Valuation in emerging technoscience business: a case study of Finnish biobank research

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Abstract

Purpose – The paper contributes to the discussion on valuation in organization studies and strategic management literature. The nascent literature on valuation practices has examined established markets where producers and consumers are known and rivalry in the market is a given. Furthermore, previous research has operated with a narrow meaning of value as either a financial profit or a subjective consumer preference. Such a narrow view on value is problematic and insufficient for studying the interlacing of innovation and value creation in emerging technoscientific business domains.

Design/methodology/approach – The authors present an empirical study about value creation in an emerging technoscience business domain formed around personalized medicine and digital health data.

Findings – The results of this analysis show that in a technoscientific domain, valuation of innovations is multiple and malleable, entails pursuing attractiveness in collaboration and partnerships and is performative, and due to emphatic future orientation, values are indefinite and promissory.

Research limitations/implications – As research implications, this study shows that valuation practices in an emerging technoscience business domain focus on defining the potential economic value in the future and attracting partners as probable future beneficiaries. Commercial value upon innovation in an embryonic business milieu is created and situated in valuation practices that constitute the prospective market, the prevalent economic discourse, and rationale. This is in contrast to an established market, where valuation practices are determined at the intersection of customer preferences and competitive arenas where suppliers, producers, service providers and new entrants to the market present value propositions.

Practical implications – The study findings extend discussion on valuation from established business domains to emerging technoscience business domains which are in a "pre-competition" phase where suppliers, customers, producers and their collaborative and competitive relations are not yet established.

Social implications – As managerial implications, this study provides insights into health innovation stakeholders, including stakeholders in the public, private and academic sectors, about the ecosystem dynamics in a technoscientific innovation. Such insight is useful in strategic decision-making about ecosystem strategy and ecosystem business model for value proposition, value creation and value capture in an emerging innovation domain characterized by collaborative and competitive relations among stakeholders. To business managers, the findings of this study about valuation practices are useful in strategic decision-making about ecosystem strategy and ecosystem business model for value proposition, value creation and value capture in an emerging innovation domain characterized by collaborative and competitive relations among stakeholders. To policy makers, this study provides an in-depth analysis of an overall business ecosystem in an emerging technoscience business that can be propelled to increase the financial investments in the field. As a policy implication, this study provides insights into the various dimensions of valuation in technoscience business to

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policy makers, who make governance decisions to guide and control the development of medical innovation using digital health data.

Originality/value – This study's results expand previous theorizing on valuation by showing that in technoscientific innovation all types of value created – scientific, clinical, social or economic – are predominantly promissory. This study complements the nascent theorizing on value creation and valuation practices of technoscientific innovation.

Keywords Biomedicine, Emerging technoscience market, Stakeholder innovation, Valuation practices

Paper type Research paper

Since the mid-20th century, the idea of innovation has been inseparable from commercial and economic pursuits. It is widely believed that innovation – an activity, a new product or a new business model – can potentially create or add value, and therefore, it is vitally important for business growth and economic prosperity (Godin, 2020; see also Schumpeter, 1983). In the field of management studies, commercialization or marketization of new knowledge and inventions have been approached from various perspectives, yet the notion of value (as profit or economic utility) has been taken for granted throughout the research field and has remained "assumed rather than analysed" (Kornberger, 2017, p. 1753). Thus, "value" does not seem to belong to the key concepts of management studies, and when the concept of value is explicitly addressed, it has a narrow economic meaning as either a financial profit or a subjective consumer preference (Kornberger *et al.*, 2015b; Kornberger, 2017). Such a restricted view on value is problematic and insufficient for studying the interlacing of innovation and value creation in emerging technoscientific business domains.

In this paper, we realign innovation and value by making an empirical analysis of a case in an emerging technoscience business domain formed around personalized medicine and digital health data. Our study is embedded in analysing an exemplary case. The case is FinnGen research consortium, which aims to produce a data set combining genome sequence data of 500,000 Finns with their personal health data and then to use this dataset in international research projects in personalized medicine and drug development with both academic research groups and private companies (for a detailed description of the project, see below). FinnGen is a perfect case to study in two senses. First, it represents today's data-intensive biomedical science and innovative research and development (R&D) organized as wide international public–private partnership networks. Second, it is a grand national effort seeking to accelerate both biomedical science and business around biomedical high-tech and personalized medicine. Therefore, FinnGen is a perfect keyhole through which to look at an emerging technoscience business domain in general and health data economy in particular. We examine value creation in an emerging technoscience business domain by focusing on valuation, i.e. processes and practices that "make things valuable" (Kornberger *et al.*, 2015b) in this context. Our analysis seeks to answer the following questions. What types of value are attributed to different items and activities within FinnGen-related practices and rationales? What is the significance of economic and commercial value, and how is it interlaced with other value dimensions?

Several studies in new economic sociology (e.g. Callon *et al.*, 2007; Beckert, 2009; Muniesa, 2011; Ortiz, 2014), science and technology studies (STS) (e.g. Dussauge *et al.*, 2015a; Birch, 2017b; Birch and Muniesa, 2020) and management studies (e.g. Kornberger *et al.*, 2015a; Kornberger, 2017) have suggested that value should be seen neither as an attribute of a thing (a product, firm, etc.) nor a preference of a subject (consumer, buyer, etc.) but as an outcome of practices that attach value to things or activities by defining, assessing or measuring them, making calculations upon them or modifying stakeholder's preferences. Our approach is affirmative to this view, and we draw especially on STS literature on sociotechnical and political valuation practices in the domains of technoscience (e.g. Dussauge *et al.*, 2015a;

Muniesa, 2017; Birch, 2017a, b; Birch and Muniesa, 2020; Birch *et al.*, 2021), as well as on studies of valuation in business management (Kornberger *et al.*, 2015a; Kornberger, 2017). This literature offers us a broad perspective that allows us to address topics particularly relevant for understanding value creation in emerging technoscience business domains. Our analysis focuses on three such topics. First, within a technoscience domain, types of value attached to a novel item, technique or activity are not just or even predominantly commercial or monetary. Second, the practices and discourses of valuation in technoscience business address expectations and potential of a whole "ecosystem" or "platform", not only the actors traditionally considered as market actors, that is, firms, customers, competitors and suppliers. Third, through an in-depth analysis, we show that all types of value created – scientific, clinical, social or economic – are predominantly promissory.

The paper is structured as follows. We first discuss studies on valuation as an approach to understand better value in innovative R&D, and we develop further a research perspective on valuation practices in strategic management introduced by Kornberger and colleagues (Kornberger *et al.*, 2015b; Kornberger, 2017). After that, we present our case, the data and the methods of our analysis. In the findings section, we show how valuation unfolds in the practices in an emerging technoscience business domain. The results of our analysis show that in such a domain, valuation of innovations is multiple and malleable, entails pursuing attractiveness in collaboration and partnerships and is performative in relation to seeking competitive advantage in the global market, and due to emphatic future orientation, values are indefinite and promissory. We conclude with our contributions to management studies regarding the conceptualization of valuation of innovation and value creation in emerging technoscience business domains.

Theoretical approach: valuation practices in innovative technoscience business

In the field of management studies, Kornberger and colleagues (Kornberger *et al.*, 2015a; Kornberger, 2017) called for re-focusing studies on strategic management by approaching value in a new manner that directs attention to valuation practices and processes in management and business which determine whether something is of value. Such practices involve individuals and institutions, and through them, the value of objects (products, firms etc.) or activities are defined, assessed, or measured. In studies of actual business domains or industries, valuation practices usually mean a compound of devices, discourses and practices that make objects, actions or institutions like firms commensurable by the means of calculation, categorization, ranking, and visualization (e.g. Pénet, 2015; Pollock and Campagnolo, 2015; Doganova *et al.*, 2015; Birch, 2017b; Kornberger, 2017). Those studies tend to relate valuation to market competition and claim that competition does not take place between the (intrinsic) value of products or companies but between valuation practices. Kornberger (2017, p. 1755) even argues that strategic agency in business management should be "understood in relation to an actor's capacity to influence and cope with valuation practices".

The approach outlined above is insightful and intriguing for studying valuation in established competitive markets such as higher education, hotel business, or cities (Kornberger, 2017), or insurance (e.g. Ossadón, 2015). However, a concept of valuation practices restricted to calculation, categorization or ranking is insufficient when seeking to understand value and valuation in emerging technoscientific business domains. Such theorizing on valuation considers rivalry in the market as a given and the producers and consumers as known. Thus, we develop further this approach to valuation and modify it to fit in a setting where the market is in an embryonic state and the market competition is in a state of becoming, which is characteristic to emerging business domains related to technoscientific innovations. In such a context, the positions of producers, customers, and investors are not fixed but under negotiation, and the

value of goods, companies, and activities is mostly prospects of future value. Such phenomenon remains undertheorized in research on strategic management (e.g. Adner and Kapoor, 2010; Dattée *et al.*, 2018).

Strategic management research depicts innovation as a market and a competitive arena in a technocratic manner. The central dynamics of such a market relate to the ways by which customers and competitors accept the value proposition the innovating firm provides, and to the value proposition game, where the firm seeks to control or maximize value with a control over resources by balancing the cost–benefit ratio or with an advantage by being the first in the market, faster than the competitors (Adner and Kapoor, 2010). While effective in addressing the complexity of the market dynamics, this approach is too reductionist for analysing the value of innovation, which is assumed rather than measured in the market. Furthermore, this line of theorizing on value is problematic in its one-sided focus on business value creation, which leads to dismissing the dynamics through which other types of value, such as clinical, social, and health-related, join in negotiating and determining value expectations.

To broaden the concept of valuation practice, we utilize STS studies on valuation in technoscientific domains (e.g. Dussauge *et al.*, 2015a; Muniesa, 2017; Birch, 2017a, b; Birch and Muniesa, 2020; Birch *et al.*, 2021). Those studies adopt the concept of valuation, originating from Dewey's (1939) pragmatist philosophy, to highlight the processual nature of the value of things and actions and emphasize that specific practices and discourses attribute, define, and assess the value of things (Muniesa, 2011), which is essential for maintaining techno-economic domains (Dussauge *et al.*, 2015a; Birch and Muniesa, 2020). Central to valuation are situated practices through which certain types and/or a certain amount of value are attributed to a thing or an action, or things are ordered according to their value (Helgesson and Muniesa, 2013; Dussauge *et al.*, 2015b; Kornberger *et al.*, 2015b; Birch and Muniesa, 2020). Enacting things usually implies their valuation, quite often in many regimes of worth simultaneously, and thus, the value of something that is made in practices (Helgesson and Muniesa, 2013; Dussauge *et al.*, 2015b).

From this perspective, value is created or added in innovative R&D through various sociotechnical or political practices and discourses that attach and attribute value to things or activities, and define, assess, and measure value within a technoscientific business domain, such as personalized medicine. The value, for example, attached to patient data or a potential biomarker by valuation practices and discourses can be simultaneously multiple, malleable, and not merely or even predominantly commercial or monetary (Dussauge *et al.*, 2015b; Beltrame and Hauskeller, 2018; Datta Burton *et al.*, 2022; Fiske *et al.*, 2023). Furthermore, all types of activities in a technoscience domain such as biomedicine can be considered as practices of valuation. When techno-economic things (a new technique, product, or innovative company) are enacted – in both everyday research practice and contexts where R&D efforts are advocated, assessed, or otherwise performed – they are attributed with manifold value (Helén and Tarkkala, 2022).

The approach on valuation described above allows us to highlight that value creation in emerging technoscience business is essentially prospective (Figure 1). In such business, the valuation practices and discourses mostly address expectations and potential of a new technology or innovative firms involved, or even a whole ecosystem or platform. Due to this, the promissory or even imaginary character of value dominates embryonic technoscience business domains, and within them, value creation comes with speech and practices that raise and maintain expectations of revenues, profits, and other blessings that new technology will bring in the future (Brown and Michael, 2003; Borup *et al.*, 2006; Beckert, 2016). In the context of emerging technoscience business, all types of value are interlaced with future possibilities, probabilities, and visions, and thus, they tend to be inexact and "unaccountable" (Birch, 2017a, pp. 433–434). The vagueness in valuation results from the difficulty in defining the value through calculation

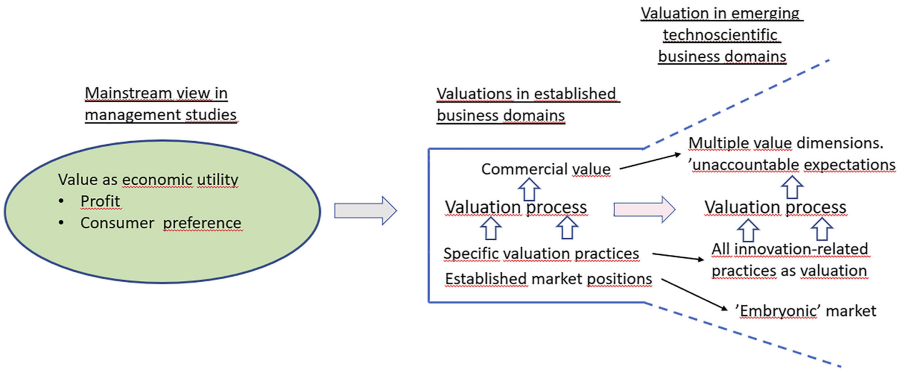

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Figure 1. Towards valuation in emerging technoscientific business domains: a conceptual shift

or accounting, and because there is no guarantee that the value or acclaimed utility will exist, economic value varies (see Birch, 2017a; Muniesa, 2017).

The case, data, and methods

Our empirical analysis draws on in-depth studies of biobanking and personalized medicine in Finland, conducted in three projects from 2009 to 2019 [1]. Based on our previous analyses (Lehtimäki *et al.*, 2019; Helén and Lehtimäki, 2020) and experiences in those projects, we chose to carry out our analysis on valuation as a case study focused on the FinnGen consortium that currently is the grand national spearhead endeavour in personalized medicine in Finland. We chose the interpretive case study method (Stake, 2005; Yin, 2014; Welch *et al.*, 2011) because it best elaborates the contextualized logic of valuation practices in an emerging technoscience business domain, which is our study's main purpose. In an interpretive case study, the rich contextual description is essential for understanding the phenomenon because it enables addressing the specific characteristics of the case and embracing the local narratives and sensemaking of people involved (Welch *et al.*, 2011). The case study approach allows accounting for contextualized contingencies of a general theory (Alvesson and Kärreman, 2011; Ketokivi and Choi, 2014; Yin, 2014). We investigate simultaneously both a general theory of valuation practices and valuation in a specific context. This enables us to remain open to unanticipated findings while actively mobilizing and problematizing the existing conceptual framework. With critical inquiry of a concrete case of emerging technoscience business, we illustrate, challenge, and rethink a theory and concept of valuation practices. In the following, we introduce out case in detail, then we present our data, and finally, the analytical process.

Biomedical technoscience and prospective business: the case of FinnGen

In August 2017, a large-scale genome-mapping endeavour was launched at the Medical Campus of the University of Helsinki in Meilahti. The effort was named "FinnGen", and it was unprecedentedly extensive on the Finnish scale because it aimed to genotype 500,000 Finns and combine genome variant data with longitudinal personal health data originating from multiple national health registries. The data sets compiled could be then utilized in biomedical research attempting to identify associations between genetic factors and health outcomes, for example, genetic risk for specific diseases or effectiveness of drug treatments. On its website, FinnGen characterizes itself as "one of the largest studies of this type" (https://www.finngen.

fi/en/news/GSK-and-Sanofi-join-FinnGen), and it resembles the Health Sector Database in Iceland and UK Biobank as a national genomics initiative (Tupasela, 2021).

The University of Helsinki is the host organization of FinnGen, the nest of the consortium is biomedical research institute the Finnish Institute of Molecular Medicine (FIMM), and Professor Aarno Palotie is FinnGen's director and front man. The consortium is organized as "partnerships" with domestic academic and healthcare institutions – University Medical Faculties and their university hospitals in Helsinki, Turku, Tampere, Oulu, and Kuopio; biobanks and their public owners' institutions (Wellbeing service counties (HVAs), the Finnish Institute for Health and Welfare (THL), the Finnish Red Cross Blood Service) – and Big Pharma and other medical companies as R&D collaborators and financiers. FinnGen's and its researchers' main research activity is engaging with international large-scale genome-wide association studies (GWAS) using extensive data sets collected from all over the world.

FinnGen's scientific activities are essentially *biobank research*. The term biobank refers to various social and technical arrangements for collecting, storing, and exchanging biological specimens and associated medical and other health-related data for biomedical research (e.g. Gottweis and Petersen, 2008; Yuille *et al.*, 2008). The idea of biobank emerged in the wake of the Human Genome project at the turn of the millennium, and since then, the biobanks are widely considered a vital infrastructure for biomedical science and R&D, especially in medical post-genomics (e.g. Beltrame and Hauskeller, 2018; Gottweis and Petersen, 2008; Lauss *et al.*, 2011; Tarkkala, 2019; Yuille *et al.*, 2008). Currently, there are 11 biobanks in Finland; most are regional clinical biobanks that have formed a co-operative, FINBB, as the national service point facilitating access to their sample and data repositories. A few years after its launch, FinnGen has since become the largest user of the Finnish biobank data, and thus the most important customer of the Finnish biobanks. Consequently, when FinnGen defined its objective to genotype 500,000 biobank participants in Finland, this task also became the priority of Finnish biobanking. In sum, FinnGen is a massive data sourcing operation: in addition to 500,000 samples in biobanks' repositories, the consortium uses personal data from 11 national population and healthcare registers and samples and data from 15 previous epidemiological and cohort studies.

Referring to a massive data sourcing and associated research based primarily on large-scale data analytics, FinnGen claims to be, "one of the very first personalized medicine projects at this scale" (https://www.finngen.fi/en/node/17). "Personalized" medicine refers broadly to the visions of future medicine in which diagnosis and treatment based on the knowledge of "average" patients will be replaced by individually tailored diagnoses, risk assessments, and medical care. The latter are derived from biomedical knowledge capable of precisely capturing "all" health-related individual differences and singularities (e.g. ESF, 2012; Tutton, 2014). At the turn of the millennium, ideas and imaginaries of personalized medicine were attached to the promises of genomics to revolutionize medical care (Hamburg and Collins, 2010; Hedgecoe, 2004; Tutton, 2014).

Since the 2010s, the prospect of personalized medicine has been associated closer with data-driven medicine. The promise of future medicine is now predominantly dedicated to the data mining focused on masses of digitalized biological and health data with the help of high-throughput computers, advanced algorithms, and artificial intelligence. Advocates of personalized medicine have high hopes that such extensive analytics will result in more precise and individualized prevention, diagnoses, and treatments, and more efficient healthcare in general (e.g. Flores *et al.*, 2013; Swan, 2012).

Following the trend of early 2000s around the Western world, personalized medicine became the main framing in which the purpose, justification, prospective benefits – especially medical – and other great expectations of data-driven genomic medicine were and are today articulated and performed in Finland (Tarkkala *et al.*, 2019). In this framing, the importance of biobanks for biomedical science is also defined in terms of personalized medicine as the vital

infrastructure facilitating the efforts to advance future medicine in Finland and internationally. FinnGen has made Finnish biobanks its subcontractors in data sourcing, and it has taken over the flagship position of personalized medicine in Finland. As the flagship, FinnGen emphatically addresses an important dimension of medical post-genomics and personalized medicine, namely economic and commercial prospects associated with them. "Personalizing" prevention, diagnosis, and treatment of diseases should bring unprecedented reductions in healthcare expenditure, enormously boost commercial activities, and open new business opportunities in global medical bioeconomy (e.g. Jakka and Rossbach, 2013; Grand View Research, 2022).

Similar to many projects around the world (e.g. Rose, 2001; Fletcher, 2004; Rajan, 2006; Ong, 2016), FinnGen has taken advantage of these great economic and commercial expectations for personalized medicine and digital health data, and the business domain around those expectations have engendered. As we will show in detail, FinnGen presents itself as an "academic-industrial collaboration" and highlights the potential commercial benefits it can provide directly to its collaborators at home and abroad, and indirectly by boosting domestic business around personalized medicine. The consortium's business aspect is eminent in its attempts – and success – to acquire financing from Big Pharma enterprises and high-tech biomedical companies. That FinnGen applied public financing from the national innovation agency Business Finland and its predecessor Tekes, instead of conventional academic funding sources, also reflects this orientation. From this, 13 companies – among them Pfizer, Roche's Genentech, Merck, and AstraZeneca – provide funding that equals 60–70% of the over 90 million euros budget and Business Finland provides the rest.

Our analysis focuses on FinnGen's commercial pursuits and business aspect. We study the consortium as an exemplary case of the commercialization of biomedical science within a technoscience business domain emerging around personalized medicine. Through our case, we analyse the relationship between innovation and value creation in this context.

Data and methods

As stated, our FinnGen case analysis draws on our previous studies of biobanking and personalized medicine in Finland from 2009 to 2019. In them, we collected and analysed an extensive data set comprising 35 interviews of biobank managers, experts, and researchers; documentary material (policy papers and reports on personalized medicine and biobanks, presentations, and journal articles on those themes); and the field notes (mostly by the first author) from approximately 30 public or semi-public seminars, workshops, and meetings on biobanks, biobank research, and personalized medicine. The data used for this paper consist of releases on the (FinnGen, 2023), talks, and writings of the consortium's spokespersons and associates, and field notes from half a dozen FinnGen events from the years 2017–2021 (Table 1). In our analysis, we juxtaposed the FinnGen data with the data and findings from the wider domain of Finnish biobanking and personalized medicine.

Following an established practice of in-depth exploratory and inductive analysis, we conducted our analysis through several steps of rereading and reinterpretation, transitioning among our empirical material data, theoretical concepts, and research literature while refining our analysis of the valuation practices (Alvesson and Kärreman, 2011; Ketokivi and Choi, 2014). Our iterative process had three stages of data analysis: (1) thematic analysis, (2) analysis of discourses that attribute value for biobanking and biobank research, and (3) analysis focusing on the intertwining of the texts, discourses, and the context of innovation policy and commercialization.

We started with thematic analysis, whereby we first examined how FinnGen as an institution and the people involved discuss value and especially expectations related to sourcing

Table 1.
Properties of the empirical material collected from 2009 to 2021

Source of data	Description	Empirical material
Interviews	In-depth, open-ended discussions with key informants in biobanking	35 interviews
Documents	Publicly available policy papers, strategy documents, and reports on personalized medicine and biobanks	15 national strategies and policy documents
Presentations in events	Workshops, seminars, and other public and semi-public events	120 presentations
Media material	Internet pages, press releases, and journal articles	300 pages
Research publications	Research reports on biobank research and personalized medicine	50 published reports or articles
Researcher engagement	Authors' longitudinal engagement in the field; field notes, at-site participation, and observation	30 workshops, meetings, seminars, and events

Source(s): Table compiled by authors

and utilizing biobank and other health data. We coded our textual material according to keywords including "benefit", "value", "utility", "use*", "enable*", "potential", "interest" and "utilize". With these keywords, we extracted sections of data for detailed meaning-making analysis focused on the variation of the meaning of value creation and value expectations performed and enacted in relation to data sourcing and refinement at FinnGen. The process of sorting out the pieces of text most relevant to our analyses allowed us to narrow our empirical material.

In the second phase, we focused on discourses of valuation. Three sets of questions guided our analysis. First, we focused on what aspects of innovation were regarded valuable at FinnGen, and in what sense they were considered valuable. Second, because our study highlights value potential and the promissory aspect of valuation, we examined the discourse about the attempts and means by which FinnGen acted upon or maintained value expectations. Finally, we focused on the economic aspect of valuation. We asked how commercial value, or rather, value potential, was understood at FinnGen, and what was the weight and role of commercial value concerning other value dimensions.

The second phase of our analysis resulted in understanding the basic elements of the valuation at FinnGen and within the Finnish biobanking and personalized medicine domain. What things and activities were attributed with what types of values and value potential; which issues were brought up in connection to value creation; and which actors, stakeholders and relationships between them were considered significant for enhancing or hindering value creation? After we outlined this scenery, we continued towards the practical context of FinnGen.

The final analytical step led us from valuation discourses to the practices while we examined the discourses of valuation and the scenery they have painted as related to concrete pursuits, actions, projects, and endeavours to promote personalized medicine. This allowed us to see valuation related to concrete innovation activities at FinnGen, with a specific policy and business context framing it. Values, value potential, expectations performed, and expectations reasoned over by FinnGen appeared now as practically significant, meaningful, and influential. However, valuation discourse opened a view to practical reasoning on value creation entangled with FinnGen and its partners' actual pursuits, efforts, and everyday work of building infrastructures for innovative biomedical R&D and for conducting such R&D.

Findings

In this section, we present the findings of our empirical analysis on how valuation unfolds within the FinnGen consortium and domestic partnership networks. Our analysis shows the

ways in which valuation of innovation is entangled with rationales, practices, and even everyday pursuits of the actors operating in a technoscience business domain around personalized medicine. In sum, our findings underline that value or utility of an innovation, or any other thing attached to efforts to advance personalized medicine, is not a quality to be easily measured or assessed, but rather to be seen as if an artefact that various practices create and maintain.

We start by presenting what FinnGen and the people and institutions involved with it consider valuable in FinnGen's R&D activities and data sourcing infrastructure serving them. Our analysis demonstrates that value and value potential attached to personalized medicine and biobank research are multiple and malleable. Then, we examine valuation discourse on collaboration within FinnGen and its wider context of biobanks, data sourcing, and personalized medicine in Finland, and the pursuit for public–private partnerships crossing national borders and boundaries between academic science and biomedical business. Finally, we show how valuation in the emerging personalized medicine business domain tends to be emphatically future oriented, and thus, engenders value as indefinite and promissory.

Multiplicity in valuation

In biomedicine, every object, activity, resource, or outcome of biomedical R&D is likely to be encircled by various scientific, clinical, healthcare, and social value that interlace with commercial value related to profits acquired by sales of new biomedical commodities or by investments in biomedical companies (Mittra, 2016). Discourses on personalized medicine, biobanking, and other data sourcing facilitating the development of future medicine encompass multiple values and utilities because they portray biomedical research as promising with more precise and personally customized prevention and treatment of diseases. It is performed as if it is a revolutionary force that will provide many types of benefits to a broad set of stakeholders nationally and globally, including science, clinicians, healthcare, patients, citizens, society and economy (Tutton, 2014; Baltrame and Hauskeller, 2018; Prainsack, 2019; Datta Burton *et al.*, 2022; Fiske *et al.*, 2023). A list on FinnGen's website epitomizes such all-encompassing valuation: "general benefits´to medicine and benefits to " "the public, Finnish companies, biobanks, the healthcare system, and academic research", as well as "strengthening of the business ecosystem" are among the blessings FinnGen will bring; on top of that, "all breakthroughs that arise from the project will eventually benefit healthcare systems and patients globally" (www.finngen.fi/en/goals_and_benefits).

At a closer look, FinnGen, its spokespersons, and its experts unfold their understanding of value of the consortium's work from scientific aspects. According to Aarno Palotie, "FinnGen is an endeavour focused purely on research" (Palotie *et al.*, 2019, p. 990). Experts and managers in charge of running Finnish biobanks collecting and managing sample and healthcare data for FinnGen share an ethos compatible to Palotie's claim because they consider facilitating or even enabling both basic and clinical biomedical research as the primary task of biobanking (Tarkkala, 2019; Helén and Lehtimäki, 2020). Furthermore, they associate a particular value chain to this scientific utility. Thanks to the great help of basic work done in FinnGen and biobanks, biomedical research is capable of making "discoveries" and "breakthroughs" at a more rapid pace, and new knowledge is then available to be translated to new, more efficient, and more precise diagnostic devices or treatments that benefit the patients and healthcare in general.

An indispensable element of this value chain is *data*, and FinnGen and Finnish biobanks as its subcontractors contribute to all dimensions of value creation in personalized medicine through collecting, managing, and refining data. More precisely, "real-life data" is at the heart of discourse on value and utility of FinnGen and biobank research in general. The phrase

continuously repeated in documents and interviews refers to clinical data (patient records, lab results, prescription records, etc.) and personal data from national health or population registers that can be attached to the tissue samples. FinnGen is doing such combination with 500,000 genotyped Finns and underlines this aspect as its special feature as compared to large genome sequencing projects in other countries (e.g. Palotie, 2018).

> The genome data are combined with health data originating from multiple national health registries. Data from these registries provide longitudinal, lifetime follow-up data from each Finnish resident. (. . .) This unique data combination allows the FinnGen research team to identify correlations between genetic factors and health outcomes such as disease susceptibility or effectiveness of drug treatments in the Finnish founder population. The study has a huge potential to serve medicine initiatives and enrich drug discovery programs by enhancing drug target identification and prioritisation. (https://www.finngen.fi/en/news/GSK-and-Sanofi-join-FinnGen).

FinnGen's highlighting is congruent with the reasoning of people involved in biobanking in Finland. Since the early 2010s, Finnish discussion emphasized that compiling datasets by combining patient data from different sources with sample data is the *raison d'etre* the Finnish biobanks and biobank research, and that availability and capability for efficient sourcing of "real-life data" throughout the well-organized data repository and healthcare infrastructure, are widely seen as the most valuable utility of biobanks and biobank research in Finland (Tarkkala, 2019; Tupasela *et al.*, 2020). In a report preparing a merger of regional biobanks, this was presented in the following way:

> An essential potential for creation of value in Finnish biobanks is considered to be research data acquired by combining human tissue samples with information from electronic health records. (. . .) There is demand for longitudinal, full coverage collections among both academic and company researchers. Especially clinical data collected in Finland are very valuable and create a competitive edge that other countries do not have. (Selvitystyö Taysinja Tyksin erityisvastuualueiden biopankkien yhdistämisestä, 2016, p. 6)

Finnish biobank experts emphasize that such data that, for example, FinnGen uses, do not exist ready to be picked. Instead, data need to be made up by collecting tissue samples from the donors or reformatting old pathological or other tissue collections to biobank samples, and by sourcing "real-life data" from electronic health records (EHR) and clinical laboratory databases, population registers, and other data repositories. This requires an extensive network of human and non-human actors – nurses, clinicians, laboratory personnel with various technical expertise, ICT experts, test tubes, needles, consent forms, sample processing robots, scanners, freezers, ICT equipment and software, etc. – connected and coordinated for data production and many types of expertise (Tarkkala, 2019; Helén and Lehtimäki, 2020). This *infrastructure* and *expertise* of data sourcing and management is a fundamental basis of value creation in data-intensive biomedical research associated with personalized medicine. Notably, all the prospective benefits listed on FinnGen's website (see above), and thus the scientific, clinical, social, and commercial value potential of the consortium, derive from utilizing the national infrastructure of biobanks and "real-life data" repositories and expertise in data sourcing from them.

Collaboration as valuation

"Real-life data" and data sourcing infrastructure are seen to radiate value also by facilitating opportunities for *collaboration*. Government policy papers, talks in events on biobanking or personalized medicine, our expert interviews and field notes, and FinnGen's documents and writings underline repeatedly that activities around data – that is, data sourcing and compiling sample and "real-life data" together – are of value and utility to the Finnish stakeholders because they may expand, accelerate, and widen the scope of collaboration in

biomedical R&D, especially with academic researchers and global biomedical companies. In addition, Finnish discussion and reasoning on "real-life data" and collaboration around the data as the core of valuation of biobank research tend to highlight commercial value potential.

Following the international hype about the on-going mapping of human genome, which gave an incredible boost to medical bioeconomy and genome industry (e.g. Brown and Michael, 2003; Helén, 2004), and following the effort to establish the Health Sector Database in Iceland in the late 1990s (Rose, 2001; Fortun, 2008), commercialization was assumed as a core element of biobanking and biobank research already in the early 2000s. Furthermore, expectations and the strive for economic benefits have spearheaded the discussion and plans for developing the Finnish biobank research over the past 15 years, leaving clinical and public health benefits secondary (Tarkkala *et al.*, 2019; Tupasela *et al.*, 2020). In the reasoning related to commercializing biobank research, collaboration, as described above, was at the core of valuation and highlighted as an indispensable element of value creation (Lehtimäki *et al.*, 2019; Helén and Lehtimäki, 2020; Tupasela, 2021). FinnGen is the main offspring and emblem of this reasoning, its underlying assumptions, and the line of action it induced.

As an idea and in practice, FinnGen's essence is collaboration. It has created a domestic network of academic biomedical research institutions, biobanks, public healthcare organizations, and some companies specialized in biomedical data analytics and management for sourcing and refining health-related data from multiple Finnish repositories. The consortium sees that such an "ecosystem" FinnGen orchestrates considerably increases the value creation potential of Finnish health data and opportunities to actualize that potential in science, healthcare, and business.

Furthermore, FinnGen considers transnational collaboration as being of prime value. Its research activity and use of Finnish data concentrate on participation in large-scale GWAS studies with massive data sets collected from all over the world, and its main scientific partner is the Broad Institute of MIT and Harvard University, a stronghold of global medical genomics. FinnGen characterizes itself as "academic-industrial collaboration", a phrase that refers specially to cross-border commercial collaboration and active seeking for partnership with international pharmaceutical and other biomedical companies. The consortium's business orientation is most eminent in its attempts to acquire financing from Big Pharma enterprises and high-tech biomedical companies through collaboration in biomedical and pharmaceutical R&D (see below). FinnGen presents its commercial pursuits as interlaced with scientific objectives, medical utilities, and social benefits it presents to bring.

> The international pharmaceutical industry is a core element of the FinnGen endeavour. The industry takes care of over 70 percent of the financing, and the rest comes from Business Finland. Researchers with excellent scientific merits from the industrial partners are actively involved in planning and conducting the project as a community, across the company boundaries. The unique model of collaboration is possible because FinnGen is an endeavour focused purely on research. (Palotie *et al.*, 2019, p. 990)

FinnGen presents its collaboration model as exceptional, and underlines that the consortium is primarily scientific and precompetitive, despite the Big Pharma corporations' major role. Moreover, cutting-edge biomedical science FinnGen and its collaborators conduct will result in an all-encompassing variety of common good: great benefits to medicine, healthcare, Finnish academic research, the public, economy, and companies, and, finally, "all breakthroughs that arise from the project will eventually benefit healthcare systems and patients globally" (www.finngen.fi/en/goals_and_benefits).

Regarding valuation, FinnGen presents a two-faced self-image as an academic-industrial partnership and an academic pursuit with "purely" scientific objectives serving the public and common good. Such duality is quite typical of projects and institutions related in biobanking and data sourcing for data-intensive biomedical research in Finland and

elsewhere (e.g. Fortun, 2008; Ong, 2016; Vezyridis and Timmons, 2017; Timmons and Vezyridis, 2017; Beltrame and Hauskeller, 2018). In FinnGen, these two aspects are reconciled by business reasoning adopted from operative models a regional biobank, Auria, first introduced in Finland in the early 2010s (Lehtimäki *et al.*, 2019; Helén and Lehtimäki, 2020). FinnGen identifies itself as an academic stakeholder and considers its engagement with biomedical business and collaboration with major pharmaceutical companies as *instrumental*. This means that the commercial dimension of research facilitates progress in biomedicine and, most important, provides financial resources to sustain research. Because business activities with private companies are considered indispensable for maintaining FinnGen's extensive research agenda, instrumental activities focused on addressing commercial collaboration and marketing the partnership have become FinnGen's key or even dominant tasks. The consortium's spokespersons and documents express the commercial objectives and their priority clearly. On its website, FinnGen declares that one of its main objectives is to create a business ecosystem in Finland that,

> (. . .) is hoped to invite large international pharmaceutical companies and companies representing other industries to Finland. Especially international companies are hoped to increase their investments in Finland, financing of Finnish research and innovations and new companies generated by the ecosystem even after the end of the project (www.finngen.fi/en/goals-and-benefits)

Thus, FinnGen's commercial pursuit is not restricted only to itself because it has raised expectations of boosting biomedical business on a national scale. In a way, the consortium promises that invitation to Big Pharma corporations as collaborators and financiers of FinnGen would,

> (. . .) strengthen innovation and business activities nationally, because it is expected to increase cooperation between Finnish companies, healthcare operators, researchers and/or companies and international researchers and/or companies (. . .) The project will benefit companies in the form of new business opportunities e.g. in software design, IT solutions, genetic services, clinical testing, diagnostics and early-stage drug development (www.finngen.fi/en/goals-and-benefits).

FinnGen's business activities mainly regard seeking partnerships in biomedical and pharmaceutical R&D with international companies. People at the consortium believe that initiating collaboration with a significant pharmaceutical corporation or other medical company requires FinnGen to have something "unique" for medical R&D that "attracts" potential partners. In promotional discourse on FinnGen (and on Finnish biobank research more widely) two attractions are superior to others: "unique" genetic composition of the Finnish population and well-ordered and systematically collected "real-life data" (see above) in public healthcare and population registers. Especially the latter are seen as utterly attractive to potential global corporate partners. A biobank project manager described the Finnish data's unique features in the following way:

> If [the clients] need more data associated with the sample, then there are not many places where they can get similar data as we have. Elsewhere in the world, there are not clinical data collected from such a long period, and then we have PIN [national personal identity number] through which we can connect all the data [from different sources] with each other. And the law allows the biobank to acquire data from public registers, like the cause of death from Statistics Finland or information on drug reimbursements from the Social Insurance Institution of Finland. (Biobank project manager, 2017)

However, FinnGen's business reasoning suggests that the main element facilitating collaboration with company partners is not the data's uniqueness – sample data in biobanks and especially, "real-life data" – *per se* but services in data sourcing, management, and analytics that FinnGen can provide to its collaborators. There is a quite widespread assumption within the Finnish biobank research domain that pharmaceutical and other medical companies are

interested in biobank services for two reasons. First, they provide access to wide repositories of sample and – especially – clinical and other patient data (Tarkkala, 2019; Tupasela *et al.*, 2020). Second, Finnish biobanks can source data sets from their sample collections, patient record databases at hospitals and healthcare districts, and national healthcare and population registers, and then customize the data according to the customers' wishes (Lehtimäki *et al.*, 2019; Helén and Lehtimäki, 2020). Deriving from this actual infrastructure and related assumptions, FinnGen's core attraction is formed by its top-quality data management services, which open access to "unique" data of a "unique" population to the collaborators and provide them expertise in customized data sourcing and data refinement.

People at FinnGen and Finnish biobanks acknowledge that their target population and number of samples are very small when compared to the extensive data of big sequencing projects, such as European 1+ Million Genomes and All of Us in the U.S., and the depositories of transnational genome companies, such as 23and Me and WuXiNextCODE (e.g. Jarvenpaa and Markus, 2018). Therefore, FinnGen may distinguish itself from competitors and be attractive to potential collaborators through the high quality of Finnish data. The Finnish public health data infrastructure – biobanks, healthcare registers, and EMR databases – are claimed to have excellent capability to produce steadily high-quality data (Tarkkala, 2019). Considering FinnGen's operations are embedded in this data infrastructure, the consortium can perform having value potential due to the exceptional quality of data – especially "real-life data" – it provides access to its partners.

FinnGen performs the value potential of its data also by highlighting the "unique" genetic characteristics of the Finnish population. For decades, the Finnish medical geneticists have been claiming that the Finnish population is particularly good for studying genetic aspects of diseases because it is rather homogeneous in its genetic composition, and certain genetic variations associated with both rare diseases and disease susceptibility are considerably more common than in any other population (Tupasela, 2016; Tarkkala and Tupasela, 2018). According to FinnGen, this specific quality of the Finnish population and data sourced from it have the potential to create scientific, clinical, and commercial value (Tupasela, 2021). Collaboration with FinnGen would be attractive especially to company partners in drug development because using FinnGen data sets can make the sequencing used to find accurate molecular targets for candidate drugs faster and cheaper:

> Genotype analysis covering approximately 800,000 genetic markers are conducted to the FinnGen samples, with the help of a genotyping chip. Due to the structure of the Finnish population, whole genome sequencing is not needed; instead, those genomic variations not represented on the chip can be detected with the help of Finnish reference sequence data and statistical imputation. As a result, all genetic variances with occurrence of more than one in one thousand in the population can be detected in every person under study. With this method the cost is 25–30 euros per sample, while the sequencing of the whole genome costs over 1,100 euros. (Palotie, 2018, p. 1546)

Valuation by national branding

FinnGen's business rationale is embedded in the national branding of the Finnish biobanking and research on personalized medicine. Finland has adapted national branding as a general innovation policy framework. Within this framework, experts and advocates of biobank research joined forces with innovation policy officials and agencies in the early 2010s in efforts to increase attraction for Finnish biomedical research. For marketing purposes, they designed a unified image and "one voice" to make Finland a brand as the "most advanced testbed in the world" for biomedical innovative R&D (Figure 2). Nation branding is an elementary valuation practice in Finnish biobanking and personalized medicine, especially regarding commercial value potential, which is quite typical of similar national projects around the world (Tupasela, 2021).

Figure 2.
A picture from a promotional slideshow by the Finnish innovation fund Sitra. https://www.slideshare.net/SitraHyvinvointi/finland-your-testbed-for-the-next-generation-research-medical-innovation

Source(s): Figure compiled by Sitra, publicly available on-line

FinnGen's business rationale focuses on attracting collaborators abroad. The elements that make FinnGen attractive are exactly the same as in Finland's national branding, and the consortium tends to present itself at home and abroad as the flagship of the brand – and quite successfully, thus far. As business, FinnGen focuses on performing attractive opportunities for collaborative R&D with a great potential for commercial gain. For potential partners – preferably Big Pharma companies – collaboration with FinnGen (including financial investment) provides the main entrance to the "most advanced testbed in the world" and – most important – opens an access to "unique" data (in biobanks, population registers, and healthcare registers) of a "unique" population, accompanied with top-quality data management services and expertise in biomedical R&D (Tarkkala *et al.*, 2019; Tupasela *et al.*, 2020). This model for commercializing biobank data through partnership resembles that of DeCode Genetics in Iceland (Rose, 2001; Fortun, 2008), and similar collaboration models are widely adopted in Denmark (Hoeyer, 2019; Tupasela, 2021).

For capitalizing the attraction of "unique" Finnish population, data, and data management infrastructure, FinnGen has developed a kind of club model for commercial partners. The partnership arrangement is such that by paying a fee of a couple of million euros, the company partner receives rather extensive access to FinnGen's genotype data, sample data at Finnish biobanks, and associated health and population register data in collaboration with the FinnGen researchers. The consortium has been quite successful, considering it has managed to obtain 13 companies in the collaborator club, including corporations such as Pfizer, Roche's Genentech, Merck, and AstraZeneca, and collect financing that covers 60–70% of its approximately 80 million euros budget.

Despite emphasis on commercialization, reasoning over value and utility of FinnGen's research, Finnish data, and data management infrastructure in the consortium's documents and spokespersons' talks tends to underline the consortium's "purely scientific" and "precompetitive" character (Palotie, 2018; Palotie *et al.*, 2019), and to intermingle scientific, clinical, social, and ethical value dimensions with seeking of commercial gains. Such hybrid valuation is quite commonplace for biobanking and public–private partnership projects in

biomedicine and life sciences around the world (e.g. Birch and Tyfield, 2013; Mittra, 2016; Beltrame and Hauskeller, 2018).

But what is the relationship between economic valuation and other value dimensions in this this context (see Dussauge *et al.*, 2015b)? FinnGen and its advocates undermine hybrid valuation described above by presenting different types of value in such a practical order that makes economic value creation predominant. This means that economy forms a semantic umbrella or master frame that brings other value dimensions of biobank research together and subsumes them, and thus, commercial success in business collaboration – or prospects of success – becomes the prime criteria and objective of R&D efforts (see Muniesa, 2017). In essence, FinnGen is a consortium for large-scale transnational collaborative research with a prime purpose of seeking collaboration with and funding from big pharmaceutical corporations, other medical companies, and ICT companies. As stated, these commercial pursuits are instrumental yet primary in FinnGen's operations, and both scientific activities and social benefits in Finland are subordinate to commercialization. More precisely, FinnGen's business model imposes a reverse order of valuing the benefits and utility of FinnGen's actual research, data, and data infrastructure, Finnish biobanks included. At FinnGen, valuation discourse emphasizes the consortium's scientific nature and declares that scientific discoveries and medical benefits are the project's primary and most valuable objectives; yet striving for commercialization seems to dominate its activities. Due to assumptions related to an economy of attraction (see above), the instrumental seeking of commercial benefits in corporate collaboration is primary for FinnGen in a temporal sense: the "endeavour focused purely on research" (Palotie *et al.*, 2019, p. 990) must first focus on ensuring the continuity of funding by attracting international company partners and financiers before engaging in research activities that seek scientific discoveries and medical benefits. In this order, commercial prospects dominate in the valuing of data, data sourcing, data management infrastructure, expertise in data refinement, and the use of the data in research. Consequently, scientific and R&D activities and achievements are subordinate to this business rationale.

Valuation by expectations

Valuation associated with FinnGen primarily means creating and maintaining various value prospects associated with utilizing the Finnish samples and health-related data in biomedical R&D. When the spokespersons – and Finnish experts, advocates, governmental innovation policy officials, and politicians more widely – reason what is valuable in FinnGen and biobanking associated with it, they predominantly refer to value and utility that the Finnish "uniqueness" as milieu for sourcing and that refining genetic and "real life" data will possibly, probably, hopefully, or eventually create biomedical discoveries, clinical use, social benefits, commercial revenue, or profit for investments. Valuation of biobank research and personalized medicine comes with great expectations all over the world (e.g. Fortun, 2008; Martin and Collin, 2014; Tutton, 2014; Ong, 2016; Sun, 2017), which is typical of emerging techno-economic domains (e.g. Brown and Michael, 2003; Borup *et al.*, 2006). Finland is no exception. The value of FinnGen and Finnish health data sourcing are conceived of as primarily prospective – the value lies in their assumed potential. A quote from an executive director for biotechnology and precision at Pfizer exemplifies the way by which FinnGen's value as potential is repeatedly underlined on its website and in other documents.

> Pfizer is excited about the potential of the FinnGen consortium to provide a more holistic understanding of the genetic basis for the onset and progression of human disease and response to therapeutic intervention (. . .) We hope that FinnGen will ultimately influence the discovery of new therapies that can help improve patient's lives. (https://www.finngen.fi/en/quotes)

In FinnGen's business reasoning, expectations are inseparable from the attraction in which the value of FinnGen and its associated data infrastructure are embedded. For potential partners, both academic and commercial, FinnGen may be attractive to collaborate with or to make a financial investment in because they expect that FinnGen can deliver something that will bring revenue or other benefits. Consequently, valuation discourse and practices at FinnGen – and more widely about Finland as a perfect testbed for personalized medicine (see above) – essentially regard creating and maintaining these value expectations. Furthermore, much of the consortium's activities are preoccupied with maintaining the prospects and credibility for the professional and scientific community, the company partners, and even the public. Therefore, valuation mostly regards making promises and backing them up.

The promises indicating the value potential of FinnGen and Finnish health data are rather imprecise, hardly measurable, and simultaneously, very broad or even all encompassing. FinnGen's website provides multiple examples of such vague grandiosity. The consortium claims that, "all breakthroughs that arise from the project will eventually benefit healthcare systems and patients both locally and globally" and pronounces to provide new kind of data that enables researchers

> to create more reliable solutions for healthcare, anticipation and prevention of diseases in the future [and] allow pharmaceutical companies to develop more personalised and efficient medicines and treatment also for diseases for which there is no treatment at the moment. (www.finngen.fi/en/goals-and-benefits)

FinnGen attempts to perform the general promises and value potential more concretely in numerous ways. For example, a counter on FinnGen's website shows in real time the number of persons genotyped. In addition, news on research findings are regularly published on the website as a kind of showpiece of breakthroughs-to-come, which may provide concrete support to the claims of FinnGen's value potential.

These efforts are rather scattered, and thus, FinnGen's future possibilities, visions, probabilities, and promises remain inexact and "unaccountable" (Birch, 2017a, b). This applies to commercial value expectations as well. Such vagueness implies two issues. First, the value is hard to define by calculation or accounting; second, there are no guarantees that acclaimed value, utility, or benefit exists – or will exist – at all. Therefore, FinnGen's partners – both academic and the companies – engage in collaboration with the consortium or finance it primarily based on the hope that value potential associated to FinnGen and Finnish health data will actualize to a certain extent. In fact, the word "hope" is often repeated in commercial partners' comments on FinnGen's website. In a similar manner, the public financier Business Finland, the governmental innovation and export agency that has provided FinnGen 30 million euros of funding, bases its evaluation of the consortium's value potential on assumptions about attraction and hope. A Business Finland executive's statement illustrates this well.

> The FinnGen project is like a magnet that draws the interest of the global pharmaceutical industry to Finland and brings significant new players and investments to strengthen the ecosystem (. . .). We expect remarkable growth in research and development investment over the next years. FinnGen has also worked extremely well in creating links between the international pharma and Finnish companies, which we hope will eventually generate more innovation, business, and cooperation models. (https://www.businessfinland.fi/en/whats-new/news/cision-releases/2020/finngengrowstooneoftheargestprivatepublicstudiesintheworld/)

Discussion

Our article contributes to the discussion on value and value creation in management studies by providing a broad approach on valuation practices (Muniesa, 2011; Helgesson and

Muniesa, 2013; Dussauge *et al.*, 2015b; Kornberger *et al.*, 2015b) in emerging technoscience business. As compared to established business domains, emerging technoscientific business domains are usually in an embryonic, pre-competition phase where the market is forming and the positions of suppliers, customers, producers, and their collaborative and competitive relations are not yet established. Our analysis of value creation at the FinnGen consortium, a major actor in the emerging innovation domain for personalized medicine in Finland, demonstrates that management studies would greatly benefit from analysing value regarding valuation practices (see Kornberger, 2017). FinnGen and its collaborators' utilization of biobanks and other health data depositories forms complex sociotechnical assemblages, and due to this complexity, the products – data, infrastructure, scientific results, etc. – do not have some intrinsic value *per se*. Instead, value and utility are created, added, maintained, and modified in biobanking and personalized medicine by discourses and practices that attribute a certain type and/or certain amount of value potential to "real-life data", infrastructure, or expertise.

Our study broadens contemporary discussion on valuation in management studies (e.g. Kornberger *et al.*, 2015a; Kornberger, 2017) and studies on techno-economies (e.g. Dussauge *et al.*, 2015a; Birch, 2017a, b; Birch and Muniesa, 2020). We show that when data in biobanks and other health data repositories, an infrastructure, and expertise are enacted, they are attributed with some sort of value. We analysed what aspects FinnGen as an organization and the people involved in it consider valuable in terms of innovation for personalized medicine and valuable in what sense. Our prime finding was that, as the stakeholders see it, FinnGen's value creation potential is inseparable from "real-life data" and lies specifically in expertise associated with the consortium to collect, manage, circulate, and refine data from various sources swiftly and flexibly. Thus, FinnGen is – or can be – of utility for pursuits advancing personalized medicine as data sourcing and refinement *service*.

Thus, all practices associated with FinnGen and the ecosystem surrounding it are valuation practices: everyday practices of sample taking from the donors, data sourcing from EMRs, or data curation for making a set of "real-life data"; utilization of health data in pharmaceutical R&D; assessing biobanking for making an innovation policy "roadmap"; or advocating the consortium in a business ecosystem meeting or seminar with MPs – all these activities enact and perform value of FinnGen and its work.

Furthermore, our analysis showed four core aspects of valuation of "real-life data" and FinnGen as a data-sourcing hub (Table 2). First, value and utility assigned to FinnGen, and the benefits of personalized medicine in general, are *multiple* because scientific, clinical, and social value dimensions of biomedical innovation intermingle with each other and are interlaced with economic value. Second, *collaboration* among domestic stakeholders (scientists and academic institutions, clinical experts and healthcare institutions, and private companies) and with partners abroad (top academic institutions and especially private pharmaceutical corporations) is considered indispensable for FinnGen's value creation and for the business domain around personalized medicine. Third, *national branding* is presented essential for building a competitive advantage globally. Finally, valuation rationale at FinnGen is mostly articulated in terms of *expectations* and assumptions about the future. All types of value are attached to the consortium's work via speech and practices that raise and maintain hopes of revenue, profits, and other blessings that innovation and new technology in personalized medicine will bring. Expectations and value as potential are especially underlined regarding FinnGen's commercial valuation.

Our analysis of FinnGen as a representative of emerging technoscience business addresses four topics crucial for comprehending value creation in this kind of business domain. First, value attached to a novel item, technique, or activity are not only, or even predominantly, commercial or monetary but multiple within an emerging domain where technoscience and business are entangled (see Dussauge *et al.*, 2015b; Datta Burton *et al.*,

Valuation	Multiplicity	Collaboration	Branding	Expectations
Value Entanglement	Interlacing of social, clinical, health, and commercial value	Exploiting the value potential of an entire ecosystem	Performing competitive advantage in the global market	Promising future competitive advantage and return-on-investment
Characterization of Value	Malleability	Attractiveness	Competitiveness	Promissory
Embedding of Value	Business model as an instrument for innovative R&D	Biomedical infrastructure and biomedical research with "real-life data"	Efficiency in data sourcing and management	Potential for future revenues
Beneficiaries	Scientists, clinicians, healthcare, patients, people, society, economy, entrepreneurs and companies	FinnGen and other researchers, biobanks, clinicians, and pharmaceutical, medical, and IT companies	International academic and business collaborators, Big Pharma, FinnGen, and the domestic business ecosystem	Investors, business collaborators, Big pharma, and domestic business partners

Source(s): Table compiled by authors

Table 2. Dimensions of valuation in emerging technoscience business

2022; Fiske *et al.*, 2023). FinnGen is characterized by malleability of valuation in which scientific, clinical, and social value dimensions are interlaced with commercial valuation. In its business model, business pursuits and the meaning of commercial value are instrumental because they serve efforts for pushing innovative R&D further and creating the sustainability of scientific endeavours. In practice, activities and rationale for commercialization has gained the prime role at FinnGen because they are seen vital for keeping on the consortium's research going.

Our second highlight is the importance of collaborative value creation in technoscience business. FinnGen and the people involved in it considered joint efforts among donors, experts in data management and biobanking, scientists, clinicians, and medical and IT companies at home and abroad indispensable for maintaining biomedical infrastructure and conducting successful biomedical research with "real-life data". Moreover, much of FinnGen's efforts focus on organizing and intensifying collaboration among the domestic stakeholders and seeking commercial collaboration with pharmaceutical or other medical enterprises abroad. Pursuit for attractiveness is a central aspect of valuation in enticing collaborative partners and raising interest among investors and national government agencies that are needed for ensuring the future development of the technoscientific business. We claim that the emphasis on collaboration in our case brings forth an aspect of the practices and rationale of valuation – especially the characteristics to emerging technoscience business, namely, that valuation addresses value potential of an entire ecosystem or platform, not only the actors traditionally considered as market actors, that is, firms, customers, competitors, and suppliers.

Third, national branding plays an important role in establishing the technoscientific business that requires both national and global investors, customers, business, and academic collaborators. Personalized medicine is a technoscientific business domain that evolves rapidly in different countries globally, and the competitiveness of academic and business solutions require national effort in innovation policy, legislation, public-private partnerships, information infrastructures, etc. to ensure efficiency in data sourcing and management that is in the centre of competitive advantage (Tupasela, 2021).

Finally, we underline the significant role of expectations in valuation. Our FinnGen analysis demonstrates that all types of value – scientific, clinical, social, or economic – attached to new knowledge, items, innovative firms, or the ecosystem are predominantly promissory. When people involved in biobank research in Finland reason over the value and utility of health data, they refer to data sourcing infrastructure or biobank research in future tense regarding the benefits utilization of data in research will possibly or hopefully bring in terms of biomedical discoveries, clinical use, social benefits, or commercial revenue or profit (Tarkkala *et al.*, 2019; Tupasela *et al.*, 2020). FinnGen's value is conceived of lying in its assumed potential, both scientific and commercial, and valuation mostly regards creating expectations and providing them support and justification.

In sum, our study contributes to the discussion on value and value creation in management studies by widening Kornberger's (2017) discussion on valuation practices from established business domains to emerging technoscience business domains. As compared to established business domains, emerging technoscientific business domains are in a pre-competition phase where the market is forming and the positions of suppliers, customers, producers, and their collaborative and competitive relations are not yet established. Our analysis shows that in such an embryonic business milieu where commercial value upon innovation is in the making, valuation practices constitute the prospective market and the prevalent economic discourse and rationale focused on potential future value. This is in contrast to the established markets where valuation practices are determined at the intersection of customer preferences and competitive arenas where suppliers, producers, service providers, and new entrants to the market present value propositions.

Our analysis of valuation in emerging technoscience business broadens Kornberger's (2017) main argument that management studies would greatly benefit from analysing value regarding valuation practices instead of seeing value as an attribute of a thing (product, firm, etc.) or a preference of a subject (consumer, buyer, etc.). As an extension to Kornberger's view, our study points out three features of emerging technoscience business domains. First, valuation practices in such a domain interlace several scientific, social and economic value dimensions with commercial value when attaching and attributing value to things and activities. Second, valuation practices (and associated business models) in an embryonic business milieu are predominantly about attracting partners for innovative R&D as probable future beneficiaries, performing competitive advantages of national and international ecosystems, and defining the potential for future value. Finally, valuation practices in such a setting tend to attribute value potential to the whole technoscientific ecosystem, not only to single innovation or companies.

Conclusions

In this paper, we have examined value creation in an emerging technoscience business domain through an empirically grounded approach on valuation practices. Although our analysis focuses on the specific case of FinnGen, the flagship project of medical genomics and personalized medicine and the major user of biobanks and other health data repositories in Finland, we argue that the features of valuation identified in the analysis likely characterize similar emerging domains of innovation business. We believe this approach can help scholars in management studies to understand better valuation, that is, the practices and processes that determine whether something is considered valuable and how these practices constitute the business domain's functioning and characteristics.

As managerial implications to health innovation stakeholders in the public, private and academic sectors, our study provides new knowledge about the ecosystem dynamics in a technoscientific innovation. To business managers, the findings of this study about valuation

practices are useful in strategic decision-making about ecosystem strategy and ecosystem business model for value proposition, value creation and value capture in an emerging innovation domain characterized by collaborative and competitive relations among stakeholders. To policy makers, our study provides an in-depth analysis of an overall business ecosystem in an emerging technoscience business that can be propelled to increase the financial investments in the field. In addition, it provides them with a broad understanding of the various dimensions of valuation in technoscience business for making governance decisions that facilitate and regulate usage of digital health data for medical innovation.

Note

1. The mentioned research endeavours are *Good(s) for Health* research consortium (2015–19, funded by Academy of Finland), *Personalized Diagnostics and Care* R&D consortium (2014–18, funded by The Finnish Innovation Agency Tekes), and Privacy Regimes in Variation and Transformation: The Emerging Field of Post Genomics research consortium (2009–12, funded by Academy of Finland and ELSA GEN).

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