Building sustainable hospitals: A resource interaction perspective

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Building sustainable hospitals: A resource interaction perspective

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ABSTRACT

In response to a growing influence of patients, higher specialisation, technological advancement and the need to provide care services more efficiently, the issue of sustainability in healthcare has gained prominence. The purpose of this paper is to investigate how the social and economic sustainability of healthcare are dependent on interconnecting resources across organisational borders and in different settings over time. Adopting a product development process perspective, the paper explores the gap between a planned healthcare facility and how it actually came to be used, through a longitudinal case study of the Skandion clinic, a small, highly specialised, hospital in Sweden. The findings suggests that integration of healthcare resources over time is central to achieve social and economic sustainability goals. The results hereby contend the prevailing view of hospitals as independent organisational units and highlights the need for more holistic analyses of sustainability in healthcare. Analyses which take into account the complex interdependencies stretching across networks of interconnected facilities and organisational units.

1. Introduction

Hospitals are a crucial yet expensive resource in any healthcare system. Both the initial investment and the running of a hospital are associated with high costs (Rechel, Wright, & Edwards, 2009). These large public expenditures necessitate a good return in terms of efficient and purposeful healthcare services and the development of a sustainable healthcare system (Weisz, Haas, Pelikan, & Schmied, 2011). Most modern healthcare systems are undergoing rapid change due to phenomena such as technological advancement, aging populations, higher involvement of patients, and innovative ways of providing care (Bromley, 2012; Scott, Ruef, Mendel, & Caronna, 2000). However, the hospitals are often outdated and unable to meet the new demands, which has led to burgeoning public expenditure on healthcare facilities all over Europe (Rechel, Erskine, Dowdswell, Wright, & McKee, 2009). Sweden is no exception to this trend, with investments in healthcare buildings that reached approximately 10 billion euros between 2019 and 2021 (SOU, 2020:15). With this level of public expenditure comes a responsibility to secure the long-term sustainability of these new hospitals (Rechel et al., 2009).

The concept of sustainability is based on three interdependent pillars: environmental, economic and social (Carter & Rogers, 2008; Elkington, 1994; Hunt, 2011). In a healthcare setting, sustainability translates into the systemic coordination of key processes and resources distributed by healthcare actors to achieve economic, social and environmental objectives (Buffoli et al., 2013; Hussain, Ajmal, Gunasekaran, & Khan, 2018; Lega, Prenestini, & Spurgeon, 2013; Scheirer & Dearing, 2011). It is thus imperative that efficiency of patient treatment is balanced with economic constraints. However, providing new treatments by building new hospitals constitutes a key challenge for the sustainability of current and future healthcare systems (Ulrich et al., 2008).

While acknowledging the interdependence of all three aspects of sustainability, this study focuses on the *social* and *economic* aspects of providing a new healthcare technology – proton therapy – through the development, production and use of a new hospital. Social sustainability has generally been given far less attention than environmental sustainability, and there is a need to further develop the understanding of this dimension (Eizenberg & Jabareen, 2017; Pfeffer, 2010). In addition, much of the healthcare management literature highlights the difficulty of separating the social and economic aspects of providing healthcare services, which are intertwined in the sense that they satisfy social needs using public expenditure (Kuhlman & Farrington, 2010; Olsen, 1998). In line with this, there have been calls for a systems approach to enhance

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the understanding of healthcare delivery and the structure and dynamics of the healthcare system, while acknowledging the many interdependencies within that system (Reid & Compton, 2005). Therefore, in order to study sustainability in the context of healthcare provision, there is a need to consider the relationship between the relevant social and economic factors, as well as the interdependencies that are an inherent part of the healthcare system.

For this reason, this study adopts the industrial network approach, or Industrial Marketing and Purchasing (IMP) perspective, which provides an interactive viewpoint on the development and use of physical and social resources in interorganisational contexts (Snehota & Hakansson, 1995). From this perspective, the services that resources provide are determined by how they are combined with other resources (Håkansson & Waluszewski, 2002; Penrose, 1959). Consequently, the benefits of resources – economic and otherwise – are derived through interaction processes based on the goals and actions of interacting actors. Adopting an industrial network approach implies that a healthcare system can be seen as a network of interconnected actors, who coordinate and combine resources to increase the efficiency and quality of healthcare processes. As such, the social and economic sustainability of healthcare are dependent on the interconnectedness of resources, i.e., how resources can be combined to provide services and benefits. Healthcare systems are one of the most interdependent and complex types of organisations (Kodner & Spreeuwenberg, 2002; Thomas, Ketchen Jr, Trevino, & McDaniel Jr, 1992), which means the way in which physical and social resources are interconnected across organisational units impacts the fulfilment of sustainability goals (Kodner & Spreeuwenberg, 2002).

This paper is based on an empirical study of how a new resource, i.e., a new form of cancer treatment (proton therapy), was introduced into the Swedish healthcare system through the development, production and use of a highly specialised hospital: the Skandion clinic. At the time of the investment, in 2006, the Swedish healthcare system had an insufficient supply of radiotherapy for cancer patients. In addition to the pressing clinical need for extra capacity, proton technology caused less damage to surrounding tissue than existing treatments, thereby improving treatment outcomes and over time the social sustainability of the population. The implementation of proton technology required the establishment of a new hospital, the procurement of design and construction services to build it, and substantial ongoing funding for operational costs. However, while the ambition to establish the new therapy was strong at the start of the project, neither the social nor economic expectations were subsequently met, and to date relatively few patients have been treated, resulting in budget deficits. To understand why the original intention of the Skandion clinic was not realised – i.e., why social and economic sustainability were not achieved – the IMP perspective, and more specifically the resource interaction approach, is used here to investigate how the social and physical resources were combined to build the clinic. *The purpose of this paper is to investigate how the social and economic sustainability of healthcare are dependent on interconnecting resources across organisational borders and in different settings over time.*

The remainder of the paper begins with a review of the research on social and economic sustainability within healthcare management, followed by an outline of the theoretical underpinning of the study, i.e., the resource interaction approach and the developing, producing and using (DPU) framework. Then comes an outline of the method for the longitudinal case study of the clinic, followed by the case itself, which is divided into three sections for the three settings of development, production and use – each section pointing to interfaces related to the focal resource of proton technology. After that, there is a discussion of the role of these interfaces in providing services and benefits, and their impact on social and economic sustainability. The final section outlines the main conclusions of the study regarding the development and use of a new hospital, and the implications for healthcare management and policy in achieving sustainable healthcare.

2. Previous research and theoretical underpinning

Internationally, the organisation of healthcare is undergoing fundamental change in response to the growing influence of patients, higher specialisation, technological advancement and the need for greater efficiency (Bromley, 2012; Oates, Weston, & Jordan, 2000). These core issues relate both to the social and economic sustainability goals of healthcare and to the construction of new hospitals. As a central resource in a changing healthcare landscape, the function of hospitals in relation to other resources and their systemic organisation is also changing (Pantzartzis, Edum-Fotwe, & Price, 2017). How to plan, construct and use hospitals in a sustainable manner is thus intimately related to the rapidly developing field of healthcare and the systemic changes such development requires. The following two sections review the previous research on social and economic sustainability in healthcare generally, and the sustainability of hospitals in particular. The theoretical tools utilised to investigate the social and economic sustainability of the Skandion clinic are then presented.

2.1. Social and economic sustainability in healthcare

The social dimension addresses the 'human side' of sustainability in healthcare, encompassing aspects such as quality of life, belonging, equity, solidarity and organisation, while the economic aspect includes issues such as effectiveness and efficiency (Capolongo et al., 2016; Kuhlman & Farrington, 2010; Marimuthu & Paulose, 2016). The literature on sustainability in healthcare mainly focuses on environmental issues within healthcare management (Ertz & Patrick, 2020; Rich, Singleton, & Wadhwa, 2013) whereas social sustainability is still a developing area of research. The few studies addressing the social dimension commonly adopt a supply chain perspective, e.g., Hussain et al. (2018), who explore the drivers of and barriers to social sustainability, concluding that a greater focus is needed on the interaction between stakeholders (policymakers, customers, employees and suppliers) to make social sustainability a more prominent concern in healthcare supply chains. Another recurrent theme is the creation of frameworks and models to measure social sustainability (e.g., AlJaberi, Hussain, & Drake, 2017; Buffoli, Gola, Rostagno, Capolongo, & Nachiero, 2014; Capolongo et al., 2016; Khosravi & Izbirak, 2019). The common denominator of all these frameworks is the inclusion of a multiple stakeholder perspective and an emphasis on 'humanised' variables, i.e., the patient's perspective, employee satisfaction and engagement, organisation of activities, and the reciprocity of these factors. The systemic perspectives, linking social sustainability factors to economic and technical factors are still few.

The economic dimension of sustainability in healthcare is usually related to escalating public expenditure and whether it is proportionate to the benefit gained from healthcare services (Borgonovi & Compagni, 2013; Nolte & McKee, 2004). However, quantitative studies confirm that increasing healthcare expenditure is correlated with lower mortality rates (Crémieux, Ouellette, & Pilon, 1999; Stukel et al., 2012), implying a positive impact on social sustainability (Borgonovi & Compagni, 2013). Economic sustainability can, however, also be regarded as a function of social sustainability in that efficient use of limited resources is necessary to achieve optimal social sustainability (Gibson, 2006, 2010; Kuhlman & Farrington, 2010). Kuhlman & Farrington (2010, p. 3439) propose that *"the view is further restricted [economic dimension] if we confine ourselves to the aggregate amount and not with its distribution or what the money can buy"*. The reciprocity between the economic and social dimensions of healthcare is thus an important point of departure that needs a more in-depth explanation and understanding.

2.1.1. Sustainable hospitals

The research on sustainable hospitals is also an emerging field, with two dominant areas: green issues such as CO_2 emissions and the use of disposables and plastics (Kaplan, Sadler, Little, Franz, & Orris, 2012;

McGain, 2010, and social issues such as improving the healing environment of patients, the working environment of staff, physician-patient relations, and the hospital as a research institution (Bottero et al., 2015; Capolongo et al., 2015; Di Cicco, 2002; McGain & Naylor, 2014). There are also some integrated perspectives such as 'socio-ecological' sustainability (Weisz et al., 2011), which acknowledges the alignment between economic, ecological and social factors, or perspectives connecting multiple social factors instead of viewing them as isolated (Pinzone, Lettieri, & Masella, 2012). For instance, Buffoli et al. (2014, p. 7) state that hospitals should be studied *"not only as subject but also as an operating machine"*, thus underlining the importance of the organisation of healthcare in capturing economic and social sustainability issues. But, despite this basic understanding of the interconnection between economic and social issues, most sustainability studies are still limited to the internal activities of the hospital building and focused on numeric measurements.

In research on integrated care, the sustainability of a hospital is comprehended as a function of the facility in relation to its patients' *full* treatment procedure (Hall, Belson, Murali, & Dessouky, 2006). The research confirms that the integration of healthcare activities is critical to the improvement of care quality, patient safety, and efficiency (Charns & Tewksbury, 1993; Gröne & Garcia-Barbero, 2001; McKee, Mercure, Edwards, & Nolte, 2020), whereas a lack of coordination is one of healthcare's largest cost drivers (Peikes, Chen, Schore, & Brown, 2009; Strandberg-Larsen & Krasnik, 2009). This means that all units involved in treatment procedures will impact the efficiency and quality of care in all other hospital units.

As a concept, *healthcare integration* describes everything from the coordination of work teams in clinical practice to the coordination of entities at a system level (Boon, Mior, Barnsley, Ashbury, & Haig, 2009; Gillies, Shortell, Anderson, Mitchell, & Morgan, 1993; Kodner & Spreeuwenberg, 2002; Minkman, 2012). However, the common definition of integration relates to the coordination of inter- *and* intra-organisational care procedures (Ahgren & Axelsson, 2011; Evans, Baker, Berta, & Jan, 2014). Despite the fact that many models of healthcare integration adopt a multiple actor perspective, they tend to be based on quantitative measures that presuppose standardised input values (Strandberg-Larsen & Krasnik, 2009). Other qualitative perspectives derived from, for example, implementation science (Bauer, Damschroder, Hagedorn, Smith, & Kilbourne, 2015) tend to either delimit the perspective to a specific professional group or process, or to standardised input values (Fisher, Shortell, & Savitz, 2016; Goodwin, 2019). Thus, many of the current approaches tend to reduce integration to an optimisation event, presenting homogeneous resources in processes that are delimited in both time and scope.

The central purpose of a public healthcare system is to treat patients and grant them equal access to healthcare within given economic frames, so social and economic sustainability are key objectives of any such system (Saviano, Bassano, Piciocchi, Di Nauta, & Lettieri, 2018). Achieving these objectives by building a new hospital, from a systemic and integrated care perspective, involves complex integration of internal and external care-providing processes (Garrick, Sullivan, Doran, & Keenan, 2019; McKee & Healy, 2000). The planning and construction of new hospitals is therefore intimately related to the planning of healthcare activities – an interconnection that has been severely neglected (Garrick et al., 2019). Thus, the question of how to achieve coordination across the hospital-building process – from planning, through construction, to efficient end use – must first be solved to bring about economically and socially sustainable healthcare systems. This study moves beyond the prevailing view of the hospital as an independent unit (McKee et al., 2020; Rechel et al., 2009) and 'static' measurements of sustainability confined to specific points in time. It addresses sustainability by emphasising the planning, construction and use of a hospital building and focuses on the interplay between physical and social resources, and the benefits they create over time.

3. Theoretical underpinning

This paper investigates the introduction of a new cancer treatment technology through the product development of a specialised hospital – a highly complex product whose context of use also constitutes a *system of users* with diverging perspectives, goals and needs (Ferlie & Shortell, 2001). During the long process of development and construction of this new resource, many different actors impacted and shaped the direction of its development. As a result, the value and features extracted from it, i.e., the functions of the final product, reflect each actor's perspectives and goals, as well as the contextual prerequisites of each situation throughout the product development process (Håkansson & Waluszewski, 2007; Harrison & Håkansson, 2006). The DPU framework helps reveal the interconnection between the economic and social sustainability factors, i.e., how the economic logic dominating each setting impacted the development of Skandion, its proton technology, and the organisation of related processes over time.

3.1. The DPU framework – Developing, producing and using new products

The empirical settings of *development*, *production* and *use* signify an overall logic that comes from developing, producing and using new resources such as products. They represent different *economic logics* that organisations engage in to produce and implement new products (Håkansson & Waluszewski, 2007; Rosenberg, 1994), but they are not mutually exclusive and do not belong to any specific actor. Different actors can be involved in more than one setting, e.g., future users who take part in the development of new products (Von Hippel, 1986). The settings are interrelated across the entire product development process and each one shapes the economic features of the resource. In relation to social and economic sustainability, the DPU framework highlights the interconnectedness of the social and economic facets directing the development of the focal resource (in this case, the proton technology). If patients are the central focus in the development of a healthcare facility, the treatments given there will have a social impact by expanding treatment options for patients and reducing illness in the population. But patients, when regarded as a key resource, also carry with them an economic dimension by allocating the economic resources of the healthcare system to the treatment facility.

The developing setting is normally associated with high uncertainty due to its large investments without the assurance of future returns. What triggers an organisation to develop a new product is related to the specific resource to be developed, and a radically new resource will mean larger adaptations in established structures and higher costs (Håkansson & Waluszewski, 2007). Capital investments in hospitals are risky, as there is little knowledge to help decisionmakers organise how the facilities will operate (Healy & McKee, 2002). Nevertheless, decisions in the development phase are based on estimations of future use and, in a healthcare setting, the central objective is the treatment of illness in the population. Design decisions are related to economic use in terms of increasing the capacity of the healthcare system or enhancing the efficiency of treatment (Buffoli et al., 2014). *The producing setting's* most important task is producing a product that generates value for users, as they bring the revenue that motivates production (Håkansson & Waluszewski, 2007). In order to produce a new product, a set of resources must become settled, i.e., resources that were changeable in a development setting have to find a 'fixed' combination structure (Ibid.). Although construction is a project-based way of producing unique products, the production of buildings follows standardised procedures that carry over to subsequent projects (Winch, 2010). These standards impact the physical structure of buildings and determine the possibilities and limits of their use – in this case, the healthcare services to be provided there (Garrick et al., 2019). *The using setting* relates to users seeing the new product as valuable, either by earning profits from it or improving existing activities through its use. The using setting may also use a new resource to decrease costs or improve existing processes

(Håkansson & Waluszewski, 2007). The positive effects of using *the new*, however, must be evaluated in relation to changes in established structures.

The DPU framework constitutes the overarching setting of the product development process. However, in order to grasp how the proton technology has contributed to social and economic sustainability in the healthcare system, there is a need for a detailed analysis, which can be done using the resource interaction approach.

3.2. The resource interaction approach

As argued earlier, it is only when a resource is *embedded into use,* i.e., connected to other physical and social resources, that social and economic sustainability can be realised (Bengtson & Håkansson, 2007). This study applies the *resource interaction approach* (RIA) (Håkansson & Waluszewski, 2002; Snehota, 1990), which we use as an analytical tool to capture the embedding process of Skandion and its proton technology into the healthcare system. For the purpose of this paper, the RIA reveals patterns of interdependency between resources in the healthcare system. These patterns pinpoint how the focal resource (the proton technology) is embedded into the healthcare system at different points in time throughout the product development process (Baraldi, Gregori, & Perna, 2011). Identifying the resources to which the proton technology is, or is not, connected, reveals the ways in which the technology contributes social and economic value to the healthcare system. The RIA is an *analytical tool* that captures the *underlying dynamics* of healthcare integration, and as such can be used to analyse and discuss healthcare sustainability. Put differently, many of the determining factors of achieving social and economic sustainability, for instance creating continuous use and availability of the proton technology, can be revealed. The next section will examine the main tenets of the RIA relevant to the understanding of how resource interaction is captured.

The RIA is based on the assumption that resources are heterogeneous (Penrose, 1959), which means that the value and features of resources are subjective in the context that brings them into use (Snehota, 1990). How a resource is utilised thus depends on the context of current or potential use (Snehota & Hakansson, 1995). A resource's capability to create economic and social value is thus contingent on the resources to which it is related. Furthermore, the achievement of social and economic sustainability depends on proper integration of care activities, i. e., how resources are used, assessed and interrelated through different actors over time and space, pointing to specific incidents of interaction, or lack thereof.

Applying the RIA to a development process highlights the dynamic aspect of resources, where a resource's heterogeneity gives it a potentially infinite number of features that can be utilised in an infinite number of ways, and what features are activated or hidden is determined through its current interactions (Snehota, 1990; Snehota & Hakansson, 1995; Waluszewski, 1990). While resources through their heterogeneity may create seemingly endless possibilities, the existence of interfaces (i.e., the point where resources interconnect) will delimit resources' possibility to develop further (Håkansson & Waluszewski, 2007). The fact that resources are interconnected over larger network structures means that changes in one interface will create friction in several related interfaces (Håkansson & Waluszewski, 2002). This does not only entail resistance to change, but also a need for further change. Friction occurs as a consequence of earlier investments, when the new has to be systematically related to previous investments to avoid rejection, which in turn restricts a resource's use (Ibid.).

Actors control resources, but they can only partly control a set of resources and must utilise them for specific activities in order to exploit their value (Prenkert, Hasche, & Linton, 2019). Investigating the development of a resource, then, is a matter of tracing interaction patterns across the settings of the development process that, due to their diverging underlying economic logics, assess the economic and social value of resources differently and activate them in different ways through interaction over time and space (Baraldi, Gressetvold, & Harrison, 2012; Håkansson & Waluszewski, 2002). The time dimension is central to development processes due to the continuous adaptation taking place between resources as they interconnect over time, which shows that the value of a resource is never static but changes over time and across different resource constellations (Håkansson & Waluszewski, 2002). Nevertheless, a resource carries a history of interaction that affects its possibilities for further adaptation. The contexts it enters represent investments made over time, i.e., *investments in place* that constitute structures of interdependent resources into which new investments need to fit (Håkansson & Waluszewski, 2007). A public healthcare setting is no exception, where a range of social structures (e. g., 'standard' knowledge in terms of guidelines and large-scale treatment procedures) and physical investments in things such as technological equipment and facilities (Wagrell, 2017), both restrict and create possibilities for a new resource's development towards social and economic sustainability.

3.3. Social and physical resources and resource interfaces

Several studies classify resources as either physical or social (e.g., Gressetvold, 2004; Håkansson & Waluszewski, 2002; Jahre, Gadde, Håkansson, & Persson, 2006). Physical resources include equipment, products, production machinery, factories and information systems, whereas social resources include knowledge embedded within an organisation, coordination skills, and a wide range of human resources and business relationships. Business relationships are a crucial resource since resource-combining efforts (i.e., trying to relate a specific resource to others in order to create value) often occur across organisational boundaries. Furthermore, social resources are necessary to organise the continuous resource combining and utilisation within and between organisations (Strömsten & Håkansson, 2007). The knowledge and competence required to do so is generated and refined through interaction processes and is thus embedded into the resource combination (Gadde & Håkansson, 2008). By studying resource interfaces, therefore, it is possible to trace earlier interaction patterns that entail different kinds of knowledge and competencies, and shape resource structures.

Resource interfaces capture interactions as they reveal the effects of adaptation processes. They can therefore be used to understand the consequences of developing existing resources or introducing new resources into established resource structures (Baraldi et al., 2012). Interfaces are always affected by a set of other interfaces, so the function and value of any interface can only be created over time as it adapts to the other interfaces evolving around it (Strömsten & Håkansson, 2007). In this way, resource interfaces may reveal how resources not directly connected to the focal resource (but related in the second and third degrees) can still affect it (Håkansson & Waluszewski, 2002; Baraldi, 2003). The effects of interactions are thus exposed at the interface of resources, as they have adapted to one another (Håkansson & Waluszewski, 2002). There are three categories of interface: *physical interfaces* between any two physical resources, *social interfaces* between any two social resources, and *mixed interfaces* between a physical and a social resource (Baraldi et al., 2012). From such categorisations, it appears that mixed interfaces play a role in creating economic value, because purely physical interfaces cannot create value without the involvement of the organisations handling them (Strömsten & Håkansson, 2007). Resource interfaces can also be investigated in terms of how 'deep' or 'shallow' they are (Baraldi & Waluszewski, 2007). The depth refers to the level of adaptation in specific resource combinations – the more specific the combination between resources, the higher the interdependency and depth of the interface. For example, a deep interface refers to resources that were developed in relation to each other that necessitate specific adaptations and can most likely not provide the same function if taken out of that specific constellation (Ibid.). Shallow interfaces show less specificity in terms of interdependence in a specific constellation, e.g., a factory that produces many different (standardised) products does not have a deep interface with any of the products it produces, but rather shallow interfaces with many different standardised products. Both deep and shallow interfaces are of interest here, since they, in combination with a number of interfaces, say something about a specific resource's embeddedness. *Interface embeddedness* refers to how interfaces are interconnected (directly and indirectly) in a network and how they affect each other (Strömsten & Håkansson, 2007). Previous studies show the difficulties of embedding new solutions and knowledge into established networks, where resources have adapted to each other over time and developed deep interfaces that are difficult to change (Baraldi & Waluszewski, 2007; Bengtson & Håkansson, 2007).

4. Method

The aim of this paper is to explain the factors relating to the economic and social sustainability of a new hospital (the Skandion clinic) by studying how the focal resource of proton technology became embedded in the healthcare system over time and throughout the product development process. The proton technology is thus the focal resource, not the physical building, since the technology constitutes the essential *function* of the hospital. Furthermore, functionality is central to assessing the hospital's possibility to create value in the healthcare system and thus to achieve social and economic sustainability. This study seeks to understand how a new resource becomes embedded into a network so as to create a 'valuable whole' (Bengtson & Håkansson, 2007).

The RIA was chosen to map the resource interaction patterns underlying the development process that were crucial for the building to fulfil its purpose. The exploration of this phenomenon required depth, detail and richness of data, so a single case study approach was adopted (Dubois & Gadde, 2002; Eisenhardt, 1989). Single case studies are also appropriate for longitudinal studies and the study of change processes (Eisenhardt, 1989). The case study was carried out over time in a longitudinal manner.

The case has both an *exemplary* and *critical* character (Yin, 2017). It is *exemplary* insofar as it demonstrates how a healthcare facility needs to interconnect with an entire healthcare system, and *critical* in that the clinic is unique. As such, it provides two insights into the social and economic sustainability of hospitals. The first of these insights is that, as the only provider of a new type of radiation treatment, Skandion has a unique function in the national healthcare system. The second insight is that the organisational setting and the advanced technology requires specialised products related to economic and social sustainability.

Defining Skandion as a hospital is perhaps questionable, because it is referred to as a clinic in practice. Nevertheless, the definition of what qualifies as a hospital is fairly broad. Garrick et al. (2019) discuss how to distinguish a hospital from other healthcare facilities and refer to a growing number of "single specialty hospitals" that "cater only for elective admissions" (Garrick et al., 2019, p. 48). By this definition, Skandion is a highly specialised hospital where patients can only get admitted by referral from a specialist. Furthermore, Skandion is administratively independent and performs all the administrative functions of a hospital in the Swedish healthcare system.

The data set is comprised of 25 interviews, with 21 being done in 2012–2013 and four follow-up interviews in 2019 (see Appendix 1 for a detailed overview). The first period of data collection focused on the construction project, including how crucial resources combined to complete the building, i.e., a focus on the development and construction phases. The interviews were semi-structured (Hesse-Biber & Leavy, 2010) and were with the following actors: client/developer, main contractor, tenant/user organisation, subcontractors, architect, planning coordinator and med-tech supplier. The second part of the data collection was a follow-up study investigating the hospital when operational, and included interviews with the head of the clinic, the director, and former project workers from the facility's owner, *Akademiska Hus* (AH). Additional secondary data were collected between 2018 and 2019, including construction firm documents, economic statements, and newspaper articles reporting the outcomes of the treatments offered at the new hospital.

The interviews focused on resources and interorganisational collaboration in order to trace the use and development of resources within and across the firm's boundaries and the boundaries of the project, thus capturing interaction patterns across time and space. The interviews also aimed to capture the intentions of the project, when and how resources were developed and used, and the treatment outcomes of the new hospital. The interviews and secondary data provided a comprehensive illustration of the underlying interaction patterns in the settings of development, production and use.

The case analysis was guided by the RIA (Håkansson & Waluszewski, 2002) to detect patterns of interdependency between resources, i.e., resource interfaces in the developing, producing and using settings of the hospital. The application of the DPU framework enabled a process perspective that could capture the variation and development of resource interfaces over time, as well as how they shaped the focal resource (proton technology) and contextualised the resource interactions within each setting. Accordingly, interfaces were identified in relation to: the intention of providing a new type of radiation treatment in the new hospital (developing setting), the design and construction of the hospital to enable the use of proton technology (producing setting), and the management of the hospital and provision of proton therapy (using setting). The interfaces presented in the case description were chosen due to their relevance in accomplishing the intended outcomes of the respective settings (outlined above) and the economic logic shaping each setting.

5. Proton therapy in the Skandion clinic: a new cancer treatment in the swedish healtcare system

Proton therapy cancer treatment utilises *proton* radiation – a technology that causes less damage to surrounding healthy tissue than conventional *photon* radiotherapy.[1] After a decision was taken to offer this type of treatment in the Swedish healthcare system, a new specialised hospital, Skandion, was developed in Uppsala for this purpose. The hospital was inaugurated in 2016 and has since treated approximately 200–300 patients per year. The total investment has reached 1.2 billion SEK and the clinic is currently struggling with large budget deficits and a low inflow of patients. The case description captures the resource interfaces in relation to the proton technology, which is here treated as the focal resource as it explicates the actual *function* of the hospital in relation to other resources in the healthcare system. The table of interfaces presented at the end of each setting below takes its point of departure in proton technology because the integration of Skandion's functions, with the intention of providing proton therapy, can highlight the sustainability aspects of Skandion as a treatment resource in the healthcare system.

5.1. The developing setting of Skandion

The developing setting included a needs assessment, a plan for how to organise investment in proton technology, and a plan for a building to host the new service for the Swedish national healthcare system.

The initiative to build Skandion was first triggered by a national review of radiotherapy back in 1996, which revealed that the Swedish healthcare system lacked capacity for essential radiotherapy treatment and that it was being used less in Sweden than in other countries (SBU, 1996). Another review in 2005 underlined the need for more radiotherapy and suggested approximately 2200–2500 patients annually in

[1] One-third of all Swedes will suffer from cancer at some point during their lifetime and approximately 50% of all cancer patients in Sweden receive some kind of radiation therapy (*Cancerfonden*, 2019).

Sweden could be eligible for proton therapy (Glimelius, Ask, Bjelkengren, et al., 2005). The economic investment was justified by these estimates, and leading oncologists from different regions of the healthcare system were active proponents for the introduction of proton therapy. The final decision to build Skandion was jointly taken by all regions in 2003, and the project was launched in 2006.

Proton radiotherapy was, at the time, a cutting-edge technology in cancer treatment and considered far more effective and precise than the standard photon therapy. The clinical results were crucial in choosing proton therapy, which suggested improved treatment outcomes – especially for children who were more vulnerable to the damage caused by treatment throughout their lifetime (Zackrisson, 2019). That said, proton therapy was not an established procedure at the time, and more research and clinical studies were needed to properly demonstrate its effectiveness. As expressed by a leading Swedish oncologist at the time: "We are investing in this clinic to investigate if proton therapy is a good treatment method, and we will conduct research on at least 80% of the patients".

At the launch of the project in 2006, a new organisation, *Kommunförbundet avancerad strålbehandling* (KAS), was established to run the hospital. This was a pragmatic way to solve the question of Skandion's ownership, as Sweden has a decentralised healthcare system consisting of 21 independent regions and the investment was too large for any single region to carry alone. The benefit Skandion provided was national, the issues of the hospital's location and how to distribute costs and ownership had to be carefully handled. KAS was the result of a collaboration between the seven regions with university hospitals appointed to run the clinic. It is still run today, by KAS, as an independent organisation and each region has its own political representation. The operations of the clinic are handled by KAS, but its operational costs are divided between all 21 regions.

During the development phase of Skandion, KAS was expected to assemble all the competencies necessary for the planning of healthcare processes and treatment procedures in the facility. However, KAS' capacity was limited as it had only two members of staff, i.e., an oncologist and the chief physicist.[2] Even though their main task was to create an efficient patient flow *inside* the hospital, they also tried to coordinate patient referrals *to* the hospital. KAS formed a medical board consisting of specialist oncologists and physicists to meet weekly online and discuss each patient case. Its main task was to provide diagnostic expertise on patient referrals and evaluate each patient's eligibility to receive the expensive treatment – a system referred to as 'distributed competence logic'.

However, the estimates of patient inflow before reaching the evaluation board were mistakenly based on general cancer prevalence, and the initial estimate of 2500 patients a year was soon revised down to 1500 patients. In addition, the process of getting patients to the clinic was never matched to the needs of patients and caregivers or fully problematised during development.

5.1.1. Summing up the developing setting

Table 1 below illustrates the interfaces that were important in shaping the configuration of Skandion in this setting, with a focus on its functionality. (See Tables 2 and 3.)

Table 1
Interfaces in the developing setting of Skandion.

Interface	Main findings
Proton technology and the patients *Type:* physical interface *Characteristics:* shallow	The patients were viewed as very generalised in the developing setting – a broad, homogenous group of cancer patients. They were viewed as a physical resource in relation to the proton technology, as their function was as an input factor able to realise its social sustainability value. The interface was shallow as it lacked specificity.
Proton technology and the regions *Type:* mixed interface *Characteristics:* shallow	The regions had to come together in relation to proton technology. A joint investment by all regions was necessary, as no region could have covered the investment alone. This represented a multifaceted interface behind which 21 different regions existed – nevertheless, in relation to the investment in proton technology, they appeared as a single interface. The interface was shallow as it lacked specificity other than generalised needs and it reflected the difficulty of reaching economic sustainability, but nevertheless led to the creation of KAS.
Proton technology and KAS *Type:* mixed interface *Characteristics:* deep	This interface arose as a consequence of economic and organisational issues related to the proton treatment. A new organisation had to be developed to enable the investment in proton technology and the management of its services. This was also an interface where the social resource was dispersed over many different organisations, but it was deep in that it was very specific and developed in relation to proton technology, and had a decisive impact on both social and economic sustainability values.
Proton technology and proton research *Type:* mixed interface *Characteristics:* shallow	The planned research activities were related to specific oncologists spread over seven different hospitals. The direct interface with proton technology was therefore considered as shallow, as it was dispersed over many different organisational units and many different researchers lacking a connection to the physical place where research could be conducted. This interface impacted social sustainability values because research to a large extent determined the medical development of a new treatment.

5.2. The producing setting of Skandion

The producing setting included the design and construction of the new hospital, which were organised by the temporary project organisation assembled for that purpose. However, the proton technology itself, i.e., the cyclotron delivering the proton radiation for the treatment, also dictated much of the process. Indeed, several of the actors engaged in the design and construction of Skandion viewed the building as a 'container' for the cyclotron.

In 2010, *Akademiska Hus* (AH) was contracted as both the developer and future owner of Skandion. However, AH specialised in constructing and managing higher education buildings, not hospitals, so what was essentially constructing a mini nuclear plant (the cyclotron) in the middle of a city, then managing its healthcare processes and curing patients was a huge challenge. Therefore, AH entered into a partnering agreement[3] with NCC Construction[4] to provide additional expertise early in the project. It was also a way to share economic risks between the involved actors, which can be significant in large and complex construction projects. AH and NCC constituted the core of the project organisation, jointly appointing other actors such as architects,

[2] The chief physicist plays a central role in radiation treatment, controlling technical aspects such as dosage calculation, treatment safety, and the physical security of the building and equipment.

[3] An unusually close form of collaboration for the construction industry, where collaboration and 'open books' were part of the contract. The most common form is a predetermined contract specifying what has to be delivered and at what cost, so the customer has more or less full control over the construction design.

[4] NCC construction is among the largest construction companies in the Nordic region, providing services encompassing infrastructure projects, public properties such as schools and hospitals, and commercial buildings (www.ncc.se).

Table 2
Interfaces in the producing setting.

Interface	Main findings
Proton technology and the partnering contract *Type:* mixed interface *Characteristic:* deep	This interface had an impact on a range of other social interfaces in that it allowed the project organisation to collaborate around the proton technology and create *specific solutions* through a complex mix of knowledge and competencies adapted to the proton technology. This interface was deep as it constituted the platform for the creation of adapted solutions in relation to the proton technology – solutions that could not be substituted with standardised solutions. It also had a positive impact on social sustainability issues, allowing for new solutions to arise and economic sustainability values in terms of risk sharing and enhancing efficiency through close collaboration.
Proton technology and KAS *Type:* mixed interface *Characteristic:* shallow	KAS handled the social aspects of the technology in relation to the construction project. However, it lacked sufficient knowledge to handle the integration of the social aspects of the technology in use. The interface was shallow since it lacked specific adaptations and the knowledge needed to embed the technology as a social process within the producing setting. This interface thus had a negative impact on both social and economic sustainability.
Proton technology and IBA *Type:* mixed interface *Characteristic:* deep	IBA had the necessary knowledge and expertise to embed the technical functions of proton technology into the producing setting – something that shaped a large part of the building and its functions. This interface was deep since it contained very specific and unique knowledge to embed the technology into the producing setting. Both the IBD and other IBA facilities were important resources in this interface. This interface had a positive impact on social and economic sustainability values, as it enhanced necessary and specific technical knowledge in the project and facilitated integration of the same.

consultants, material suppliers and subcontractors so as to achieve the best possible integration of the cyclotron into the facility.

A third important actor in this setting was the Belgian equipment supplier, IBA, which provided the cyclotron and a team of experts to supervise this potentially dangerous equipment at all times. IBA had a range of specific requirements for the building in order to make their equipment safe and easy to use, and it therefore had to be intimately involved in the planning and construction of the hospital.

Due to time limitations, the production and planning took place in parallel, allowing the project organisation to suggest alterations to the design. Yet, translating the technical requirements into actual construction solutions involved many actors in the project organisation. NCC, which was in charge of coordinating the actors involved in the construction, needed the assistance of AH to translate IBA's technical requirements, which were summarised in an integrated building document (IBD). For the project organisation to fully understand the IBD, as well as how to install and use the cyclotron, joint visits were made to three other proton radiation facilities in other countries. The project manager from IBA also moved to Uppsala and was located on-site to further assist the project organisation. This direct interaction resulted in more efficient decision-making processes and a better understanding between the actors. Also, when installing the cyclotron, technical experts from an IBA facility in Italy came to Uppsala to assist.

KAS had an important role in the production process, i.e., to reconcile the clinical purpose of the technology with the spatial requirements of the building. However, as KAS consisted of only two people who

Table 3
Interfaces in the using setting.

Interface	Main findings
Proton technology and patients *Type:* mixed interface *Characteristic:* shallow	This mixed interface has a broad impact on the embedding of proton technology on a national level. The use of proton technology has been very limited, mainly on children and adults with brain tumours, and not the large pool of cancer patients initially anticipated. This is partly due to the lack of knowledge at local levels and the lack of research on proton technology. This interface has a highly negative impact on social sustainability as only a limited number of patients have access to treatment.
Proton technology and proton research *Type:* mixed interface *Characteristic:* shallow	This mixed interface impacts the patient inflow and use of proton technology. Due to distributed competence, the level of research to broaden the application has been hindered. More research is needed to settle the standards for treatment procedures, i.e., develop guidelines.
Proton technology and the treatment procedure *Type:* mixed interface *Characteristic:* shallow	This mixed interface also impacts the use of proton technology, where the complex process of 'distributed competence', preparation at the home clinics, lack of knowledge, and an incoherent reimbursement structure result in few patients receiving treatment. This interface has a negative impact on economic sustainability, causing few paying patients and inefficient/lack of use of the technology.
Proton technology and photon technology *Type:* technical interface *Characteristic:* shallow	The original intention for proton technology was to develop it in parallel with traditional photon technology to offer broader cancer treatment options. However, while photon radiation has developed a lot with associated guidelines, standards and research, proton technology still lacks guidelines. As a consequence, the two technologies have developed into competing technologies instead of increasing social sustainability to patients with cancer.
Proton technology and KAS *Type:* mixed interface *Characteristic:* deep	The interface between the proton technology and KAS is deep and interlinked as KAS was specifically developed to handle the technology in relation to other care providers. However, as a new organisation, it has been challenging for KAS to relate the technology to the large number of other resources in the system that were not accounted for in the developing stage. The lack of patients (inflow of cash), high running costs of the clinic and the establishment of administrative routines and systems (that also have a financial and administrative burden) limit the use of the technology and have a negative impact on social and economic sustainability.
Proton technology and the regions *Type:* mixed interface *Characteristic:* deep with Uppsala region, shallow with other regions	The mixed interface between proton technology and the regions varies, since it is a multifaceted interface representing many different organisations, even though it may

(*continued on next page*)

Table 3 (*continued*)

Interface	Main findings
	appear as one. The interface between proton technology and Uppsala region is strong due to the relatively high number of patients and the historically embedded knowledge of proton technology. The interfaces with other regions are shallow as they do not refer enough patients, which is partly due to a lack of knowledge about proton therapy, but also due to the high cost of treatment. The impact of this interface is negative on both social and economic sustainability values, due to imbalanced costs/payments and low accessibility for patients.
Proton technology and AH *Type:* mixed interface *Characteristic:* shallow	The shallow interface between proton technology and the owner of the facility also seems to hinder the embeddedness of the new technology, due to the inflexibility of the property owner. The shallow interface could also be a result of the different economic logics of KAS (a public, non-profit care provider) and AH (a for-profit, state-owned real estate firm). AH puts boundaries on potential changes to the building and therefore also on possibilities to change existing operations, causing negative effects on social and economic sustainability values.

didn't know how to translate the specifications of the technology into building process requirements, the project organisation regularly had to make decisions on its behalf.

In conclusion, the partnering contract enabled AH to handle the complexities of building the hospital and created an arena for dialogue between all the actors, generating efficient cooperation between them. It also provided some unanticipated solutions such as the use of digital tools (BIM) in the design and construction (thus minimising faults on-site), joint procurement of materials and services, and the design of an award-winning[5] 'healing environment'.

5.2.1. Summing up the producing setting

In this setting, the technical aspects of the proton technology were the main focus. This stands in contrast to the developing setting, where the social aspects of the technology were prioritised.

5.3. The using setting of Skandion

Skandion opened for patients in 2017. In 2020, the hospital was still struggling with budget deficits due to a lack of referrals. The expected number of referrals was based on estimates relating to the supposed need for more radiotherapy back in 2003. How is it possible to understand the lack of patients?

Only children and patients with brain tumours are eligible for proton treatment, i.e., cases where avoiding radiation damage to surrounding tissue is critical. These two groups constitute only a small percentage of cancer patients, but the initial forecast of 1500 patients per year was based on a much broader group of patients. However, in order to refer a broader spectrum of patients, more research and clinical evidence is still needed. The accessibility of proton therapy from a patient perspective is inconvenient, due to the complicated and formalised treatment procedure. The chain of caregivers involved in a patient's treatment journey is long and complex. The first step is a patient getting a cancer diagnosis at their home clinic, where a physician evaluates whether the patient is more suited to proton therapy than the radiotherapy options available locally. If evaluated as suitable for proton therapy, the physician sends the patient to the specialist board (the distributed competence system) for a possible referral to Skandion. If the patient gets accepted, a preparation procedure starts at one of the seven university hospitals, which becomes the new 'home clinic' for the patient. The preparations take about two weeks and involve calibrating the radiation and dosage. The patient is also allocated an oncologist, both at their home clinic and at Skandion. When at Skandion, the patient has to go through the same preparation procedure again to confirm the accuracy of the data. When the treatment period is over, the patient returns to their home clinic for aftercare and checkups. The responsibility for the patient is thus distributed among many different caregivers, which demands a high level of administrative and medical coordination.

The current situation at Skandion is that 'distributed competence' is being used to organise further research into proton technology. The physicians divide their time between their home clinics and Skandion in order to prevent competence depletion from the university clinics, ensure a broad competence for Skandion, and establish Skandion as a *shared research facility* between the seven regions with university hospitals. The physicians are supposed to conduct research while at Skandion, but the research activity has been very limited due to a lack of continuity, given the short time periods spent at the clinic (Zackrisson, 2019). This lack of research means that the group of patients eligible for treatment still cannot increase, and that new knowledge utilised for treatment guidelines and standardised procedures cannot be created. During the development of Skandion, there was an emphasis on research, with plans to conduct clinical trials on 80% of the patients. The subsequent lack of research is one of the major factors behind low patient inflow (Zackrisson, 2019).

The radiotherapy provision currently available in Sweden has developed significantly since 2003, with *photon* radiation treatment undergoing dramatic technical advancement. It is not primarily the radiotherapy technology that has changed, but the related technologies and diagnostic procedures. Consequently, photon therapy has become more precise, causes less damage in tissue surrounding the tumour, and has more precise calculations of dosage and treatment area. With these improvements in place, the conventional photon treatment is 'closing in' on proton treatment in terms of treatment results (Zackrisson, 2019). Unlike photon therapy, proton therapy is not an established treatment method and has not significantly improved since it was introduced in Sweden. Moreover, the lack of patients coming to Skandion could be a result of both the complicated referral procedure and the high cost. From the paying units' perspective (the local clinic or region of the patient), it is a question of weighing the benefits of different treatment options against the cost. During the development of Skandion, the regions agreed that no single unit should alone bear the cost of sending a patient there, but that it should be jointly carried by all regions as way of relieving the pressure on already burdened cancer clinics. Now, however, it seems that most regional clinics are bearing the costs of sending a patient to Skandion on their own budgets. If photon therapy is already part of the basic care programmes and less expensive (which it usually is), sending a patient to Skandion becomes a tough financial decision where the benefits of using protons instead of photons needs to be clear.

When investigating the geographical location of Skandion's patients, it becomes clear that there is a disproportionately high number of patients from the Uppsala region. For example, in 2017, Uppsala referred 145 patients to Skandion, compared with 19 patients each from Linköping and Örebro (UNT 20180221, 2018). In addition, proton technology has actually been available in the Uppsala region since the 1950s at The Swedberg Laboratory,[6] which suggests that oncologists and physicians in the region have strongly embedded knowledge about it. The patients' geographical proximity to Skandion may also explain the bias,

[5] In 2015, Link architects won an award for designing the building façade based on the aspects of form, function, innovation and environment.

[6] The Swedberg Laboratory was closed when Skandion was established.

as patients under cancer treatment may not be able to travel far.

KAS as a new organisational unit has distinct challenges in relation to the economic deficits. As mentioned above, KAS has a lower inflow of patients, which still impacts its operations. It is an independent organisation that can be understood as region in its own right and, by carrying its own costs, it is entirely dependent on receiving patients from the regions. Therefore, KAS created administrative structures and connected them to the regions' systems to enable information sharing and coordination of treatment. Tools such as digital patient records, financial and payroll monitoring, and procurement competence create well-functioning interfaces to other resources around the technology. In the regions, these functions are handled by large, specialised administrative departments, but due to KAS being such a small unit, it was a complex and expensive challenge. However, in 2019, the problem was solved by KAS integrating its administrative functions with those of Uppsala region in return for a fee. In addition to the administrative complexities and costs, the running of the cyclotron itself is very expensive because it can never be switched off, thus fixed costs remain high and the less it is utilised the higher the costs for KAS. The regions pay an annual fee to KAS covering 70% of its total running costs (raised from 50% to 70% in 2019 to aid KAS with its large deficits) along with an additional fee per patient. The patient fee is an important source of income, but, without a significant increase in the intake of patients, KAS will slide further into deficit.

AH is still the owner of Skandion, which is unusual for a hospital in this system because the regions are normally the owners. This suggests KAS, as an independent organisation, should be the owner of Skandion under 'normal' circumstances. Despite being a state-owned company, AH is profit-driven, hence the rent paid to AH is one of KAS' largest expenses. Having an external owner also makes KAS and its proton treatments less flexible because any changes to the facility have to be negotiated with AH. Consequently, in 2019, a discussion with AH was initiated suggesting KAS take over as property owner.

5.3.1. Summing up the using setting

Expanding the availability of proton treatment requires that it must become fully embedded into cancer treatment programmes at a national level. It is, however, evident that many of the crucial interfaces are very shallow and hindering that process.

6. Discussion

Building a hospital is a complex process requiring meticulous planning, a comprehensive understanding of the activities to be undertaken within the hospital, and how to relate the hospital to the healthcare system on a network level from both short- and long-term perspectives. As previously argued in this paper, the social and economic sustainability of a new hospital can be evaluated based on its integrative capacity in relation to other resources, both within and outside hospital borders. Such integrated perspective of hospitals is increasingly important against the background of the ongoing structural changes in healthcare systems (Pantzartzis et al., 2017), towards higher specialisation among providing units resulting in networked structures with high demands on coordination and integration of healthcare activities. The Skandion clinic provides a speaking example of such development and in the following section, each setting is first discussed separately after which the settings are connected to provide an overarching network-level discussion on proton technology and sustainability.

6.1. Developing, producing and using proton technology

In the developing setting, the dominant actors pushing for development were the physicians and political actors in the regions – the latter deciding on investments. The main triggers behind development were rooted in the scarcity of radiotherapy and the need to satisfy treatment needs within the wider healthcare system. These 'triggering factors' were, however, based on shallow interfaces, i.e., estimations of future use built on standardised indicators such as "all cancer patients", without any assessment of specific patient needs. Likewise, the regions needs and prerequisites in cancer treatment were also standardised in this setting, presuming a homogeneous need. The missing interfaces in the developing setting were thus a mixed interface between proton technology and established cancer treatment procedures in the regions and a technical interface between photon and proton technology.

These shallow or missing interfaces were not, however, central to *development*, following the economic logic driving this setting, with other resources proving more crucial. The resource interface that was decisive in pursuing development belonged to the KAS, and it was indeed a deep and specific interface developed as a solution to an otherwise unattainable 'systemic investment' in proton technology. Furthermore, in this setting, the proton technology itself had an assumed intrinsic value as a systemic *treatment* resource, and it was not considered as 'radically new' in terms of its systemic functions, but as an expansion of the already existing treatment structures.

The shallow interfaces had a short-term positive effect on social and economic sustainability by triggering development to take place at a point in time when it was much needed. However, the long-term effects on sustainability were negative, which will be further discussed below.

In the producing setting, the focus was on constructing a 'container' for the new technology, i.e., a physical building. The dominant actors in this setting were the numerous experts behind the project organisation constructing the building. Given that buildings are unique and project-based products, the economic logic driving this setting was to construct a building that fulfilled its purpose within budget and time frames. The interface with the technology was indeed deep, and it enabled specific knowledge that contributed to the physical structure housing the technology, thus optimising its pre-set functions in use. KAS, on the other hand, stood out in this setting as the single shallow interface that, from a longer term perspective, would undermine clinical efficiency and organisation, which had not been fully integrated into the physical structure of the hospital. The deep interaction within the project organisation had a positive effect on social sustainability by enabling the development of new solutions for patients, such as a 'healing environment'. The influence on economic sustainability concerned time frames and budget, which were easier to achieve given the shared responsibilities established by the partnering contract. The shallow interface with KAS did not impact the progress of the construction in this specific setting, but contributed negatively to social and economic sustainability in the long term.

In the using setting, the aim is to improve and expand existing cancer treatment with proton technology. However, following the economic logic of this setting, the positive effects of using the new must be evaluated in relation to necessary changes in the established structures. In the using setting, the proton technology becomes a 'systemic resource' that must fit into a large system of interconnected caregivers and overlapping treatment procedures, so when *in use* the proton technology has a new set of direct and indirect interfaces where mutual adaptation is required. The effect of the shallow and missing interfaces in the developing setting becomes explicit in the using setting. For example, due to the technological advancement of photon therapy, the two methods are now competing for the same resources instead of being complementary. Photons have the advantage of being the established method and all the huge structural investments that entails, will be both expensive and difficult to change. Also, the improvements in photon therapy makes it difficult for the paying regions to justify the higher cost and lengthy, complicated treatment procedures of proton therapy, even from a purely medical perspective.

Already at a developing stage, photon therapy consisted of *specific* resource constellations and settled interfaces towards cancer patients, that determines the future possibilities for using proton therapy, hence adaptations between the new and the old.

Moreover, the central 'input factor' to enable use of proton therapy is the patient, who carries a number of resource interfaces to other healthcare resources that will impact the patient's interface with proton therapy. For instance, diagnosis, interaction with regional care providers, reimbursement systems, and IT systems to coordinate patient data are some of the crucial resources connected to the patient and to which the proton technology must develop deep interfaces in use. To complicate things further, these resources are not independently related to the single patient but connected to other local resources, which means they are fully embedded into a number of various stable structures in the regions that are difficult to change or adapt to.

All of the mixed interfaces involving the regions, KAS, and research are central as they have the capacity to influence physical resources and create change in stable interfaces. As argued earlier, physical resources cannot create value without the organisations handling them (Strömsten & Håkansson, 2007), and these social resources are pivotal as they control the conditions and adaptation processes for embedding the proton technology into existing structures. Research has a broad and direct impact in this case, since more is needed to settle treatment guidelines for proton therapy and expand the group of eligible patients. But, since responsibility for research is shared with other institutions, this interface is indirectly connected to cancer research undertaken at the university hospitals. Due to these kinds of investments being in place, the established interfaces resist change (Håkansson & Waluszewski, 2002) and hinder the new from making alterations to established interfaces.

The overall goal of this setting is to improve and expand existing treatment structures, but the excellence of the building and the high capacity of the technology are less significant to the achievement of social and economic sustainability. Rather, it is the social interfaces, directly and indirectly related to the proton technology, that are the determinants of sustainability.

Examining the interfaces of the three settings highlights the resources that were most valued in each. This is due to the economic logics shaping the settings and how the development of resources impacted the social and economic sustainability of each one. In order to provide a holistic picture of the embedding of proton technology at an aggregate network level (i.e., the healthcare system), the focus will now shift to the interconnectedness of resources across the settings.

6.2. Connecting development, production and use

The purpose of this paper is to explain how the social and economic sustainability of healthcare are dependent on interconnecting resources across organisational borders and in different settings over time. The DPU framework has elucidated how resources are interrelated over time and space following the different economic logics of the actors represented in each setting, which in turn shape the resource structures that ultimately settle the conditions of use.

Taking the full product development process into account has shown that many of the most salient resource interfaces' specificity was neglected during development, e.g., the patients, established treatment procedures/technologies, the regions and research. But these resources were embedded into different structures of established physical and social resources in which they had specific functions, were organised in specific ways, and held specific knowledge in relation to cancer treatment and its procedures. It is this specificity that become visible in the using setting and appears as *friction* (Håkansson & Waluszewski, 2002). The complexity of the established structures will hereby determine the embedding of proton technology into use, rather than the excellence of the building or the capacity of the proton technology itself. This *is due to network-level resource interdependencies* that have become activated in relation to the proton technology in use (Håkansson & Waluszewski, 2007). Moreover, moving from being a 'passive resource' calls for mutual adaptations.

These network-level interdependencies and dynamics created over time are thus crucial in the assessment of social and economic sustainability goals, since decisions made in each setting may appear sustainable from a short-term perspective where resources are simplified and/or taken out of the larger context in which they will be utilised. The specificity and depth of resource interfaces point to how they are used in relation to other resources and reveal the possibilities for future adaptation (Håkansson & Waluszewski, 2002). Rather than a higher degree of interface specificity being directly correlated to sustainability goals, it is a matter of properly assessing the context to which the new must be related, and which can serve the different purposes of sustainability goals. Higher specificity means taking into account many diverging yet decisive factors, both social and physical, and how these impinge on each other (the interface categorisation) and pinpoint how social and economic factors are highly intertwined.

7. Conclusions

The results of this study have confirmed that integration of healthcare activities is key to the achievement of social and economic sustainability in healthcare systems. Integration of care activities is this far poorly investigated and has drawn little attention within the healthcare sustainability literature where the view of the hospital as an independent unit prevails (McKee et al., 2020). This study thus underlines that a hospital is indeed a system within a broader system, and achieving sustainability in a new hospital requires developing deep interfaces between a range of physical and social resources over time.

Integrated care has been called "the glue holding healthcare entities together" (Kodner & Spreeuwenberg, 2002, p. 2). In such cases, the RIA framework provides a lens through which this 'glue' can be further analysed. By combining the RIA and DPU frameworks, this study has outlined the content of integration that points to how the economic shaping of resources affects their possibility to create social value, thus highlighting how social and economic sustainability are intimately related. The study has also demonstrated the processual character of integration and the importance of time, as actors adapt resources to their economic goals and incentives, thus setting boundaries for future use. The heterogeneous view of resources provided by the RIA also adds to the understanding of resources' value creation, where an integrated care perspective instead propose standardised input values (Minkman, 2012). For example, viewing 'all cancer patients' at a specific point in time as a homogenous group or the way that social and economic processes are viewed as separate and independent (Strandberg-Larsen & Krasnik, 2009). Trying to understand healthcare integration and coordination from such a limited point of view, and departing from a single event or standardised resources as input values, fails to include the social and economic shaping of resources that takes place over time, provides them with specific features and determines the possibility ofsocial and economic sustainability.

The managerial implications of this study concern how to handle the dynamics that underlie healthcare integration. If the system is moving towards greater integration and more specialised network structures (McKee et al., 2020), healthcare managers need to adapt accordingly, which means treating efficiency and effectiveness as generalised integration activities within isolated entities will be misleading. Research on integrated care highlights the importance of coordinating both interorganisational and intraorganisational activities, which will become increasingly difficult but crucial to accomplish for achieving sustainable healthcare systems in a changing healthcare landscape.

The policy implications of this study, based on needs in practice, emphasise the need for support in systemic planning, which today is lacking (Havenvid et al., 2022). In a small healthcare system such as Sweden's, expensive resources must be shared efficiently, but there is currently no mechanism to make coordination more efficient. This study shows that even the early phases of development are very important in shaping future use – especially where there is little help for decision-makers to structure and organise hospitals' capacity in relation to other healthcare units. Such help includes 'preparing' existing structures to make adaptation easier, i.e., making the new compatible so that the development process harmonises with the continuous development of other established resources in the system.

The theoretical contributions of this study further the understanding of social and economic sustainability in a healthcare setting by linking them to current developments in the sector, and make visible a networked structure of integrated care processes. Since resources are to a large extent shared among many different care providers, within such a system the tools to assess sustainability must also be adapted. By applying the analytical tool RIA (Håkansson & Waluszewski, 2002) to capture interdependencies stretching across organisational borders, this study shows how they affect the attainment of social and economic sustainability goals. It also shows how social and economic sustainability are dependent on a highly complex integration of social and physical resources over time, while most studies attempt to measure the sustainability of hospitals as independent units, or assess their sustainability at a specific point in time (McKee et al., 2020).

Appendix A. Table of interviews

Organisation	Position	Date	Duration
1. Akademiska Hus (public developer)	Project manager Interview #1	10–10-12	1 h
2. NCC (contractor)	Project manager Interview #1	10–10-12	1 h
3. Sweco (consultant)	Planning/coordination consultant Interview #1	02–11–12	1.5 h
4. NCC (contractor)	Project engineer	02–11–12	1 h
5. KAS (tenant)	Chief Physicist	04–11–12	1 h
6. Akademiska Hus (public developer)	Project manager Interview #2	21–11–12	1.5 h
7. IBA (cyclotron supplier)	Project manager Interview 1	21–11–12	1.5 h
8. NCC (contractor)	Site manager Interview #1	22–11–12	1 h
9. Bravida (subcontractor ventilation & plumbing installation)	Project leader ventilation	04–12-12	1 h
10. NCC (contractor)	Project manager Interview #2	19–04-13	1.5 h
11. Akademiska Hus (public developer)	Construction manager	13–10-13	1 h 15 min
12. Akademiska Hus (public developer)	Project manager Interview #3	16–10-13	1 h
13. Akademiska Hus (public developer)	Project manager Interview #4	22–10-13	1 h
14. Link Arkitekter (architect)	Architect	25–10-13	1 h
15. ArtCons (consultant)	Art consultant	25–10-13	1 h
16. Sweco (consultant)	Planning/coordination consultant, Interview #2	29–10-13	1 h
17. KAS (tenant)	Director of KAS	30–10-13	1 h 15 min
18. NCC (contractor)	Site manager Interview #2	08–11-13	1 h
19. Akademiska Hus (public developer)	Project manager Interview #5	08–11-13	1 h
20. IBA (cyclotron supplier)	Project manager Interview #2	14–11-13	1.5 h
21. Link Arkitekter (architect)	BIM coordinator	27–11-13	1 h
22. Akademiska Hus (public developer)	Project manager Interview # 6	01–10-19	1 h
23. Akademiska Hus (public developer)	Manager technical maintenance	25–10-19	1 h
24. KAS (tenant)	Operations manager	07–11-19	1 h
25. KAS (tenant)	Director	05–12-19	1 h

References

Ahgren, B., & Axelsson, R. (2011). A decade of integration and collaboration: The development of integrated health care in Sweden 2000–2010. *International Journal of Integrated Care, 11*(Special 10th Anniversary Edition).

AlJaberi, O. A., Hussain, M., & Drake, P. R. (2017). A framework for measuring sustainability in healthcare systems. *International journal of healthcare management, 13*(4), 276–285.

Baraldi, E., Gregori, G. L., & Perna, A. (2011). Network evolution and the embedding of complex technical solutions: The case of the leaf house network. *Industrial Marketing Management, 40*(6), 838–852.

Baraldi, E., Gressetvold, E., & Harrison, D. (2012). Resource interaction in inter-organizational networks: Foundations, comparison, and a research agenda. *Journal of Business Research, 65*(2), 266–276.

Baraldi, E., & Waluszewski, A. (2007). Conscious use of others' interface knowledge: How IKEA can keep the price of the lack table constant over decades. In *Knowledge and innovation in business and industry* (pp. 91–120). Routledge.

Baraldi, Enrico (2003). *When information technology faces resource interaction. Using IT tools to handle products at IKEA and Edsbyn (Sweden)* (Doctoral thesis). Uppsala: Uppsala Universitet, företagsekonomiska institutionen.

Bauer, M. S., Damschroder, L., Hagedorn, H., Smith, J., & Kilbourne, A. M. (2015). An introduction to implementation science for the non-specialist. *BMC Psychology, 3*(1), 1–12.

Bengtson, A., & Håkansson, H. (2007). Introducing "old" knowledge in an established user context: How to use wood in the construction industry. In *Knowledge and innovation in business and industry* (pp. 66–90). Routledge.

Boon, H. S., Mior, S. A., Barnsley, J., Ashbury, F. D., & Haig, R. (2009). The difference between integration and collaboration in patient care: Results from key informant interviews working in multiprofessional health care teams. *Journal of Manipulative and Physiological Therapeutics, 32*(9), 715–722.

Borgonovi, E., & Compagni, A. (2013). Sustaining universal health coverage: The interaction of social, political, and economic sustainability. *Value in Health, 16*(1), S34–S38.

Bottero, M. C., Buffoli, M., Capolongo, S., Cavagliato, E., di Noia, M., Gola, M., & Volpatti, L. (2015). A multidisciplinary sustainability evaluation system for operative and in-design hospitals. In *Improving sustainability during hospital design and operation* (pp. 31–114). Cham: Springer.

Bromley, E. (2012). Building patient-centeredness: Hospital design as an interpretive act. *Social Science & Medicine, 75*(6), 1057–1066.

Buffoli, M., Capolongo, S., Bottero, M., Cavagliato, E., Speranza, S., & Volpatti, L. (2013). Sustainable healthcare: How to assess and improve healthcare structures' sustainability. *Annali di Igiene, 25*(5), 411–418.

Buffoli, M., Gola, M., Rostagno, M., Capolongo, S., & Nachiero, D. (2014). Making hospitals healthier: How to improve sustainability in healthcare facilities. *Annali di Igiene, 26*(5), 418–425.

Capolongo, S., Bottero, M. C., Lettieri, E., Buffoli, M., Bellagarda, A., Birocchi, M., … Volpatti, L. (2015). Healthcare sustainability challenge. In *Improving sustainability during hospital design and operation* (pp. 1–9). Cham: Springer.

Capolongo, S., Gola, M., Di Noia, M., Nickolova, M., Nachiero, D., Rebecchi, A., … Buffoli, M. (2016). Social sustainability in healthcare facilities: A rating tool for analysing and improving social aspects in environments of care. *Annali dell'Istituto Superiore di Sanità, 52*(1), 15–23.

Carter, C. R., & Rogers, D. S. (2008). A framework of sustainable supply chain management: Moving toward new theory. *International Journal of Physical Distribution and Logistics Management, 38*(5), 360–387.

Charns, M. P., & Tewksbury, L. J. S. (1993). *Collaborative management in health care: Implementing the integrative organization*. Jossey-Bass Inc Pub.

Crémieux, P. Y., Ouellette, P., & Pilon, C. (1999). Health care spending as determinants of health outcomes. *Health Economics, 8*(7), 627–639.

Di Cicco, S. (2002). Well-being in Hospitals. *USO-Built Report Series, 75*.

Dubois, A., & Gadde, L. E. (2002). Systematic combining: An abductive approach to case research. *Journal of Business Research, 55*(7), 553–560.

Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of Management Review, 14*(4), 532–550.

Eizenberg, E., & Jabareen, Y. (2017). Social sustainability: A new conceptual framework. *Sustainability, 9*(1), 68.

Elkington, J. (1994). Towards the sustainable corporation: Win-win-win business strategies for sustainable development. *California Management Review, 36*(2), 90–100.
Ertz, M., & Patrick, K. (2020). The future of sustainable healthcare: Extending product lifecycles. *Resources, Conservation and Recycling, 153*, Article 104589.
Evans, J. M., Baker, R. G., Berta, W., & Jan, B. (2014). *The evolution of integrated health care strategies. Annual review of health care management: Revisiting the evolution of health systems organization*.
Ferlie, E. B., & Shortell, S. M. (2001). Improving the quality of health care in the United Kingdom and the United States: A framework for change. *The Milbank Quarterly, 79* (2), 281–315.
Fisher, E. S., Shortell, S. M., & Savitz, L. A. (2016). Implementation science: A potential catalyst for delivery system reform. *Jama, 315*(4), 339–340.
Gadde, L. E., & Håkansson, H. (2008). Business relationships and resource combining. *The IMP Journal, 2*(1), 31–45.
Garrick, R., Sullivan, J. J., Doran, M., & Keenan, J. (2019). The role of the Hospital in the Healthcare System. In *The modern hospital* (pp. 47–60). Cham: Springer.
Gibson, R. B. (2006). Sustainability assessment: Basic components of a practical approach. *Impact Assessment and Project Appraisal, 24*(3), 170–182.
Gibson, R. B. (2010). Beyond the pillars: Sustainability assessment as a framework for effective integration of social, economic and ecological considerations in significant decision-making. In *Tools, techniques and approaches for sustainability: Collected writings in environmental assessment policy and management (pp. 389-410)*.
Gillies, R. R., Shortell, S. M., Anderson, D. A., Mitchell, J. B., & Morgan, K. L. (1993). Conceptualizing and measuring integration: Findings from the health systems integration study. *Journal of Healthcare Management, 38*(4), 467.
Glimelius, B., Ask, A., Bjelkengren, G., et al. (2005). (2005) number of patients potentially eligible for proton therapy. *Acta Oncologica, 44*, 836–849.
Goodwin, N. (2019). Improving integrated care: Can implementation science unlock the 'black box'of complexities? *International Journal of Integrated Care, 19*(3).
Gressetvold, E. (2004). *Product development – Effects on a company's network of relationships*. Trondheim: Department of Industrial Economics and Technology Management, Norwegian University of Science and Technology.
Gröne, O., & Garcia-Barbero, M. (2001). Integrated care: A position paper of the WHO European Office for Integrated Health Care Services. *International Journal of Integrated Care, 1*.
Håkansson, H., & Waluszewski, A. (2002). *Managing technological development. IKEA, the environment and technology*. London: Routledge.
Håkansson, H., & Waluszewski, A. (Eds.). (2007). *Knowledge and innovation in business and industry -the importance of using others*. London: Routledge.
Hall, R., Belson, D., Murali, P., & Dessouky, M. (2006). Modeling patient flows through the healthcare system. In *Patient flow: Reducing delay in healthcare delivery* (pp. 1–44). Boston, MA: Springer.
Harrison, D., & Håkansson, H. (2006). Activation in resource networks: A comparative study of ports. *The Journal of Business and Industrial Marketing, 21*(4), 231–238.
Havenvid, M., Sundquist, V., Linné, Å., & Wagrell, S (2022). Kunskapsintegration i sjukhusprojekt - Lärdomar från fyra samverkansprojekt och färdplan framåt. https://vpp.sbuf.se/Public/Documents/ProjectDocuments/10f0026a-1438-4a2c-9814-f71520c51ee8/FinalReport/SBUF%2013781%20Slutrapport%20Kunskapsintegration%20i%20sjukhusprojekt.pdf. (Accessed 12 May 2022).
Healy, J., & McKee, M. (Eds.). (2002). *Hospitals in a changing Europe*. Open University Press.
Hesse-Biber, S. N., & Leavy, P. (2010). *The practice of qualitative research* (2nd). London: Sage.
Hunt, S. D. (2011). Sustainable marketing, equity, and economic growth: A resource-advantage, economic freedom approach. *Journal of the Academy of Marketing Science, 39*(1), 7–20.
Hussain, M., Ajmal, M. M., Gunasekaran, A., & Khan, M. (2018). Exploration of social sustainability in healthcare supply chain. *Journal of Cleaner Production, 203*, 977–989.
Jahre, M., Gadde, L. E., Håkansson, H., & Persson, G. (2006). *Resourcing in business logistics - the art of systematic combining*. Liber and Copenhagen Business School Press.
Kaplan, S., Sadler, B., Little, K., Franz, C., & Orris, P. (2012) (1641st)*, 29. Can sustainable hospitals help bend the health care cost curve?*. Commonwealth Fund.
Khosravi, F., & Izbirak, G. (2019). A stakeholder perspective of social sustainability measurement in healthcare supply chain management. *Sustainable Cities and Society, 50*, Article 101681.
Kodner, D. L., & Spreeuwenberg, C. (2002). Integrated care: Meaning, logic, applications, and implications–a discussion paper. *International Journal of Integrated Care*, 2.
Kuhlman, T., & Farrington, J. (2010). What is sustainability? *Sustainability, 2*(11), 3436–3448.
Lega, F., Prenestini, A., & Spurgeon, P. (2013). Is management essential to improving the performance and sustainability of health care systems and organizations? A systematic review and a roadmap for future studies. *Value in Health, 16*(1), S46–S51.
Marimuthu, M., & Paulose, H. (2016). Emergence of sustainability based approaches in healthcare: Expanding research and practice. *Procedia-Social and Behavioral Sciences, 224*, 554–561.
McGain, F. (2010). Sustainable hospitals? An Australian perspective. *Perspectives in Public Health, 130*(1), 19–20.
McGain, F., & Naylor, C. (2014). Environmental sustainability in hospitals–a systematic review and research agenda. *Journal of Health Services Research & Policy, 19*(4), 245–252.
McKee, M., & Healy, J. (2000). The role of the hospital in a changing environment. *Bulletin of the World Health Organization, 78*, 803–810.
McKee, M., Mercure, S., Edwards, N., & Nolte, E. (2020). *The changing role of the Hospital in European Health Systems, European Observatory of Health Systems and Policies*. Cambridge University Press.
Minkman, M. M. (2012). The current state of integrated care: An overview. *Journal of Integrated Care, 20*(6), 346–358.
Nolte, E., & McKee, M. (2004). *Does health care save lives? Avoidable mortality revisited*. The Nuffield Trust.
Oates, J., Weston, W. W., & Jordan, J. (2000). The impact of patient-centered care on outcomes. *Family Practice, 49*(9), 796–804.
Olsen, I. T. (1998). Sustainability of health care: A framework for analysis. *Health Policy and Planning, 13*(3), 287–295.
Pantzartzis, E., Edum-Fotwe, F. T., & Price, A. D. (2017). Sustainable healthcare facilities: Reconciling bed capacity and local needs. *International Journal of Sustainable Built Environment, 6*(1), 54–68.
Peikes, D., Chen, A., Schore, J., & Brown, R. (2009). Effects of care coordination on hospitalization, quality of care, and health care expenditures among Medicare beneficiaries: 15 randomized trials. *Jama, 301*(6), 603–618.
Penrose, E. (1959). *The theory of the growth of the firm*. New York: John Wiley & Sons.
Pfeffer, J. (2010). Building sustainable organizations: The human factor. *Academy of Management Perspectives, 24*(1), 34–45.
Pinzone, M., Lettieri, E., & Masella, C. (2012). Sustainability in healthcare: Combining organizational and architectural levers. *International Journal of Engineering Business Management, 4*, 38.
Prenkert, F., Hasche, N., & Linton, G. (2019). Towards a systematic analytical framework of resource interfaces. *Journal of Business Research, 100*, 139–149.
Rechel, B., Erskine, J., Dowdswell, B., Wright, S., & McKee, M. (2009). *Capital investment for health: Case studies from Europe*. World Health Organization. Regional Office for Europe. https://apps.who.int/iris/handle/10665/326419. (Accessed 21 September 2020).
Rechel, B., Wright, S., & Edwards, N. (2009). Investing in hospitals of the future (no.16). WHO regional office Europe.
Reid, P. P., & Compton, W. D. (2005). In J. H. Grossman, & G. Fanjiang (Eds.), *Building a better delivery system: A new engineering/health care partnership*. Washington (DC): National Academy of Engineering and Institute of Medicine, National Academic Press US.
Rich, C. R., Singleton, J. K., & Wadhwa, S. S. (2013). *Sustainability for healthcare management*. Taylor & Francis.
Rosenberg, N. (1994). *Exploring the black box. Technology economics, and history* (pp. 9–23). Cambridge: Cambridge University Press.
Saviano, M., Bassano, C., Piciocchi, P., Di Nauta, P., & Lettieri, M. (2018). Monitoring viability and sustainability in healthcare organizations. *Sustainability, 10*(10), 3548.
SBU rapport. (1996). *Strålbehandling vid cancer, SBU rapport nr 129/1 och 129/2*.
Scheirer, M. A., & Dearing, J. W. (2011). An agenda for research on the sustainability of public health programs. *American Journal of Public Health, 101*(11), 2059–2067.
Scott, W. R., Ruef, M., Mendel, P. J., & Caronna, C. A. (2000). *Institutional change and healthcare organizations: From professional dominance to managed care*. University of Chicago Press.
Snehota, I. (1990). *Notes on a theory of the business Enterprise* (Doctoral Thesis). Department of Business Administration, Uppsala University.
Snehota, I., & Hakansson, H. (1995). *Developing relationships in business networks*.
SOU (2020), Slutbetänkande av Utredningen om offentlig-privat samverkan, styrning och kontroll (2020:15), Socialdepartementet.
Strandberg-Larsen, M., & Krasnik, A. (2009). Measurement of integrated healthcare delivery: A systematic review of methods and future research directions. *International Journal of Integrated Care*, 9.
Strömsten, T., & Håkansson, H. (2007). Resources in use: Embedded electricity. In *Knowledge and innovation in business and industry* (pp. 39–65). Routledge.
Stukel, T. A., Fisher, E. S., Alter, D. A., Guttmann, A., Ko, D. T., Fung, K., & Lee, D. S. (2012). Association of hospital spending intensity with mortality and readmission rates in Ontario hospitals. *Jama, 307*(10), 1037–1045.
Thomas, J. B., Ketchen, D. J., Jr., Trevino, L. K., & McDaniel, R. R., Jr. (1992). Developing interorganizational relationships in the health sector: A multicase study. *Health Care Management Review, 17*(2), 7–19.
Ulrich, R., Zimring, C., Zhu, X., Dubose, J., Seo, B., & C hoi, S.. (2008). A review of the research literature on evidence-based health-care design. *Health Environment Research & Design Journal, 1*, 61–125.
UNT 20180221. (2018). *4906784.aspx: Sourced 20191011*. Uppsala Nya Tidning.
Von Hippel, E. (1986). Lead users: A source of novel product concepts. *Management Science, 32*(7), 791–805.
Wagrell, S. (2017). *Drivers and hindrances to med-tech innovation: A device's guide to the Swedish healthcare galaxy*. Doctoral dissertation. Företagsekonomiska Institutionen, Uppsala Universitet.
Waluszewski, A. (1990). *Framväxten av en ny mekanisk massateknik (The emergence of a new mechanical pulp technique)*. Uppsala: Acta Universitatis Uppsaliensis, Almqvist & Wicksell.
Weisz, U., Haas, W., Pelikan, J. M., & Schmied, H. (2011). Sustainable hospitals: A socio-ecological approach. *GAIA-Ecological Perspectives for Science and Society, 20*(3), 191–198.
Winch, G. (2010). *Managing construction projects* (2nd). West Sussex: Wiley-Blackwell.
Yin, R. K. (2017). *Case study research and applications: Design and methods*. Sage publications.
Zackrisson, B. (2019). Protonterapi i dag och i morgon Kunskapsläget 15 år efter SPTC-rapporten. https://skandionkliniken.se/content/uploads/2019/03/Evidensrapport.pdf.