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MONEY, TIME, OR SAVING THE WORLD:

Balancing valuations of 'good' interdisciplinary research

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This paper analyses valuations of 'good' interdisciplinary research that manifest in research planning workshops. We use ethnographic case data from an interdisciplinary research project on vertical farming to build insight on how differing registers in the valuing of 'good' interdisciplinary research are balanced. The vertical farming project we use as a case includes researchers from sub-disciplines of the life sciences, technology, data science, and human sciences in a Finnish university of applied science (UAS). We use thematic content analysis to identify four core registers of valuing the 'goodness' of research and tensions between the following registers: money, sustainability, scientific value, and academic identity. These registers largely conform to a statistical-economical regime of academic evaluation, while sustainability draws on RRI principles and the interdisciplinary emphasis on societal problem-solving. The registers are balanced mainly through temporal and conceptual compartmentalisations. Throughout three workshop encounters over the course of a six-month period, a perpetual negotiation of the different registers of valuing 'good' research was taking place, with attempts to avoid exclusionary choices between "money, time, or saving the world".

Keywords: Interdisciplinary research, valuation studies, vertical farming, workshop facilitation, ethnography

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Introduction

If you were to ask five academics to define 'good' interdisciplinary research, you would get a handful of different answers and probably quite a few questions. The obvious challenge is to specify the 'good' – according to whom, for what purpose, and by what standards. Depending on one's standing and the standards one judges against, good interdisciplinary research may be recognised by publications in high impact journals, new technological innovations, development of cross-disciplinary relationships, policy recommendations, access to tenure-track positions, generalisable findings, or reputation and funding for the university, to list some examples.

The question of how scientific research is valuated is of considerable interest to the academic community. Studying the valuations of research held by academics themselves, Fochler et al. (2016) found that while their interviewed Austrian PhD students upheld a relatively wider variety of valuative regimes to guide their work in academia, postdocs subscribed mainly to a single dominant regime of quantitative, statistical, and economic measurement of academic success. In recent academic discussion, substantial critique has been directed at the strong reliance on such quantitative metrics to value and compare research outputs and researchers against one another (Alberts et al., 2014; Larivière & Sugimoto, 2019) and the effects have been identified to result in "a crisis of valuation practices" (Fochler et al., 2016) and difficulty to meet responsible research policy goals (Müller & de Rijcke, 2017). Meanwhile, for society at large, valuations of science traditionally appeal to societal wealth and wellbeing. Ethical valuations manifest in 21st century ideas of Responsible Research and Innovation (RRI) (Owen et al., 2012; Von Schomberg, 2013; Burget et al., 2017) and related ideas of sustainable development in higher education (Waas et al., 2010) and the interdisciplinary field of sustainability science (Clark & Dickson, 2003).

In this paper, it is not our goal to define 'good' interdisciplinary research. Nor do we attempt to present a comprehensive outlook on all different valuations given to research in academia or society. Instead, our article follows the path set by valuation studies. The article analyses snapshots of valuation as a social practice in an interdisciplinary research project investigating vertical farming. The vertical farming project (VFP) involves researchers from sub-disciplines of the life sciences, technology, data science, and human sciences in a Finnish university of applied science (UAS). VFP is situated in the context of applied science research tradition and the bioeconomy as an academic and socio-political project (Mittra & Zoukas, 2020). Our focus is on the first six months of the research project in three workshop encounters, where objects, goals, and values of the project were co-constructed and negotiated. The analysis reveals covert and overt ideas of what counts as 'good' interdisciplinary research and – most importantly – how such differing valuations are balanced together in our vertical farming case.

Our case study draws its material from discussions aimed at formulating common interdisciplinary research directions. The formulation and choice of research problems can make or break the success of a project (Kahn, 1994), yet in interdisciplinary research the very ideas of what constitutes a research problem may differ (Cronin, 2008). The discussions we analyse reveal disciplinary positioning attempts (Hah, 2020) as well as socially negotiated constructions of valuing research when researchers from different disciplinary backgrounds aim to find common ground. In analysing the overt and covert valuations engrained in the research problem formulation process, we put forward two research questions:

1) What kinds of registers of valuing are present in valuations of interdisciplinary research?
2) How do these valuations interact and influence the process of formulating research problems in interdisciplinary research?

In the following, we first lay out a theoretical approach relying on the field of valuation studies and problematisations of interdisciplinary research. Next, we present our vertical farming project case and the data collected from the project. We then describe and discuss our analysis and results.

Navigating good (enough) interdisciplinary research

Interdisciplinary research as a mode of inquiry

Interdisciplinary research is an academic trend to be reckoned with. According to proponents of interdisciplinary approaches, disciplinary science is not well equipped to tackle the complexity and wickedness of societal issues such as food crises, climate change, or public health (Klein, 2004; Brown et al., 2010; Alrøe & Noe, 2014). As Bruun and colleagues (2005) have pointed out, interdisciplinary research has been on the rise for some time and is strongly tied to utilitarian perspectives and movements from the ideal of pure basic research towards applied, problem-oriented science with foreseeable economic or societal impact. A foundational textbook by Repko and Szostak (2021) lays out seven key elements of interdisciplinarity that form into a definition of interdisciplinary studies as "a process of answering a question, solving a problem, or addressing a topic that is too broad or complex to be dealt with adequately by a single discipline, and draws on the disciplines with the goal of integrating their insights to construct a more comprehensive understanding" (Repko & Szostak, 2021, p. 9). This definition underlines complexity and a problem-based approach to research, although it notably leaves room for approaches that are not directly problem-based.

Crucially, a preference towards interdisciplinary research is reflected in certain financial preconditions of conducting research. Interdisciplinary and problem-oriented research is increasingly emphasised in programmes such as the European Union's Horizon 2020 (Boon & Van Baalen, 2019) and in Nordic research policy (Bruun et al., 2005). However, in programs which do not distinctly demand interdisciplinary research, interdisciplinarity can be a pitfall. A study of The Australian Research Council's Discovery Programme has found that interdisciplinary proposals had consistently lower funding success than disciplinary initiatives (Bromham et al., 2016). Bromham and colleagues account for this finding by speculating on the difficulty review boards may have in reviewing interdisciplinary proposals, as opposed to more clear-cut disciplinary research projects. The financial incentives for interdisciplinary research thus seem to depend strongly on the funding instrument in question.

For individual researchers, the career effects of interdisciplinarity are also contestable. Researchers who identify themselves as being in-between or outside disciplines must engage in struggles of disciplinary positioning to claim and justify their expertise as academics in a world where disciplinary categorisations are a cornerstone of academia (Hah, 2020). Interdisciplinarity can sometimes hamper success in the academic field, as a 2011 study found that interdisciplinary collaborations were less conducive of career advancement than those within a single discipline (van Rijnsoever & Hessels, 2011). However, the results are mixed, as there are indications that interdisciplinary collaboration harbours more publications for researchers (Millar, 2013) and is cited more often (Abramo et al., 2017). Furthermore, the career effects of interdisciplinarity may change as interdisciplinary Master's and PhD programmes are being established and there is a new generation of academics in the making who receive their training within an interdisciplinary or 'undisciplinary' outlook from the very start (Haider et al., 2018).

Some common struggles in the actual practice of interdisciplinary research relate to differing epistemic cultures. Researchers from different disciplines may have strikingly different ideas of what counts as 'good research' or what constitutes a research problem due to epistemological differences (Cronin, 2008; Miller et al., 2008; Leigh & Brown, 2021). Leigh and Brown (2021) stress the need to examine questions as foundational as what is being researched and what is valued as research, while Miller and colleagues (2008) advocate for outspoken epistemological pluralism in interdisciplinary projects to address these difficulties. Other difficulties may include incomplete knowledge of other disciplines, differing culture and values, methodology, and psychology (Bruun et al., 2005) as well as misconceptions and prejudices that researchers from different disciplines may have of one another (Cambell, 2005). Taking time to intentionally build collective communication competence is an important step for overcoming these challenges (Thompson, 2009). Lang and colleagues (2012) state that there are crucial problems especially in balancing research problem ownership in interdisciplinary teams.

Valuation studies as a theoretical approach to 'good research'

This article draws conceptual tools from the field of valuation studies. Valuation studies takes "valuation as a social practice" as its object of study (Helgesson & Muniesa, 2013). Valuing and valuation as active processes are separated from value (the singular noun ascribing worth) and values (the plural in the sense of standards, norms, or rules) (Kjellberg & Mallard, 2013). Furthermore, valuation studies are concerned with *valorising*, the processes aimed at making things valuable, in addition to valuation as *evaluating*, the processes of assessing value and worth (Vatin 2013). Rather than seeing valuation as a separate and external activity, valuation is thus treated as embedded into the activity of the very practice it seeks to valuate (Schrøder et al., 2021). In our case, this means viewing the planning and doing of research in vertical farming as a practice which attempts to create 'good interdisciplinary research' (*valorising*) and bring out discursive understandings of what makes such interdisciplinary research good (*evaluating*).

Historically, the investigation of valuation and the making of values has spanned several disciplines and interdisciplinary problem spaces. A scholar of valuation may investigate the valuations and valuation practices related to any number of things, including but not limited to tomatoes (Heuts & Mol, 2013), academic career trajectories (Hammarfelt et al., 2020), late-life creativity (Gallisti, 2020), work in child protective services (Schrøder et al., 2021), or waste (Lehtonen & Pyyhtinen, 2020).

Valuations of 'good research' have also been studied within valuation studies from several points of view. Prior research includes valuations of universities and university rankings (Paradeise & Thoenig, 2013), value practices in specific areas of research, such as biomedicine (Dussauge, Helgesson, Lee, & Woolgar, 2015), academic careers (Fochler et al., 2016; Hammarfelt et al., 2020), and disciplinary positioning struggles (Hah, 2020). A major component of these studies seems to be the recognition that 21st century academia is largely subject to one dominant regime of valuation (Fochler et al., 2016) which judges academic quality based on quantifiable statistical measures. Such heavy reliance on quantified metrics of value is also highly criticised, as it is seen to impoverish academic originality, scientific advancement, and societal value (Fochler et al., 2016; Müller & de Rijcke, 2017).

Societal valuations of 'good research' often rely on the notion of Responsible Research and Innovation (RRI). RRI principles and terminology can be traced back to EU science policy (Owen et al., 2012). According to a literature review by Burget and colleagues (2017), the most commonly cited definition is provided by Von Schomberg (2013), who understands RRI as an approach integrating stakeholders in all domains to empower research to take on the

"grand challenges" faced by society at large. In the case of RRI, the 'goodness' of research is thus a predominantly normative one. However, the theory behind RRI has sometimes been accused of not paying enough explicit attention to normative values (Boenink & Kudina, 2020). Whereas some commentators stress the need to adopt and channel existing or given public values in RRI (Taebi et al., 2017), Boenink and Kudina (2020) express a more contingent alternative. According to Boenink and Kudina, responsible research and innovation ought to explicitly consider and deliberate on values starting in the initial stages of research. This deliberation should incorporate transdisciplinary actors – those "involved and potentially affected by the innovation" (ibid, p. 2). The main critique of the authors is launched at a proclaimed RRI tendency to approach values as given, ready for the taking and straightforward adaptation into research. Instead, Boenink and Kudina propose a practice-based understanding of valuations as a lived-in, dynamic process, where values are shaped in human action.

A key concept for our analysis of valuation is that of *registers of valuing* (or registers of value / valuation). In their formative article "What is a good tomato?", Frank Heuts and Annemarie Mol (2013) exploratively analyse the different ways in which tomato experts valuate good tomatoes. Heuts and Mol present five different *registers of valuing*: money, handling, historical time, what it is to be natural, and sensual appeal. These registers reflect distinct albeit intermingled dimensions of how tomato experts approach the question of goodness in tomatoes. The registers are neutral in themselves, as they "indicate a shared relevance, while what is or isn't good in relation to this relevance may differ from one situation to another" (Heuts & Mol, 2013, p. 129). Using *registers of valuation* as a conceptual tool is not limited to the realm of fresh produce – the concept has been successfully applied at least in the study of late-life creativity (Gallisti, 2020) and work in child protective services (Schrøder et al., 2021). Gallisti (2020) identifies three registers of valuation for the creativity of older adults: economic value, field value (as seen by the artistic field), and lifecourse value (a specific value derived from having a long life-history of the artistic activity). Schrøder et al. (2021) report four registers of valuing child protection work as *good enough*: feeling, theorising, formalising, and costing.

The relationship between different registers of valuing is a question of major interest. Heuts and Mol (2013) specify that different registers of valuing are not definite or incompatible, and both overlaps and tensions may exist between them. In a similar vein, Dussauge, Helgesson, and Lee (2015) also place attention on the tensions involved in enacting multiple different values. Dussauge, Helgesson, and Lee (2015) map out a programme for the study of valuation in what they term *valuography*. The valuographer distances oneself in an ethnographising fashion to empirically study the "enacting, ordering, and displacing of values" (Dussauge, Helgesson, & Lee, 265). Values are treated as unstable, and the focus is on the actions taken and tensions involved in reconciling multiple differing values:

> "What appears to give a particularly strong foothold for the making of valuographies is the drawing of attention not primarily to the ordering consequences of any stabilized values, but rather to the numerous and multifaceted frictions that come into view due to simultaneous efforts to enact different values" (Dussauge, Helgesson, & Lee, 2015, p. 267)

As a more formalised approach to interpreting the relationships and tensions between registers of valuation, Schrøder and colleagues (2021) propose the notion of *sequencing*. Sequencing is put forward "as an answer to how it is possible to pursue and maintain conflicting performance ideals at the operational level of hybrid organizations" (Schrøder et al., 2021, "On the efforts of sequencing different registers of valuation", para. 1). Schroder and colleagues argue that sequencing is a practical task of separating registers of valuation in time and place, rather than a psychological one. According to Schoeder and colleagues (2021), there are five key elements to sequencing, which can be paraphrased as follows: 1. sequencing is done to make the task 'good' in any, some or all relevant registers of valuation, 2. sequencing moves between registers, hybridises them, and obscures any preferential hierarchy between them, 3. boundaries between registers are fuzzy, as they are visited in different times and spaces, 4. sequencing makes the performance of tasks unpredictable and non-linear, and 5. sequencing depends on practical things, such as software, rooms, and spreadsheets.

In this article, we will follow a valuation approach to analysing latent, emergent, and evolving valuations in the discussions and research problem formulations in vertical farming research. We use *registers of valuing* as an analytical concept to analyse the different valuations arising in interdisciplinary research discussions.

Researching the vertical farming project

Case description

Our research case comes from a Finnish UAS which started an interdisciplinary research project on vertical farming in 2019. Vertical farming is a farming method that builds upwards and grows in layers rather than horizontally (Kalantari et al., 2018) and has an ability to produce crops in limited spaces, such as rooftops. There are hopes for vertical farming to aid in supplying food to cities sustainably or to create value-added biomass for industry purposes (Al-Chalabi, 2015). The project we are investigating is based on container farming, a special type of vertical farming. Container farming involves growing biomass in a shipping container, which can provide a closed controlled environment to

suit the needs of research. Research in the controlled cultivation environment enables various possibilities in optimising growing conditions of plants, for instance in the production of specific antimicrobial compounds.

Figure 1. Inside the container farm. Photo: VFP research assistant (2020)

The strategic goals of the research project under investigation were to respond to megatrends of digitalisation and climate change. By positioning the project as part of a collective endeavour towards alleviating societal problems such as climate change, the initial project plan takes up at least a partial mission of RRI.

Four research units of the university of the UAS were involved in the vertical farming project: life-sciences, data science, technology, and educational sciences. Each research unit harbours different competences, research traditions, and interests. In this case, we the authors acting with the educational science research unit had backgrounds in political science, education, and psychology, collectively referred to in this paper as human sciences. As is common to interdisciplinary research, the human sciences were assigned to take the lead on the viewpoint of complexity (Hillersdal et al., 2020) and in this project also a meta-level evaluation of the interdisciplinary collaboration as it progresses. Within the phases of the research process discussed in this paper, the role of the human sciences was to act mainly as an observer and evaluator of the other disciplines, but in the wider scope of the research project, the human sciences also had a more active role in shaping the research. The evaluative approach was decided on with both an academic interest on the dynamics of interdisciplinary collaboration and also as a way to gain insight into how the UAS could strengthen interdisciplinary collaboration between its research units in the future.

The organisational context of our research case provides fertile ground for valuation discourses. In Finland, the role of universities of applied sciences is in flux: government funding is assigning ever more weight to research activities and a shift can be identified from pure applied research towards use-inspired basic research (Vetoshkina et al., 2022). Long-standing traditions of commercially funded research projects that support local business are also evolving, as there is a growing emphasis on sustainability and RRI, global social responsibility and societal impact. Amidst these developments, differing goals, interests, and ways of framing research need to be accommodated and reconciled in new ways.

Researcher workshops

This paper analyses transcribed recordings of three workshops with the vertical farming project researchers. The workshops took place within the span of seven months in 2019–2020. Altogether the data includes 6.5 hours of workshop discussions. As additional material, we also conducted interviews with key actors in 2019 (eleven interviews) and 2020 (five interviews) and collected other ethnographic material, including planning documents and meeting memos. The interview data consists of 17.5 hours of individual interviews. We use the additional data to make sense of the workshop data and provide a wider picture of the workshop setting, and we will only analyse discussions from the workshops in this article. The workshops were chosen as the primary data source, because of their interactivity. In the workshops, the relationships between different valuations were discussed more overtly. In the following, we provide an overview of each individual workshop.

Workshop 1 took place in October 2019. Participants included seven researchers with backgrounds in microbiology, horticulture, landscape architecture, environmental engineering, and electrical engineering as well as two educational researchers. The aim of Workshop 1 was to kick-start the ideation process for vertical farming research. Workshop 1 was initiated and facilitated by a life sciences project leader, with two of the authors mainly observing. As a result of Workshop 1, participants listed different research ideas for the project, which had already received funding some months prior. However, the funding instrument was flexible in the specifics of the research project and left much room for the researchers to deliberate their interests and hopes for vertical farming research. At this stage, self-criticism of research ideas was disadvised and 'dreaming' heartily encouraged.

Workshop 2 was held one month later in November 2019. Participants included six researchers, five of whom had also participated in Workshop 1. Workshop 2 was planned together by the authors and vertical farming project leaders to promote value discussions guided by the broad research strategy set in the initial research proposal and the strategy of the UAS. The discussion was facilitated by two of the authors, in line with recommendations by Thompson (2009) for using facilitators to build collective communication competence in interdisciplinary projects. The aims of Workshop 2 were to a) reflect on the strategic goals of the research project (smart and sustainable bioeconomy) and of the organisation (societal impact, usefulness of research) and to b) prioritise research ideas with the aid of a digital platform. The workshop started by providing a setting for discussing the broader goals and underlying valuations embedded in the research – responding to climate change and digitalisation – deliberately moving the discussion from seemingly neutral practicalities to explicit valuations. After the discussion, participants were asked to prioritise research ideas collected in Workshop 1, specifically with the value discussion in mind. To do this, each participant individually used a digital prioritisation tool (Innoduel), which then computed a top list of research ideas based on the collective prioritisation (for more detail, see Ryymin et al., 2020). Finally, the top list was discussed together.

The final workshop in the three-part workshop series was held, unlike the first two, digitally in May 2020 (due to COVID-19 pandemic restrictions). Workshop 3 took place after initial research and testing in vertical farming had gotten under way. Workshop 3 was used again as a facilitated platform, this time to discuss practicalities and further develop future research directions. Workshop 3 had nine participants, five of whom had not participated in either of the first two workshops. This workshop had the most balanced numbers between researchers from the life sciences (4), technology (3), and data science (2). Similarly to Workshop 2, two of the authors facilitated and designed Workshop 3 in collaboration with vertical farming project leaders.

The three-part workshop design developed organically as the project evolved. The idea behind the workshops followed action research principles (McNiff, 2013), as the aim of the authors in arranging workshops was to strengthen interdisciplinary research collaboration and the day-to-day work of the project (*valorising* the project, in the terms of Vatin, 2013) as well as to collect research data (*evaluating* the interdisciplinary collaboration). The workshops were intended to give researchers a push to keep working on shared research problems and to strengthen their collective communication competence (Thompson, 2009).

Method and analytical strategy

The discursive formation of different registers of value in the workshop discussions was analysed with qualitative thematic content analysis (Terry et al., 2017; Braun and Clarke, 2006). The most common differentiation in the methodological approaches to thematic content analysis is between the two types of content, manifest and latent. Manifest content analysis describes what is occurring on the surface, what is literally present and stays close to the text. Latent content analysis, on the other hand, is defined as interpreting what is hidden deep within the text. In latent content analysis, the role of the researcher is to discover the implied meanings in the discussions of participants (Kleinheksel et al., 2020; Kondracki et al., 2002; Graneheim & Lundman, 2004).

Latent thematic content analysis highlights the role of the researcher. The researcher is personally involved in the process of analysis by using mental schema, theories, and lenses in the interpretation of data (Hsieh & Shannon, 2005; Kleinheksel et al., 2020). The latent approach to qualitative thematic analysis was preferred in the purpose of reaching and understanding the richness of valuations represented in interdisciplinary negotiations. We thus follow the advice of Dussauge, Helgesson, and Lee (2015), who argue that "a valuographic research programme as envisioned here has to symmetrically examine whatever is included as well as excluded as pertinent values in a given process (cf. Galis & Lee 2014)". Furthermore, as research participants were not explicitly asked to reflect on values and valuations per se, a reading of latent content was deemed appropriate. However, some parts of the analysis were also able to touch upon manifest content, as participants occasionally brought valuations to explicit and overt attention.

The analysis was conducted by two researchers. The analysis was an iterative, data-driven process where researchers first identified condensed units of meaning with valuations behind them and labelled them with codes in the data. The codes were then sorted into categories which provided structure to the data. The categories of codes were used to identify four core thematic registers of value, which were most significant in the data. A total of 212 instances of the thematic registers of valuing were identified in the analysis of the three workshops. In naming and identifying the registers, we followed the example of Heuts and Mol (2013) in their study of the valuations made of good tomatoes. Our four-part categorisation is not definitive or all encompassing, and more registers could have been finetuned and singled out. However, we believe the four identified registers reach a point of satisfactory saturation of the data and represent the most consequential dimensions of valuation struggles engrained in our interdisciplinary research case.

Valuation discourses were most pronounced in Workshop 2 (89 coded thematic instances), but present also in Workshops 1 (77) and 3 (46). An explanation for this variance arises from the design of each workshop. While the agenda of Workshop 2 was most explicitly designed to facilitate valuation discourses, Workshop 1 provided the least structured environment for research problem

ideation, and the agenda of Workshop 3 shifted more focus onto the practicalities of the research process. In this article, we will not go into detail of the chronological developments and differences in valuations between the three workshops and suffice in concluding that discussions of underlying values kept resurfacing throughout the entire research process in our ethnographic data.

Registers of valuing

In the analysis, we identified four core registers of valuation in the negotiation of research ideas: *money, sustainability, scientific value,* and *academic identity*. The four identified registers were revisited and reformulated consistently in discussion throughout the three workshops and were also prevalent in project management meetings, as noted by the researchers in ethnographic memos. In line with Heuts and Mol (2013), we quickly noticed several overlaps and tensions between the registers, and a single register was rarely employed by itself. Similarly to the findings by Schrøder et al. (2021) of work in child protection, our results from interdisciplinary research work also show conscious efforts of balancing and reconciling the different registers with one another to qualify research as 'good' in at least one, but preferably several or all of the registers in the scope of the research project.

In the following, we first present a brief depiction of each identified register of valuation. However, the focus of our analysis is on the relations between the registers. For the scope of this paper, we have chosen to concentrate our analysis on the relations and tensions between the register and on balancing actions taken to reconcile the registers with one another. These tensions and balancing actions are inspected after the introduction of the registers.

The researchers in the following excerpts are referred to as R1, R2, and so on, with numbering beginning anew for each individual excerpt. R1 in the first excerpt is thus not the same member of the research team as R1 in following excerpts. This type of referencing was used to ensure the anonymity of the researchers.

Introducing the four registers

The first register of valuation we identified in vertical farming research relates to *money*. This register was most employed in concerns over research funding: "we should focus this next year or two in the container on things we can get more research projects and commercial projects with [--], we'll see afterwards if we don't have funding, then it's limited what we can do". As exemplified in this quote, researcher discussions often featured arguments for research strategies which would ensure the continuity of future research by obtaining funding from governmental institutions, research funds, or businesses. This manifested in the great effort researchers dedicated to writing up new project proposals. Additionally, due to long-standing traditions of tight-knit business collaboration in the UAS, business-funded research and the monetised usefulness of research for businesses were also often discussed and valued by researchers. Importantly, this business outlook did not always translate into arguments for financial benefit to the UAS itself, but rather the financial 'goodness' of the research for businesses was also seen as an end in itself. One researcher proclaimed: "the primary goal now is to develop applications for the cosmetics because we have collaborator companies in that field". The monetary register seemed to hold rather similar meanings to the individual researchers, and variation was apparent mostly in the persuasiveness or level of significance given by the researchers to financial security. However, almost all researchers appealed to this register in some way, either to promote economically sound research plans and business collaborations or by presenting other valuations as an alternative to the dominant framing of 'money talks'.

A second register relates to *sustainability* issues. Considerations of environmental and social sustainability were a key component of discussions around the research agenda of the vertical farming project. Sustainability valuations were present in many rough ideas offered for the project by researchers, such as "ecological food production" or, still more ambiguously and ambitiously, "saving Africa [from food crises and hunger]". In employing the register of *sustainability*, researchers constructed valuations of their research venture as a mission for societal problem solving. Practical actions for valorising the research as a sustainability-minded project involved seeking out partnerships with NGOs working to alleviate hunger or climate issues. The register of *sustainability* is in a way external to the core research process as performed by the researchers and reassembles the very meaning of the research to extend further in time into the research implications and implementation. The valuations researchers discursively created of sustainability were strongly problem-focused and result-oriented.

The third register we formulated has to do with *scientific value*. The UAS in our case study is caught between several differing ideas and evolving traditions of doing research. As a UAS, the focus of research is on application and problem-orientation, but both outside funding as well as the institution's own research strategy point a direction more towards use-inspired basic research and more peer-reviewed publications. The pressure towards higher scientific quality particularly in terms of publication metrics is recognised by the workshop participants: "I also see [the container] as a pretty good strategic tool. Because you know how big the goals are for publications for example, so it's an excellent research environment". Scientific value is also discussed as something the researchers value highly in terms of inner motivation as career researchers and scientists. However, the strong valuation of high scientific quality is sometimes also manifest as an outside demand the researchers

recognise but struggle to completely fulfil. In practice, scientific value was sought in the project through allocating more time from teaching to writing publications and in the employment of new researchers with strong academic backgrounds.

Our fourth and final register is *academic identity*. By the register of *academic identity*, we mean the individual academic interests, career aspirations, profile, and disciplinary background of the researchers. In academia, a great deal of weight is given to academic identity and academic autonomy (Henkel, 2005). The researchers in our study also recognised a value in steering the research project to fit with their respective research interests, disciplinary histories, and career profiles:

> R1: Probably because of my background, I'm interested in chemical composition. But that, in a way that's not so far from what R2 said, if we're talking about food production [--], of course I'm also interested in the environmental issues in it, but I'm also interested in how with food plants we can also use the growth environment to affect chemical composition.

Similarly, another researcher with an engineering background makes the research valuable with respect to fulfilling not only the researcher's own interests but also recognises as valuable the disciplinary differences in research interests between researchers from different backgrounds:

> My research interest is that yes, we are able to acknowledge certain drawbacks of the system but we have to find certain cost-benefit or not, cost-effective way to tackle this problem, so that [the life-science researchers] get to do what they want and we find cheap ways to do that in a sense.

As shown in the excerpt above, not only did researchers express their own research interests, but they also ascribed value to facilitating their colleagues in pursuing research tracks that align with their respective academic identities and discipline-specific interests. In this way, the researchers made valuations of good research in how the project fits in the research profile of the researchers involved, regardless of what these interests may be. This facilitation perspective was also strongly present in the additional interview material.

Tensions and balancing actions

In the following, we present manifestations of tension and balancing actions taken by the researchers to reconcile the goodness of the research project in multiple different registers of valuation. A single register was rarely discussed by itself for very long, as workshop participants went back and forth between the registers in discussion with each other and often referred to two or even three of the registers in single comment. Particularly the register of *money* was often in tension with the other registers. However, even as researchers continuously reflected on the contrasts and incompatibilities between registers, they simultaneously also attempted to bring the registers together and often sought formulations which allowed the registers to complement each other.

Valuations of research in registers of *sustainability*, *scientific value*, and *academic identity* were often approached by the researchers through a denunciation of the predominance of *money*. Researchers reminded themselves that research does not need to subscribe to capitalist logic: "but it isn't important for research to be… [--] …or it doesn't need to be economically profitable". The importance of the register of *money* was thus continuously reproduced through negation, which echoes the analysis of monetary valuations of good tomatoes by Heuts and Mol (2013).

Sustainability valuations often surfaced in contrast to the goal of creating commercial value or engaging in research cooperation with companies. At several times, researchers emphasised the separateness of the two: "There are such different levels to this, whether we're creating a benefit to the company in that it gets a little more production potential for its salads, or if it's a benefit to the world". An analytical division was thus made of the *monetary* and *sustainability* registers of goodness onto different "levels" of research. The levels in the above excerpt are not only practical (in whether the container is used to grow salad or to develop new climate-secure protein sources), but also used as a cognitive tool to make sense of the valuative possibilities faced by the researchers.

On the other hand, the researchers occasionally also tried to fuse the two valuative registers of *money* and *sustainability* together, as one researcher envisioned: "I thought we might save the Finnish agriculture and forestry sector amid climate change". In a more practical example:

> R1: So yes, more ecological food production and, or you can do other things too, but in that direction…
>
> R2: That's a good point. And actually, from what I've talked with companies, commercial vertical farms have been able to reduce water consumption by a great, great deal.

The excerpt above ascribes environmental concern to commercial partners, suggesting a possibility of combining research problems with a focus on environmental sustainability with commercial research projects. Notably, the excerpt is from Workshop 3, at which stage some initial research has been conducted in close cooperation with commercial partners, while long-term research foci are under concurrent negotiation. In light of the de-facto commercial orientation realised in the project, valuations of good research in the register of *sustainability* are increasingly made through the lens of *money*.

Commercial valuations were made in the workshops also in contrast to the register of *scientific value*. As revealed by workshop discussions and supplementary interview material, commercial

research commissions and tight-nit collaboration with local businesses form a major backbone of the research tradition and financial foundation in the UAS under study (see Vetoshkina et al., 2022 for further analysis). At the same time, the UAS has ambitious goals for developing its research profile and its strategic goals emphasise a shift towards use-inspired basic research (Stokes, 1997). Several statements by researchers address this tension and how valuations of *scientific value* and *money* could be both maintained side-by-side in the vertical farming project:

> It would be good to analyse and differentiate between [different research approaches] since they work in somewhat different ways in different time frames, in where the goal is some kind of business and where it's scientific value. So to identify them, so they can go forward, not everything meshed together, because they don't all work in symbiosis.

Similar to the findings of Schroder et al. (2021) in child protective services, the researchers in our case study also compartmentalise and distinguish between different registers of goodness by appealing to different time scales. In the excerpt above, the registers of *money* and *scientific value* are temporally separated – the researchers broaden their possibilities by entertaining the idea of different research strategies implemented at different times in the container. As the researchers often discuss in our material, time is a valuable commodity in the container farm. With only one container in which the growth environment is primarily the same all over, only one type of research venture can generally be pursued at a given time. Thus, while the researcher recognises the disparity between enacting the registers of *money* and *scientific value*, they are both preserved as temporally separate undertakings to be kept apart both analytically as well as practically through a compartmentalised separation in time.

As discussed earlier, valuations of *money* were constructed and enacted from at least two perspectives. Firstly, responding to commercial needs and working in close collaboration with companies was seen as meritorious in the historical tradition of applied research. Secondly, commercial projects were embraced, since research organisations need funding to conduct research, and money talks. All the while, researchers kept circling back to the need for doing something "truly scientific" (*scientific value*), keeping the personal and discipline-specific scientific interests of the researchers in discussion (*academic identity*) and creating opportunities to combine them with commercial collaboration. Furthermore, the researchers also recognised the strategic need of the UAS to strengthen its profile as a high-quality research institution. The inherent scientific value of non-commercial research was both contrasted with commercial research and constantly reformulated and adjusted to fit within the valuative framework of *money* in potential commercial projects.

Compared to the monetary register, the researchers were more varied in how often and how strongly the register of *sustainability* featured in research valuations. While all of the researchers seemed to quietly acknowledge a societal relevance in valuating research through the register of sustainability, one researcher in particular kept returning to sustainability problems, while another researcher openly recognised a lesser academic interest in climate change research:

> R1: If you're interested in climate change then the container would be really good, as you have dark, water is controlled, and then you just add CO_2.
>
> R2: But this maybe, if I think for my terms, if we get a research project then sure, but I don't really think about these as primary for my own research interest. It's interesting and OK if it comes with something but, it's not the thing I would primarily like to do.
>
> R1: [Jokingly] So you're not on the frontlines.
>
> R2: I'm not [laughs].

In this exchange, the register of *sustainability* collides with the register of *academic identity*. While for R1 research interests and sustainability valuations combine and complement each other, the other researcher R2 in the exchange keeps the two registers separate. For R2, the research project can be made good in either of the two registers, but for research to be good in both the register of *sustainability* and *academic identity* at the same time, the research venture must be divided into separate tracts to instantiate the two different registers in relative detachment.

Furthermore, the register of *academic identity* is sometimes used to compartmentalise conflicting registers of valuing into different disciplines. As the researchers discussed sustainability valuations, a researcher with a background in microbiology (R1) further personified sustainability concerns ("everything that's around it") into the research profile of another researcher (R2), whose disciplinary background combines environmental and human aspects of landscape architecture:

> R1: And these levels come up in that, as researchers, R2 and I work on different levels here and [laughs], as we've discussed with R3, R3 and I work in quite small compartments. And then R2 discusses everything that's around it. And then we're already completely lost in what it is that R2 wants, like, let us stay in our little box [laughing].

The half-jocular suggestion of "let us stay in our little box" is also a proposal for researcher and discipline-specific specialisation.

Despite some apparent conflicts and incompatibilities between the registers, the discussions attempted to maintain and appeal to each of the registers, with explicit shows of preference of one register over another extremely rare. However, in an unusual instance of directness, one workshop participant took up the

question of hierarchy in valuations during a brainstorming session in Workshop 1:

> R1: We brief [the research ideas] and then try to put them in some kind of order.
>
> R2: Order with respect to what? Money, time, saving the world, what perspective?
>
> R1: Or topic [--]. If it's a product, process, something else.

The excerpt above shows a researcher (R2) attempting to bring different registers of valuing 'good' research into direct deliberation and up for prioritisation. In this excerpt, R1 is acting as a project leader and refuses a preferential ordering of valuation in the exchange, moving from prioritisation to topic-based categorisation. The question by R1 is brushed off to accommodate the plurality of different valuations. By refusing preferential ordering, R2 maintains the possibility of conducting research that is 'good' in several registers of valuing, giving room for several alternative or even co-existing different types of research plans.

Discussion and Conclusions

This article set out to identify and analyse valuations of 'good' research in the negotiation of shared interdisciplinary research directions. The first question we asked was: what kinds of registers are present in valuations of interdisciplinary research? As an answer to this question, we found researchers to all actively evoke *money, sustainability, scientific value,* and *academic identity* as relevant registers of valuing their shared research venture. These registers reflect "a shared relevance" (Heuts & Mol, 2013, p. 129) given by the researchers to each of the four lenses through which the research project was qualified as valuable and practically made 'good'. These registers largely comply with prevailing quantifiable, statistical, and economic regimes of academic evaluation (Alberts et al., 2014; Fochler et al., 2016, Larivière & Sugimoto, 2019), yet also show appreciation for RRI principles through the register of *sustainability*. A possible explanation for the relevance given to sustainability may be linked to the interdisciplinary nature of the vertical farming project and the ambition of the UAS to gain more public funding, which both give value to societal problem solving.

The second question we asked was more nuanced. In addition to identifying registers of valuing good interdisciplinary research, we also wanted to find out how valuations interact and influence the interdisciplinary research problem formulation process. As shown in our results, the researchers dedicated distinct effort towards maintaining the separateness of different registers of valuing. The researchers categorised and compartmentalised different kinds of research strategies and corresponding registers of valuing on different "levels". This compartmentalisation occurred both temporally (different research strategies in different time frames) and conceptually (by creating analytical understandings of how different registers of 'goodness' are different or can co-exist). Particularly the temporal separation of different valuations of goodness was able to assist the research team in moving forward with research problem formulation, as it allowed focusing efforts on the registers of *academic identity* or *money* in the short term, without abandoning *scientific value* or *sustainability*.

The practical, temporal compartmentalisation of the registers thus corresponds with the notion of sequencing to accommodate differing registers of 'good' by Schrøder et al. (2021). However, contrary to Schrøder and colleagues, we also found our researchers to give much weight to the conceptual and psychological dissection of the registers. This analytical tendency likely derives from the nature of work in academia and interdisciplinary projects, where a reflective, vocal approach to the foundational questions of what is researched is particularly important (Miller et al., 2008; Leigh & Brown, 2021). Based on our findings, sequencing can also include explicit psychological and conceptual categorisations as a basis for the practical separation of different registers of valuing.

Many valuations in our material were not unique to specifically interdisciplinary research, but could be understood as valuations of good research in general, only this time manifesting in an interdisciplinary setting. The interdisciplinarity of the research project became most apparent in how researchers conveyed their own research interests and related them to the 'goodness' of the research. Through such utterances of disciplinary positioning (Hah, 2020), the register of *academic identity* occasionally served as a tool for fostering specialisations. Again, even while *academic identity* may function as an important register of valuing research in monodisciplinary settings as well, as a core register of valuing it is particularly notable in interdisciplinary research. Our material contains cases where engineering spoke most distinctly to the register of *money*, microbiology to *scientific value*, and landscape architecture to *sustainability*, which gives a simple division between disciplines, apt for the practical sequencing of registers. However, this divide was not a fixed one, and roles varied, fluctuated, and expanded continuously during the discussions. Furthermore, as the research team was small, it is difficult to separate interpersonal differences between the researchers from more institutionalised interdisciplinary differences.

The workshop discussions we have analysed provided a time and place for valuation discourses between the research team. These discourses would most likely not have been possible in normal project meetings and daily research work to the extent they took in the workshops. The workshops helped the researchers conceptualise their separate disciplinary and interpersonal

differences in how they approach making the vertical farming research 'good'. Especially the explicit focus placed on research strategy and associated values in Workshop 2 produced diverse and rich discourse of valuations.

An important practical implication of our study translates into an endorsement for facilitated workshops for interdisciplinary research teams. Facilitated interdisciplinary workshops have previously been recommended for the purpose of building collective communication competence (Thompson, 2009) and our case study adds to this recommendation. Through facilitated workshops, valuation discourses can be actively invited, giving room for conceptual clarification to work as a basis for the practical sequencing of different registers of valuation. Furthermore, workshops can be used for both *evaluating* and *valorising*. The workshops in the vertical farming project functioned as a data source for the ***evaluative*** purposes of this case study in addition to serving as a practical platform for ***valorising*** the research project to work more smoothly. We thus remind future planners of interdisciplinary research that facilitated research team workshops may be used as data sources for research in human sciences, creating further incentives for allocating time and funding to such workshop processes. Research based insights into interdisciplinary research processes, team building, knowledge creation, and valuation discourses could all be gained from the organisation of facilitated researcher workshops.

In our case study, no explicit prioritisations were made between the different registers of valuing 'good' research. "Money, time, or saving the world" rather became money *and* saving the world, preferably with scientific value and academic identity too. However, in reality resources are limited, so some prioritisations are inevitable. In our case study, a slight shift in both discussions and the practical actions of research could be identified towards the registers of *money* and *scientific value*, even as *sustainability* and *academic identity* were by no means wholly abandoned. In the vertical farming project, interdisciplinary negotiation of shared research directions was a continuous process, with no clear end point or definitive conclusion. In this perpetual negotiation, a great deal of developmental potential lies in bringing forth the latent and implicit valuations held within different disciplines and by individual researchers. This is especially true in a context where research strategy on an organisational or societal level is actively being shifted towards Responsible Research and Innovation. If the future of research is expected to increasingly lean towards *saving the world*, research teams need to be aware of the multiplicity of valuations they hold for 'good' research.

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