemented through flow down towards the Control systems, but also sub-system 3 must provide information regarding the organization in its current form. This allows sub-system 4 to formulate a clear model containing both the organization and the environment, which forms the basis of adaptive strategies. (Arghand 2022, 749-750; Dominici & Palumbo 2013, 157)

When looking at utilizing the viable systems model from an innovation management context, sub-system 4 is crucial in enhancing organizational performance and adaptability. By integrating innovation models into this sub-system, organizations are better able to leverage the insights and data-driven approaches that drive innovation. (Arghand 2022, 749-750; Dominici & Palumbo 2013, 157) This integration has the potential to enhance the organization's ability to forecast future conditions, and fine-tune planning by managing demands, ultimately contributing to improved organizational performance and adaptability. (Arghand 2022, 749-750; Dominici & Palumbo 2013, 157) By providing a comprehensive framework for organizational structure development, viable systems model (VSM) can ensure that the operations and managerial systems are governed and directed effectively, thus supporting innovation initiatives. (Arghand 2022, 750) In practice however, challenges may arise during the integration process, such as the need for aligning diverse innovation management models with the VSM framework, ensuring the compatibility of information systems, and managing the complexity of data analysis and dissemination within subsystem 4. Despite these challenges, the integration of innovation management models into VSM sub-system 4 offers the potential to enhance the organization's capacity for innovation. (Mouhib et al. 2019, 684; Gaeta et al. 2013, 2) The following example frameworks and models are those that came up during the data analysis. Various others exist in the field of innovation management that might be better or worse suited to the integration but the one's discussed serve as placeholders and examples for potential practical applications.

The Enterprise Resource Planning (ERP) system plays a crucial role in forecasting future conditions. It enables organizations to manage future demands by integrating various business processes together and thus providing a comprehensive view of the organization's operations. The historical development of ERP systems has evolved from material requirements planning to encompassing various functional areas such as finance, human resources, and customer relationship management. (Heriyati et al. 2023;5,8; Dominici & Palumbo 2013, 162) In the context of innovation management, ERP systems can facilitate the integration of data and processes, enabling organizations to make informed decisions and adapt to changing market conditions. Within the VSM framework, ERP's ability to forecast future conditions allows for the fore-mentioned fine-tuning and planning of demands. (Heriyati et al. 2023;5,8; Dominici & Palumbo 2013, 162)

Where ERP concerns forecasting future demands, Kanban, variety flows, and Just-In-Time (JIT) deliveries, contribute to the adaptability and efficiency of VSM subsystem 4. Kanban, as introduced in section 4.3.2, focuses on visualizing workflow and limiting work in progress to improve efficiency and reduce waste. Kanban's relevance to innovation management lies in its ability to optimize production processes, reduce lead times, and enhance responsiveness to customer demands. VSM guides the integration of Kanban and JIT deliveries into sub-system 4 as the emphasis of this sub-system is in the importance of information flow, coordination, and decision-making to support operations. (Heriyati et al. 2023;5,8; Dominici & Palumbo 2013, 160-162)

Handling of both vertical and horizontal variety flows is inherent in VSM as it is essential for managing the diversity of information and processes within an organization. Managing these variety flows enable the organization to adapt to changing market conditions and customer demands. Vertical variety flows enable the integration of different levels of decision-making and information processing, while horizontal variety flows facilitate the coordination of activities across different functional areas. This integration enhances the adaptability of sub-system 4 by ensuring that it can effectively manage and respond to diverse operational and innovation-related requirements. (Dominici & Palumbo 2013, 166; Kidd 2013; 4,9; Adham et al. 2015, 231-232) Furthermore, the inclusion of Just-In-Time (JIT) deliveries within VSM subs-system 4 aligns with the lean production principles of minimizing waste and optimizing value creation. JIT deliveries support the timely and efficient provision of resources and materials, contributing to the overall operational efficiency and adaptability of subsystem 4 in managing innovation processes. (Dominici & Palumbo 2013, 170)

By separating tools and technologies such as, ERP planning, forecasting, Kanban, variety flows, and JIT deliveries into a separate ecosystem of sorts, a sub-system, VSM offers a more structured approach emphasizing the importance of information flow, decision-making, and coordination. (Heriyati et al. 2023;5,8; Dominici & Palumbo 2013, 160-162)

4.3.5 Policy

Sub-system 5 encompasses all policy demands within an organization and is tasked with balancing the demands from all across the system. This is where the most indirect control is held as it forms the culture and values of the system. (Arghand 2022, 749-750; Dominici & Palumbo 2013, 157)

Theories and concepts, from the articles studied, that are integrable into sub-system 5 are the principles of Kaizen, the stochastic network approach, ecological capitalism, and the ideas of blockchain. Integrating Kaizen principles into the VSM approach for innovation network management can drive ongoing improvements in operations and processes (Dominici & Palumbo 2013, 170; Hoverstadt et al. 2020, 521-522). The stochastic network approach, on the other hand, can be used to model uncertainties and risks associated with project delivery, particularly in developing countries where uncertainties are prevalent. The integration of ecological capitalism into the VSM approach can provide insights into sustainable resource management, environmental impact assessment, and the incorporation of ecological principles into economic systems. (Hoverstadt et al. 2020, 526). Lastly, blockchain technology can be leveraged as a solution for decentralization, empowering citizens and enabling community-led governance, which aligns with the coordination and regulation functions of sub-system 5 (Marsal-Llacuna 2020, 2; Saxena et al. 2022, 11).

The Kaizen principles are rooted in the philosophy of continuous improvement. The term "Kaizen" originates from Japanese words that mean "change" (kai) and "good" (Zen). The principles emphasize the importance of making small, incremental changes to processes and systems to improve efficiency and quality. This approach encourages all employees, from top management to the front-line workers, to contribute ideas for improvement. Kaizen principles also focus on standardizing processes, ensuring that improvements are sustained over time, and fostering a culture of teamwork and collaboration. The ultimate goal is to create an environment where everyone is engaged in identifying and implementing improvements to achieve operational excellence. (Dominici & Palumbo 2013, 170)

The potential benefits in the relationship between Kaizen principles, and management style with sub-system 5 lie in the impact on the adaptability, resilience, and overall viability of innovation networks. By integrating Kaizen principles and management style theories into sub-system 5 , insights can be gained into organizational structure, communication processes, and control mechanisms. (Arghand 2022, 749-750; Dominici & Palumbo 2013, 156, 170) The integration can be done via incorporating Kaizen principles into the comprehensive and systematic model via continuous improvement practices. This can be achieved by utilizing the other sub-systems to identify areas for improvement within the innovation network and then applying Kaizen principles to make incremental changes to enhance the network's efficiency, effectiveness, and adaptability. By doing so, the viable systems approach can help ensure that the innovation network remains viable and responsive to changes in its environment, while Kaizen principles drive ongoing improvements in its operations and processes. (cf. Arghand 2022, 749-750; Dominici & Palumbo 2013, 156, 170) Incorporating Kaizen into sub-system 5 allows it to act as the natural end and start of a new feedback loop. This integration can also help in understanding how different management styles impact the organization as a whole. It can also contribute to fostering a culture of continuous improvement and self-organization, which is essential for managing complexity and dynamic environments within innovation networks. (Arghand 2022, 749-750; Dominici & Palumbo 2013, 156)

The Viable Systems Model (VSM) framework can be used to integrate work-life balance considerations into the complexities of innovation systems. This integration is achieved by recognizing the social systems within the organization and applying relative strategies for optimizing work processes and interrelationships between participants. (Heriyati et al. 2023, 9, 17; Arghand 2022, 746) The VSM approach acknowledges the existence of subsystems within the whole system and their self-regulatory and self-organizing traits, which can help in managing complexities within the organization. By understanding and managing these complexities, the VSM can contribute to creating a work environment that considers work-life balance, ultimately leading to improved project performance. (Heriyati et al. 2023, 9, 17; Arghand 2022, 746; Vahidi et al. 2019, 299) The link between work-life balance and sub-system 5 lies in the emphasis on the management styles such as Kaizen. This integration allows for understanding and managing complexities within business environments by emphasizing the importance of a management style that promotes continuous improvement and empowers workers to adapt to continuous change. Additionally, the VSM approach can provide insights into the concept of work-life balance within organizations by examining the interactions between the internal structure of the organization and its environment. (Heriyati et al. 2023, 9; Vahidi et al. 2019, 299; Dominici & Palumbo 2013, 170) This approach can help in understanding how the organization's internal processes and structures support the well-being of its employees, and how this, in turn, contributes to the overall viability of the system.

The stochastic network approach, on the other hand, is a mathematical model used to analyze complex systems with random variables. In the context of energy infrastructure delivery systems, this approach can be used to model uncertainties and risks associated with project delivery. (Hoverstadt et al. 2020, 526) By incorporating random variables such as weather conditions, material availability, and labor productivity, the stochastic network approach can help project managers identify potential bottlenecks and develop strategies to mitigate risks. This can be particularly useful in managing the complexities of energy infrastructure projects in developing countries, where uncertainties are prevalent. (Vergne 2020, 11; Hoverstadt et al. 2020, 526) The integration the stochastic network approach into sub-system 5 of the VSM provides valuable insights in the innovation context. It allows for a more holistic understanding of the organizational dynamics, enabling the development of strategies that not only optimize work processes but also consider the well-being of employees. This integration can lead to improved project performance, enhanced employee satisfaction, and a more resilient and adaptable organizational structure, ultimately contributing to innovation and sustainable growth within the organization. (Hoverstadt et al. 2020, 526; Vahidi et al. 2019, 299)

While much of the stochastic network approach can be understood to fit into sub-system 5, it is key to understand that the division is plastic, and each theory or approach is fluid and relational to more than one sub-system. (cf. Hoverstadt et al. 2020, 526) The VSM approach can incorporate the stochastic network approach to enhance the understanding of organizations by considering the dynamic interactions and information flows within the system. This can help in understanding the adaptability and responsiveness of the system to changes in the business environment, as well as the system's ability to self-regulate and maintain viability. (Hoverstadt et al. 2020, 526; Vahidi et al. 2019, 299; Arghand 2022, 749-750) The stochastic network approach can provide insights into the probabilistic nature of information flows and interactions, contributing to a more comprehensive understanding of the system's behavior and performance. In this way the approach fits into sub-system 4 as well as sub-system 5 which highlights the interrelation of each sub-system. (cf. Arghand 2022, 749-750; Dominici & Palumbo 2013, 157; Hoverstadt et al. 2020, 526)

Sub-system 5 is the part of an organizational system that is most concerned with the environment in which the system functions in. Hence why, integration of more societal concepts, rather than wholly economic or fiscal concepts, is possible. (Arghand 2022, 749-750; Dominici & Palumbo 2013, 159) The concept of ecological capitalism is a proposed alternative market economy that aims to achieve universal prosperity and environmental sustainability (Turnbull 2015, 17). It arises from the need to address the challenges of declining and aging populations, environmental degradation, and unsustainable economic policies. Ecological capitalism introduces ecological forms of owning and controlling realty, firms, and money, which facilitate increases in prosperity even with degrowth from a declining and aging population. (Turnbull 2015, 17-19) This concept emphasizes local citizen ownership and control of the means of production and exchange to provide a basic minimum dividend income for all citizens, allowing for policies of fulfillment in employment and/or leisure rather than full employment. The introduction of ecological forms of cost-carrying money tethered to a local service of nature allows market forces to encourage production techniques that reduce environmental impact. The concept of ecological capitalism is proposed as a response to the imperative of achieving a prosperous and environmentally sustainable global society. (Turnbull 2015, 20)

Clearly, a whole concept of a new market economy is not feasible to be integrated into singular organization that has to operate in the existing market economy but the ideas and principles inherent in the concept are integrable. Ecological capitalism, when integrated into sub-system 5, can provide insights into sustainable resource management, environmental impact assessment, and the incorporation of ecological principles into economic systems. (cf. Turnbull 2015, 17-19; Arghand 2022, 749-750; Dominici & Palumbo 2013, 159)

Ecological capitalism can be linked to sub-system 5 through the introduction of ecological forms of owning and controlling. This facilitates increases in prosperity even with degrowth from a declining and or aging workforce. The introduction of ecological forms of cost-carrying money tethered to a local service of nature allows market forces to encourage production techniques that reduce their environmental impact. This is in line with the principles of sub-system 5, which focuses on creating a stable state, efficient, and equitable resilient society with built-in feedback messages from its host environment. (Turnbull 2015, 17-19; Arghand 2022, 749-750)

By integrating the concepts of ecological capitalism into the innovation context, we can learn how to achieve a prosperous and environmentally sustainable global society. This integration introduces local ownership and control of the means of production and exchange, providing a basic minimum dividend income for all citizens. It also allows for the replacement of full employment policies with policies of fulfillment in employment or even leisure. Additionally, ecological capitalism enriches democracy by empowering workers, or on societal level citizens, to nurture their environment. (Turnbull 2015, 17-19, 25)

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5 Conclusions

This thesis aims to examine the potential using cybernetic systems thinking to improve innovation management through the research question *How can cybernetics be integrated to the innovation process.* This question is addressed with two further sub-questions presented in Section 1.2. The review conducted found several considerations for the integration of cybernetics into innovation management. Additionally, the review highlights the potential benefits of using cybernetic systems thinking to enhance creativity and efficiency within organizations. These finding have both theoretical contributions and practical implications.

5.1 Theoretical contributions

The existing literature on the integration of cybernetics into innovation management encompasses various fields and approaches to the integration. Yet, as mentioned previously, the literature mainly focuses on using cybernetic principles and models as tools in an existing innovation framework. This study flips the integration of these aspects to introduce innovation tools into a cybernetic framework. This approach emphasizes that innovation is a constant within an organization rather than a task to be acted upon. By shifting the focus to incorporating innovation tools into a cybernetic framework, organizations can foster a culture of continuous improvement and adaptability. This perspective highlights the importance of viewing innovation as an ongoing process that is embedded within the organizational structure. This flipped integration approach is already present in the initial framework. Some of the included articles in the review do have a similar structure of using the viable systems model as a foundation but instead of building upon the model those articles used it as a tool for analyzing and contextualizing

This thesis uses the viable systems model as the starting framework that impacts the way all the rest is understood. This is done in order to fill gaps in organizational innovation as using innovation as the foundation leaves room for blind spots and survivor bias regarding issues in the system. This approach to the integration could reduce the potential apprehension or refusal to accept a new model via introducing it together with the known.

A constant theme within the articles was the importance of human-centric work policies and human-centric approaches in innovation management (Marsal-Llacuna, 2020; Vergne 2020;

Adham et al. 2015; Heriyati et al. 2023) The articles highlight those humanistic approaches to management, which prioritize worker well-being and individual creativity, are essential for fostering innovativeness within organizations. As seen in the revised theoretical framework (fig.12) this thesis postulates human-centrism to be at the core of a viable system. Humanistic work practices serve to improve worker's rights by emphasizing the importance of creating a supportive and inclusive work environment. These practices aim to address work-life balance, prevent burnout, and empower employees, ultimately contributing to a healthier and more equitable workplace. By promoting employee involvement and empowerment, these humanistic work practices can lead to a more collaborative and respectful organizational culture, which in turn supports worker rights. (Dominici & Palumbo 2013; Pirson & Turnbull, 2016; Marsal-Llacuna, 2020; Vergne 2020; Adham et al. 2015; Heriyati et al. 202)

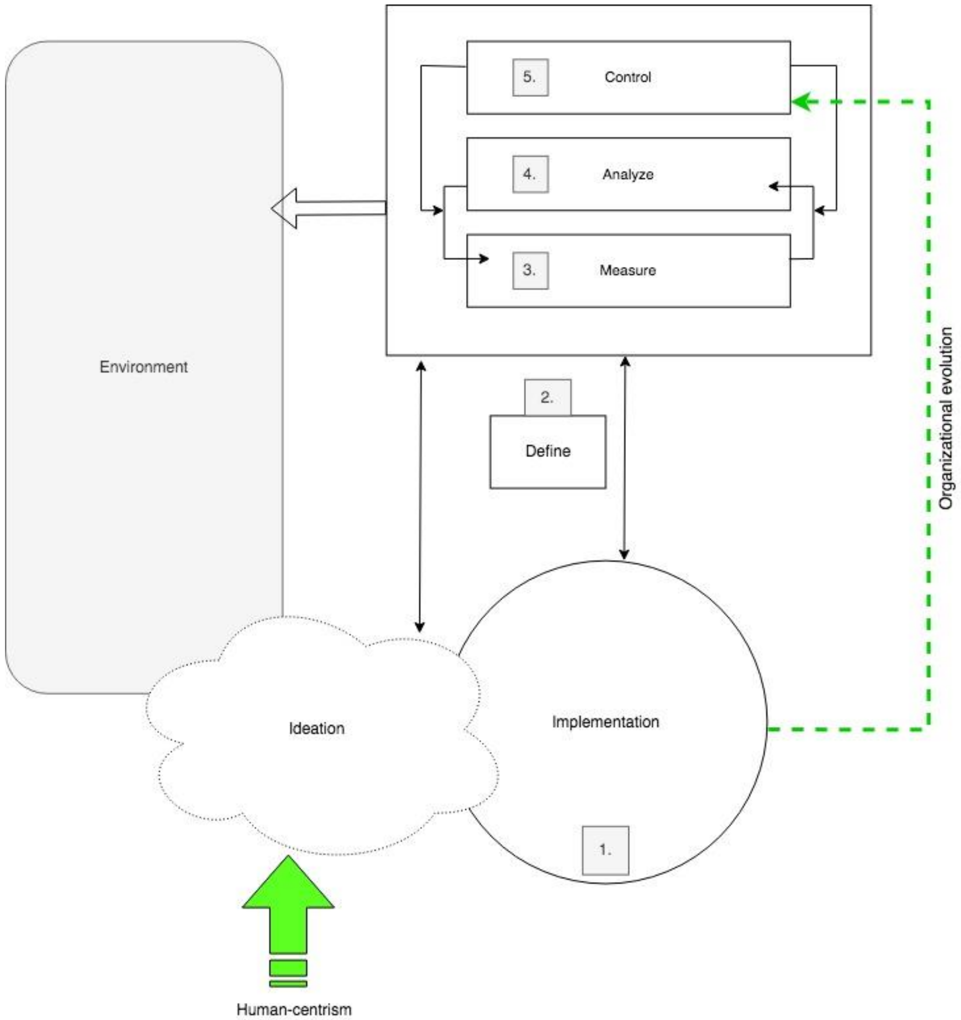

Figure 12 Revised theoretical framework.

The findings suggest that the viable systems model can also offer an avenue to fair compensation of workers by providing a framework for understanding and optimizing organizational structures and processes. VSM emphasizes the need for effective communication, coordination, and decision-making within an organization, which can contribute to fair compensation practices. By ensuring that all parts of the organization are working together harmoniously, VSM can help identify and address any disparities in compensation and ensure that workers are fairly rewarded for their contributions. (Dominici & Palumbo 2013; Orengo 2018; Mouhib et al. 2019) Additionally, worker satisfaction, achieved through better worker rights, -conditions, and empowerment, is underscored in this thesis to improve innovativeness of an organization. Human creativity and individual participation in innovation activities is also highlighted as crucial factors in driving organizational success and competitive advantage. By fostering a culture of respect, collaboration, and support for employees, organizations can tap into the full potential of their workforce and drive continuous innovation. (Dominici & Palumbo 2013; Al-Ansari & Alshare 2019; Heriyati et al. 2023)

To achieve this the viable systems model treats human-capital as a resource similar to any other allowing for better allocation of knowledge in the system as well as improved recognition and rewarding of workers. This thesis finds that humanistic approaches to innovation management through decentralized governance influences employee involvement and empowerment positively leading to higher levels of engagement and participation among a variety of stakeholders. (Heriyati et al. 2023, 2-3, 8-9; Al-Ansari & Alshare 2019, 79-80; Dominici & Palumbo 2013, ,170)

Decentralized management is posed as the key aspect to improving efficiency and allows for better handling of complexity. This thesis supports the existing understanding of decentralized management structures by emphasizing the importance of decentralized governance in managing the complexities. This aligns with the findings that decentralized governance architecture is required for firms to competently absorb the increased intricacies and variety of variables inherent in continuous improvement and partaking in innovation.

Decentralized management structures exist as a part of a larger phenomenon of organizational evolution. (Vergne 2020) The articles propose distribution of power as well as bottom-up management styles to be beneficial for organizations looking to make their innovation processes more efficient and effective. The original framework (fig.4) is based on the viable systems model and as such has an innate characteristic of a decentralized structure. Each sub-system interacts and is influenced by the other sub-systems. However, in the revised framework (fig.10) there is a clearer line from implementation/sub-system 1 and control/sub-system 5 to create a stronger connection from the daily operations to the management. This is done in order to emphasize the lack of a central power overlooking the system from the outside. Power should not be concentrated to any specific sub-systems but is divided among all sub-systems allowing each of the sub-systems to take charge and make decisions involving them. (Vergne 2020)

Decentralized structures do not only help with the division of power and effectiveness of an organization but also with risk management. As mentioned earlier, risk is not considered to be an external force to combat, but an inherent part of the system, meaning that it can be planned for and mitigated. The findings of this thesis follow this argumentation with some differentiation. Most of the articles find the decentralized structure to be the best for innovation process optimization. Though a decentralized structure has a broad dispersion of the ability to exchange data and information as well as has the benefits of a non-hierarchical organizations, it is not the best option to mitigate risk. Instead, a distributed structure is the most flexible and robust against risk. Risk mitigation however, tends no to be the main purpose for organizational innovation. The main focus tends to be on maximizing creativity and efficiency, which is why the agile nature of decentralized structure is well-suited for. Decentralized structures allow for quick decision-making and adaptability, which are crucial for fostering innovation in organizations. (Vergne 2020; Pirson & Turnbull 2016; Davidson 2023; Marsal-Llacuna 2020; Hassannezhad et al. 2023; Arghand 2022)

The proposed shift to decentralized management methods, as outlined in the articles, emphasizes the importance of fostering autonomous teams, mitigating hierarchies of command, and leveraging technologies such as blockchain. (Vergne 2020; Davidson 2023) This thesis supports the notions that these methods improve a businesses sustainability long-term. Adoption of such measures as autonomous teams can lead to increased employee engagement, empowerment, and a stronger sense of ownership, which are essential elements for sustainable business practices. Furthermore, the adoption of blockchain technology in decentralized management can enhance transparency, traceability, and accountability, thereby supporting sustainable supply chain management and ethical business operations. (Vergne 2020; Davidson 2023)

Overall, the findings of the thesis answer the research question of the thesis, broaden on the initial framework and serve to enhance the understanding of the intersection of cybernetics and innovation. Nonetheless, the importance of the findings is not limited to theory. They also have implications for practice.

5.2 Practical implications

The practical implications of this integration are crucial for organizations aiming to enhance their innovation management processes. By drawing from this thesis potential strategies and approaches for organizations can be highlighted. These may include, but are not limited to, the adoption of systems thinking to address growing organizational complexities, the implementation of decentralized governance to manage the complexities introduced by corporate social responsibility, and the utilization of the lean startup method for managing uncertainty and innovation effectively. Additionally, the viable system model can be employed to provide a comprehensive understanding of how cybernetics can be integrated to manage organizations more efficiently by optimizing the innovation processes.

This thesis provides several practical implications for different stakeholder groups. These groups will be divided into management, worker, and external environment or community around an organization.

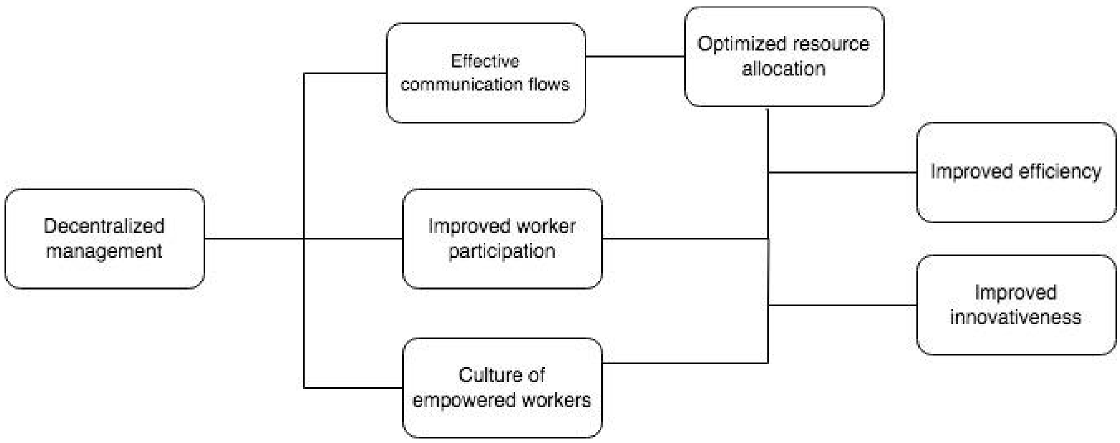

Figure 13 Managerial implications

For organization management, the implementation of cybernetic systems into innovation management processes can offer strategies and tools to optimize efficiency and resource allocation. The Viable Systems Model (VSM) can improve efficiency through worker participation, better resource allocation, and planning-based economics. Real-time adjustments based on cybernetic principles can optimize resource allocation and enhance overall efficiency. Additionally, fostering a culture of employee empowerment through participatory, multi-viewpoint methods and non-hierarchical leadership can promote innovation and mitigate work-stressors. *Implementing decentralized processes and non-hierarchical leadership can facilitate effective communication flows and organizational* *evolution*. *Integrating sustainability strategies*, Corporate Social Responsibility (CSR), and risk readiness can address extreme complexity and balance efficiency with decentralized processes.

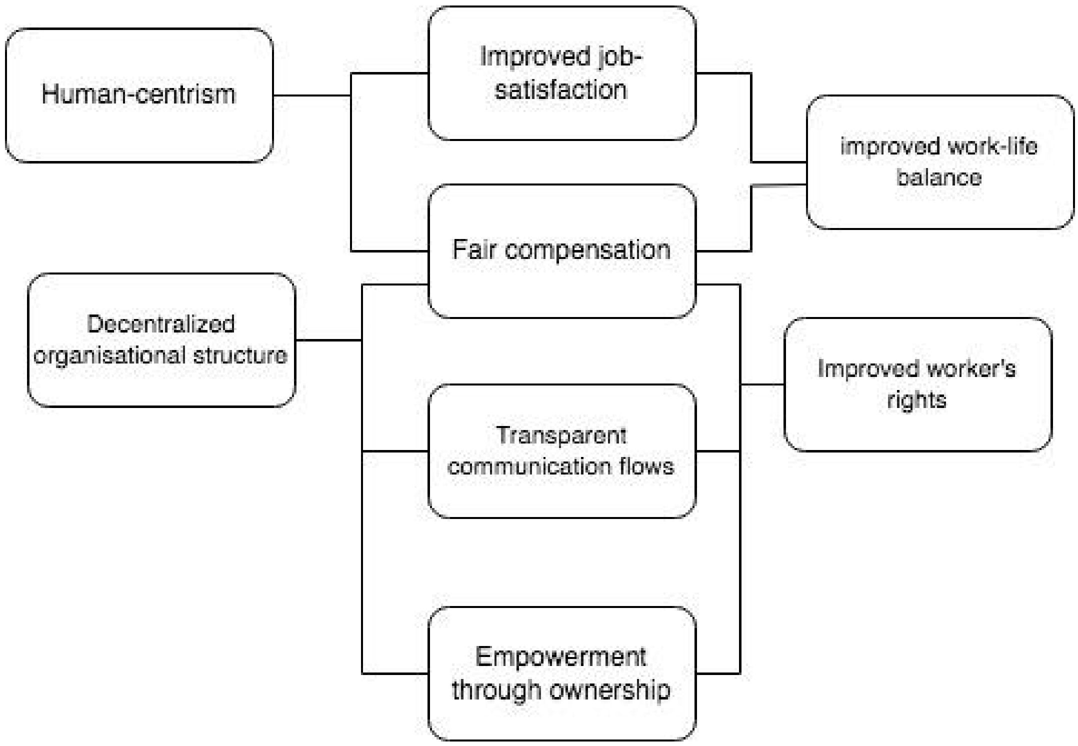

Figure 14 Worker implications

For workers, the introduction of cybernetic systems in innovation management can lead to changes in work processes, such as real-time adjustments and resource optimization, as well as a shift towards human-centric work meaning improvements in work-life balance. The shift towards decentralized leadership and bottom-up management gives the workers more ownership and power within an organization. This can result in increased job satisfaction and motivation among employees. *The viable systems model has implications of improved worker's rights through transparent communication channels, improved information flows and participatory decision-making processes as well as its potential to ensure fair and just compensation for workers*.

Regarding the external community, the introduction of cybernetic systems in innovation management can impact relationships and collaboration by promoting a more holistic and human-centric approach to innovation. *Cybernetic systems can enhance communication flows, knowledge integration, and participatory, multi-viewpoint methods, which can lead to improved collaboration with external partners and the broader community*. Additionally, cybernetic systems can contribute to sustainability strategies, corporate social responsibility (CSR), and risk readiness, which can positively impact relationships with the broader community.

5.3 Limitations and future research

Despite the theoretical contributions and practical implications of the research, the thesis does have limitations. The first being that the results are dependent on the databases used as well as the Boolean function. The Boolean function seems to be Volter specific as in it gives mainly non-relevant results when used in another database. The thesis used the same Boolean function for Scopus but due to the large number of non-relevant results some room for researcher discretion for inclusion was necessary, potentially affecting the overall findings. Additionally, the dataset size of the study may have limited the generalizability of the results to a broader context. It is important for future studies to consider using multiple databases and refining the Boolean function to ensure more accurate and comprehensive results. Moreover, increasing the dataset size could potentially strengthen the validity and applicability of the findings.

The potential future research avenues informed by the articles encompass a broad spectrum of areas within the domain of cybernetics and innovation management. These avenues include delving deeper into the specific effects of cybernetics on innovation management, such as systems thinking, organizational evolution, human-centric work, continuous improvement, sustainability strategies, risk readiness, and the interplay of themes. Additionally, future research could explore the variation of these effects across different types of organizations and industries, taking into account the role of skilled labor, knowledge workers, worker rights, and the implications of internal innovation and cybernetic management tools. The methodological approaches used in the reviewed studies, particularly the qualitative thematic analysis, present an opportunity for future research to further investigate how they influence the interpretation of the findings, including the uncovering of implicit and hidden findings within the data. Furthermore, future research could address the specific challenges and opportunities for integrating cybernetic systems theory into innovation management processes, as well as the potential ethical implications, by focusing on fostering a culture of continuous improvement, enhancing communication flows, promoting sustainability strategies, and addressing worker well-being, fair compensation, and transparent communication channels.

The potential future research avenues informed by this thesis encompasses a broad spectrum of areas within the domain of cybernetics and innovation management. These avenues include delving deeper into the specific effects of each of the key themes, such as systems thinking, organizational evolution, human-centric work, continuous improvement, sustainability strategies, and risk readiness.

Additionally, future research could explore the variation of these effects across different types of organizations and industries, taking into account the field of work and the implications of those specific contexts. Moreover, it would be beneficial to investigate how these key themes interact with each other and how they can be integrated into practical applications within organizations. Future research could delve deeper into the barriers to integrating cybernetic systems theory into innovation management processes, as well as the potential ethical implications. Exploring these aspects further can provide valuable insights for developing strategies that effectively leverage this theoretical framework for driving innovation and creating a more humanistic work environment.

Finally, an interventional study where an organization shifts to a viable systems model as it's structure would be an interesting next step in understanding the impact of cybernetic systems theory on innovation management. This could provide real-world data on the effectiveness of implementing this theoretical framework in practice and offer concrete practical recommendations for organizations looking to enhance their innovation processes.

6 Summary

This thesis aimed to investigate potential benefits the effects of cybernetic systems theory on innovation management utilizing a systematic literature review approach. This involved a thorough analysis and synthesis of existing literature to identify key themes in cybernetic management within an innovation context. The review process included data collection, data analysis, and thematic analysis to evaluate the potential benefits of integrating cybernetic systems into innovation management processes.

The key findings regarding the impact of integrating cybernetic systems theory on innovation management processes include the potential benefits of fostering a culture of continuous improvement and adaptability in organizations. The study emphasizes the importance of creating genuine value and highlights key themes such as systems thinking, organizational evolution, human-centric work, continuous improvement, sustainability strategies, and risk readiness. Additionally, the research suggests that integrating innovation tools into cybernetic frameworks can enhance organizations' adaptability and continuous improvement culture. Furthermore, it advocates for a human-centric approach within viable systems, providing practical implications for different stakeholder groups and addressing the need for humanistic approaches to management and the prioritization of worker well-being in fostering innovativeness within organizations.

The limitations and potential challenges associated with implementing cybernetic systems theory in innovation management processes include the theory's political leaning, unintuitive nature, and the lack of practical, smaller-scale solutions. Additionally, there may be barriers to integrating cybernetic systems theory into innovation management processes, as well as potential ethical implications. Furthermore, future research could explore the variation of the effects of key themes across different types of organizations and industries, taking into account the field of work and the implications of those specific contexts. Moreover, it would be beneficial to investigate how these key themes interact with each other and how they can be integrated into practical applications within organizations.

The systematic review identified several areas for further investigation in the effects of cybernetic systems theory on innovation management. These include exploring the specific effects of key themes across different types of organizations and industries, investigating how these key themes interact with each other and how they can be integrated into practical applications within organizations, delving deeper into the barriers to integrating cybernetic systems theory into innovation management processes, and conducting an interventional study where an organization shifts to a viable systems model as its structure to understand the impact of cybernetic systems theory on innovation management in a real-world setting. These areas represent potential future research avenues to enhance the understanding of the intersection of cybernetics and innovation and to provide valuable insights for developing strategies that effectively leverage this theoretical framework for driving innovation and creating a more humanistic work environment.

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Appendices

Appendix 1 JBI Critical Appraisal checklist

THE JOANNA BRIGGS INSTITUTE

JBI Critical Appraisal Checklist for Systematic Reviews and Research Syntheses

Reviewer_______________________________Date_______________________________

Author _______________________________Year______________Record Number______

		Yes	No	Unclear	Not applicable
1.	Is the review question clearly and explicitly stated?	☐	☐	☐	☐
2.	Were the inclusion criteria appropriate for the review question?	☐	☐	☐	☐
3.	Was the search strategy appropriate?	☐	☐	☐	☐
4.	Were the sources and resources used to search for studies adequate?	☐	☐	☐	☐
5.	Were the criteria for appraising studies appropriate?	☐	☐	☐	☐
6.	Was critical appraisal conducted by two or more reviewers independently?	☐	☐	☐	☐
7.	Were there methods to minimize errors in data extraction?	☐	☐	☐	☐
8.	Were the methods used to combine studies appropriate?	☐	☐	☐	☐
9.	Was the likelihood of publication bias assessed?	☐	☐	☐	☐
10.	Were recommendations for policy and/or practice supported by the reported data?	☐	☐	☐	☐
11.	Were the specific directives for new research appropriate?	☐	☐	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info ☐

Comments (Including reason for exclusion)

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Appendix 2 snapshot of data collection in Excel

B	C	D	E
Nimeke	Muu nimeke	Yhtenäistetty nimeke	Tekijä
Cybernetics of Value Cocreation for Product Development			Espejo, Raul ; Dominici, Gandolfo
Evolution of Management Cybernetics and Viable System Model			Vahidi, Amin ; Aliahmad, Alireza ; Teimouri, Ebrahim
‘Anarchist technologies’: Anarchism, cybernetics and mutual aid in community responses to the COVID-19 crisis			Swann, Thomas; Brown, Andrew D ; Alcadipani, Rafael ; Coupland, Christine ; Barros, Marcos
Theoretical notes regarding the practical application of Stafford Beer’s viable system model			Orengo, Markus
Viable IT Risk Management System by Viable System Model (VSM): Action Research for Managing IT-related Risk in the Banking Service			Arghand, Ali Akbar
Opening the black box of knowledge management mechanisms: exploring knowledge flows at a consultancy			Richter, Janek ; Basten, Dirk ; Michalik, Bjoern ; Rosenkranz, Christoph ; Smolnik, Stefan
Managing library innovation using the lean startup method			Bieraugel, Mark
Introducing the VIPLAN Methodology (with VSM) for Handling Messy Situations – Nine Lessons			Harwood, Stephen
Viability Theory and PSI Theory Interrelation Inspired by Bunge Systemic Classification: the Viable System Ontology Theory			Mouhib, Nora ; Bah, Slimane ; Berrado, Abdelaziz
Cybernetic diagnosis approach for publication productivity of Malaysian Research University			Dhillon, Sharanjit Kaur ; Ibrahim, Roliana ; Selemat, Ali
Decoding the Japanese Lean Production System According to a Viable Systems Perspective			Dominici, Gandolfo ; Palumbo, Federica
Identifying Consonance Relationships between Worker and Organization for Fostering Creativity: A Knowledge Based Approach			Gaeta, Angelo ; Ritrovato, Pierluigi ; Salerno, Saverio ; Loia, Vincenzo
Transdisciplinary Cyber-systemic Design of Instruments to Measure Academic Performance in Middle and Higher Education Systems			Reséndiz-Castro, Matilde ; Zepeda-Bautista, Rosalba ; Peón-Escalante, Ignacio Enrique
A Viable Alternative for Conducting Cost-Effective Daily Atmospheric Soundings in Developing Countries			Lafon, Thomas ; Fowler, Jennifer ; Jiménez, John Fredy ; Cordoba, Gabriel Jaime Tamayo
The 'law of requisite variety' may assist climate change negotiations: a review of the Kyoto and Durban meetings			Kidd, John
Multi-agent Simulation Research on Knowledge Management Strategies of R&D Enterprises			Kou Xiao-dong ; Wang Zhi-yu ; Yang Lin
A new forecasting scheme for evaluating long-term prediction performances in supply chain management			Hwang, Wook-Yeon ; Lee, Jong-Seok
Understanding complexity within energy infrastructure delivery systems in developing countries : adopting a viable systems approach			Awuzie, B.O. ; McDermott, P.

Julkaisussa	Väitöskirja	Opinnäyte
Systems research and behavioral science, 2017, Vol.34 (1), p.24-40		
Systemic practice and action research, 2019, Vol.32 (3), p.297-314		
Organization (London, England), 2023, Vol.30 (1), p.193-209		
Kybernetes, 2018, Vol.47 (2), p.262-272		
Systemic practice and action research, 2022, Vol.35 (6), p.747-763		
Kybernetes, 2023, Vol.52 (13), p.1-28		
Library management, 2015, Vol.36 (4/5), p.351-361		
Systemic practice and action research, 2021, Vol.34 (6), p.635-668		
Systemic practice and action research, 2020, Vol.33 (6), p.675-701		
2019 6TH INTERNATIONAL CONFERENCE ON RESEARCH AND INNOVATION IN INFORMATION SYSTEMS: EMPOWERING DIGITAL INNOVATION (ICRIIS 2019), 2019, Vol.2019, Article 9073664		
Systemic practice and action research, 2013, Vol.26 (2), p.153-171		
2013 IEEE INTERNATIONAL CONFERENCE ON SYSTEMS, MAN, AND CYBERNETICS (SMC 2013), 2013, p.1425-1431		
Systemic practice and action research, 2022, Vol.35 (3), p.395-440		
Bulletin of the American Meteorological Society, 2014, Vol.95 (6), p.837-842		
Knowledge management research & practice, 2014, Vol.12 (1), p.62-73		
2013 IEEE INTERNATIONAL CONFERENCE ON SYSTEMS, MAN, AND CYBERNETICS (SMC 2013), 2013, p.1109-1114		
International transactions in operational research, 2014, Vol.21 (6), p.1045-1060		
Journal of Construction Project Management and Innovation, 2013, Vol.3 (1), p.543-559		

Kuvaus	Kieli
In marketing theory, the shift from the paradigm of value creation to value 'cocreation' calls for a deeper grasp of the interactions between producers and customers. Marketing studies have widely focused on the value cocreation concept, but so far, the mechanism through which consumers can be involv	englanti
The Viable System Model have pulled in system specialists' interests lately. This field could help system analyzers and designers to deal with systems unpredictability and help them to handle dynamic evolving situations. This paper investigates Viable System Model recorded and late research patterns. To s	englanti
The COVID-19 pandemic that gripped the world since the end of 2019 has been felt most immediately both as a health crisis and an economic, social and political crisis. Secondary impacts of social distancing and lockdown in many countries have put strains on people's capacities to provide essential food a	englanti
Purpose This paper aims to capture current difficulties with the practical application of the viable system model (VSM). On this basis, a set of suggestions toward a more effective application of the model is made. Design/methodology/approach The study is based on observations from practical applications	englanti
In recent years, some standards and frameworks proposed the risk management structures for managing and controlling IT risk that is the main component of enterprise governance of IT. Unfortunately, these frameworks have a retrospective view of threat analysis and less pay attention to future threats i	englanti
PurposeBased on an exploratory case-based approach, the purpose of this paper is to open the KM black box and examine the relationships that link knowledge management (KM) inputs (i.e. knowledge resources and KM practices) via knowledge processes to KM performance. This paper aims to identify t	englanti
Purpose – The purpose of this paper is to argue the case that libraries should use the lean startup method for developing, managing and launching radically innovative services or products. Design/methodology/approach – Libraries need to innovate but do not have the management structure to handle the	englanti
This paper examines the utility of a novel and relatively unknown approach to handling messy situations. This approach, developed by Raul Espejo, is the VIPLAN Methodology. It is presented as a heuristic and comprises a set of six activities which act as 'pointers' to guide thinking and actions. The methodo	englanti
This paper proposes a new theory called the Viable System Ontology Theory, which is an interrelation among two well-known theories in social science. The former is the Viability theory that is widely recognized through the Viable System Model, and covers the function design of a business. The latter is Pe	englanti
It is essential for academic staffs to keep track of their publication records. Publication is seen to be the main resource for evaluation in the academic world. Besides, the publication criteria are mainly being evaluated for promotion and to access research grants from the institution or the government entiti	englanti
The increase in the complexity and variability of the business environment, due to constant and rapid changes in markets, calls for more flexible and effective production systems. Of the most valuable production systems, the Japanese lean production system (LPS) is the best known and studied, but is still r	englanti
We present our preliminary results in the definition of a model and knowledge based techniques to support creativity by establishing consonance relationships between a worker and the organization. The model is based on the Viable Systems Approach (VSA) and links this theory with Creativity and Open i	englanti
This study reports a systemic cyber application with a transdisciplinary approach of a case study, through the creation of measuring instruments to improve academic performance in middle and higher education. The objective is to amend an absence of comprehensive measurement mechanisms to promo	englanti
Radiosonde-collected data are of vital importance to a wide variety of studies that aim at understanding the interaction between land surface and the atmosphere, among others. However, atmospheric measurements in developing countries, some of which encompass areas critical to the regulation of glob	englanti
Ashby wrote about cybernetics, during which discourse he described a Law that attempts to resolve difficulties arising in complex situations - he suggested using variety to combat complexity. In this paper, we note that the delegates to the UN Framework Convention on Climate Change (UNFCCC) meeting i	englanti
In the background of transformation and upgrading of China's economy, this article builds a kind of model for R&D Enterprises based on multi-agent modeling technique, and by simulating the effects of different project group sizes on achievement of enterprise mission and capital cost control, the knowled	englanti
Supply chain management (SCM) practitioners in inventory sites are often required to predict the future sales of products in order to meet customer demands and reduce inventory costs simultaneously. Although a variety of forecasting methods have been developed, many of them may not be used in pra	englanti
Infrastructure delivery systems involve high complexity. This stems from numerous factors: a diverse range of skilled professionals, diverse cultural affiliations, incomplete contracts and complex contractual relationships among stakeholders, government policies, finance and regulatory issues, and high leve	englanti

Aiheet
Arenas ; Behavior ; Business & Economics ; Consumers ; Customers ; Cybernetics ; law of requisite variety ; Management ; Market value ; Marketing ; Markets ; Product development ; product development and innovation ; Social Sciences ; Social Sciences - Other Topics ; Social Sciences, Interdiscipli
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Alcohol ; Anarchism ; Assistance ; Community involvement ; Connexions ; Coronaviruses ; COVID-19 ; Cybernetics ; Drugs ; Economic crisis ; Healthy food ; mutual aid ; Pandemics ; Participatory research ; Political crises ; Resilience ; self-organisation ; Social response ; Support groups ; Voluntary or
Algedonic channel ; business & management ; Computer Science ; Computer Science, Cybernetics ; Cyclic recursion ; Data science ; Early adopter ; economics and business ; education ; Fractals ; Innovation diffusion ; Know-how ; Operations research ; Organization development ; Organization theory
Action research ; Adaptability ; Banking services ; Business & Economics ; Business and Management ; Cybernetics ; Enterprise risk management ; Enterprise Risk Management (ERM) ; Information technology ; IT governance ; IT risk ; Management ; Managers ; Methodology of the Social Sciences ; Or
Black boxes ; Case studies ; Case study research ; Consultancy ; Consultancy services ; Human resource management ; Knowledge flows ; Knowledge management ; Mechanisms ; Organizations ; Supply chains ; Viable system model
Academic libraries ; Business ; Company structure ; Culture ; Entrepreneurship ; Handles ; HR in libraries ; Innovate ; Innovation ; Innovations ; Leadership ; Lean project management ; Lean startup ; Librarians ; Librarianship/library management ; Libraries ; Library & information science ; Library ma
Business & Economics ; Business and Management ; Cybernetics ; Management ; Methodology of the Social Sciences ; Organization ; Original Research ; Problem structuring ; PSM ; Social Sciences ; Sociology ; Systems thinking ; VIPLAN methodology ; VSM
artificial intelligence & image processing ; Business & Economics ; business & management ; Business and Management ; Business process ; Business process design ; Business process modeling ; Business process reengineering ; Computer science ; Conceptual system ; Cybernetics ; economics and busi
Computer Science ; Computer Science, Information Systems ; Cybernetic ; Key performance indicator ; Science & Technology ; Technology ; University ; Viable
Business ; Business & Economics ; Business and Management ; Consumers ; Cybernetics ; Japan ; Japanese business environment ; Just in Time ; Lean manufacturing ; Lean production system ; Management ; Markets ; Methodology of the Social Sciences ; Organization ; Original Paper ; Production ;
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Academic achievement ; Academic performance ; Business & Economics ; Business and Management ; Case studies ; Collaboration ; Cyber-systemic-transdisciplinary ; Cybernetics ; Equity (finance) ; Higher education ; Higher university technician ; Human capital ; Learning ; Management ; Measuring
Accuracy ; Atmospheric measurements ; Atmospheric sounding ; Atmospherics ; Aviation ; Aviation regulation ; Balloons ; Business ; Commercialization ; Cost control ; Developing countries ; Developing country ; Economic aspects ; Environmental economics ; Gliders ; Global climate models ; Groun
Analysis ; Applied sciences ; Ashby's Law ; Atmospheric pollution ; Beer ; Business & Economics ; Business and Management ; Carbon footprint ; Climate change ; Convention ; Cybernetics ; earth and related environmental sciences ; Exact sciences and technology ; Information Science & Library Scienc
Analytical models ; Computer Science ; Computer Science, Cybernetics ; Computer Science, Information Systems ; Educational institutions ; Engineering ; Engineering, Electrical & Electronic ; Gaussian distribution ; Knowledge management ; knowledge management strategy ; Load modeling ; multi-age
Autoregressive model ; Business & Economics ; Computer science ; Demand forecasting ; Forecasting techniques ; Inventory ; Long-term prediction ; Long-term prediction performances ; Management ; Operations management ; Operations research ; Operations Research & Management Science ; Or
Developing countries ; Infrastructure delivery systems ; Project complexity ; Viable systems model