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How to Repurpose the University: A Resilience Lens on Sustainability Governance

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Universities have an important role in moving society towards a more sustainable future. However, this will require us to repurpose universities, reorienting and refocusing the different university domains (education, research, campus, and outreach) towards sustainability. The governance structures and processes used to embed sustainability into the activities and operations of the institution are critical to achieving the required transformation. Our current university systems which are seen as contributing to socio-ecological system *un*sustainability are resilient to change due to slow variables such as organisational and sector-wide prevailing paradigms and culture. Therefore, to repurpose a university requires us to destabilise our prevailing system, crossing a threshold into a new stable system of a 'sustainable university' across all its domains. This paper utilises an adaptation of Biggs et al. (2012) resilience principles for the governance of social-ecological systems to provide a framework to consider aspects of university governance for sustainability that can be utilised to repurpose universities towards sustainability, and destabilize unsustainable elements of the system. This paper draws out examples relating to sustainability governance within universities with regards to the four principles of (i) managing diversity and redundancy, (ii) managing connectivity, (iii) managing slow variables and feedbacks, and (iv) encouraging learning and experimentation within the context of complex adaptive systems. In this article, we have shown that using resilience in a non-normative way is possible (to decrease resilience of an unsustainable system), and that it can also be valuable to help understand how to shift organisational governance towards a particular end-state (in this case, university governance that advances sustainability). This paper provides an example of how to operationalise resilience principles of relevance to the resilience literature as well as providing a practical framework to guide higher education institution governance for sustainability.

Keywords: social-ecological resilience, resilience principles, higher education, education for sustainable development, sustainability governance, universities

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INTRODUCTION

Higher Education Contributions to Sustainability

Universities have an important role in moving society towards sustainability. Universities educate our world leaders (Jones et al., 2010), yet the lack of significant improvement in many of the world's sustainability challenges serves to feed the critique that our current higher education systems simply perpetuate "unsustainability" through, amongst others, uncritically reproducing the norms or our

unsustainable present (Orr, 2001; Sterling, 2001). Despite the myriad international and national initiatives which have served to increase the momentum of Education for Sustainable Development (ESD) in universities (see Michelsen, 2016 for a review) there remains debate about the need for reorientation and transformation of the current system (e.g., Sterling, 2001, 2013; Jucker, 2014) vs. advances which can occur within, and be steered and "nudged" by our current neoliberal and marketised university system (Bessant et al., 2015), and the extent to which the rhetoric of the role of universities in contributing to a more sustainable future is being met by action (Jones et al., 2010).

Universities are complex organisations (Sterling, 2013; Thomas, 2016) with equally complex forces shaping the higher education environment, including globalisation, commercialisation and corporatisation (Bessant et al., 2015). University activity can be split into four different "domains" of activity—the campus, research, education and outreach. Each of these domains has the potential to contribute to sustainability (Bessant et al., 2015; Niedlich et al., 2020a) in different and also interlinked ways. The "campus" domain has historically seen the most focus and progress through improvements in environmental management (Sterling and Scott, 2008), with more latterly, focus on the role of the domains of education, research and outreach in driving sustainability within and from universities (Fadeeva and Mochizuki, 2010; Barth and Rieckmann, 2016).

Important also to the complexity of the university are the missions of the university. Teaching and research are considered the first and second missions, respectively. The "third mission" is articulated in different ways, including public service (e.g., Scott, 2006), as a contribution to society (Compagnucci and Spigarelli, 2020), or entrepreneurial/economic mission based, around developing economic performance (Etzkowitz et al., 2000; Trencher et al., 2014), linked with the changing direction of university strategy towards increased income generation, commercial enterprise and business engagement (Jary, 2005; Bessant et al., 2015). The use of mission and purpose is often used interchangeably (i.e., in the mission statement of the university), and there may be a difference between the espoused purpose of a mission (research to drive societal transformation) and the practical purpose (to increase university ranking). This paper conceptualises the use of domains, missions and purposes of a university in an overlapping but separate manner. For example, a university may have a research domain covering the research activity of the university, which enacts the mission to carry out research for the purpose of, for example, driving societal transformation. All four domains of activity may intersect and contribute to both the different missions and the espoused purpose of the university. For example, research informs teaching, educational research is carried out, the campus provides a hidden curriculum for learning (Winter and Cotton, 2012; Cotton et al., 2013), and the campus can act as a living lab for research into sustainable solutions (Evans et al., 2015; Robinson et al., 2021).

Universities can be seen also as socio-ecological and complex adaptive systems with interdependencies between people (social systems) and nature (ecological systems) (Colding and Barthel, 2019), as well as subsystems that interact at different levels (Anderies et al., 2004). Therefore, universities are made up of social systems such as bureaucratic and governing structures and social-cultural norms and rules, as well as their physical space including multi-purpose buildings and green space. All of these have direct and indirect environmental (or ecological) and social impacts of their activities. Thus, governance for sustainability within universities is both part of the system itself, as well as a means to direct change in other parts of the system.

The Relationship Between University Governance and Sustainability Governance in Universities

Transforming universities to fulfil their role in a more sustainable future requires effective systems of sustainability governance, whether from an uncritical reformist viewpoint focusing on how change can be driven through the existing system; the critical transformative tradition, with a focus on the need for full system reform; or a more pragmatic tradition which advocates for working within the system while seeking greater systemic reform (e.g., Bessant et al., 2015). Governance within an organisation comprises a complex web of interacting elements, including legislative frameworks, how money is allocated to and within the organisation, processes of decision making and policy and objective setting and monitoring as well as less formal structures and relationships which steer and influence behaviour (Organization for Economic Cooperation and Development, 2003 p. 68; Oxford, 2006; Trakman, 2008).

University governance for sustainability (used herein interchangeably with "sustainability governance") is the governance of matters pertaining to social and ecological dimensions of sustainability across all domains of the university. It includes governance of matters related directly to the university itself and its activities outside of the campus boundaries, as well the influence of wider systems of governance (e.g., national regulation of higher education), as university sustainability governance does not take place in a vacuum removed from other layers of explicit governance and implicit influence.

Sustainability governance sits within the broader framework and processes of university governance. However, in this paper we take the position that sustainability must be at the core of all elements of a university's operations and activities because (nearly) all governed activities at a university have sustainability implications, whether directly or indirectly. As such, wider university governance and sustainability governance within universities must be treated as inseparable when considering structures and processes of sustainability governance in universities. Even if the matter being governed is not directly related to sustainability (that is, it is not governance *of* sustainability), the governance process still ought to be sustainable (governance *as* sustainability) and contribute to sustainability (governance *for* sustainability).

Governance for Sustainability in Universities

With a growing interest in the role of higher education in contributing to a more sustainable future there is a concurrent interest in sustainability governance in universities (e.g., Bauer et al., 2018; Leal Filho et al., 2020; Niedlich et al., 2020a,b) and in understanding the challenges, processes, and barriers to amplifying the sustainability contributions of Higher Education Institutions (HEIs) (e.g., Hoover and Harder, 2015). Governance structures form a basis for institutional action, management decisions, and regulations made within organisations and can affect the way in which sustainability is perceived and practiced in higher education (Leal Filho et al., 2020). Sustainability governance encompasses many different elements, from formal organisational staffing and reporting structures, to sustainability assessment tools, resourcing, training, communication and participation structures as well as external structures including funding sources.

In addition to these elements of sustainability governance, there are many different important *attributes* of sustainability governance in universities, including reliability and accountability, and adequate resourcing, long-term planning, staff support and the commitment of senior management (Vaughter et al., 2016; Leal Filho et al., 2020). Other important attributes of sustainability governance include participation and dialogue, the inclusion of diverse stakeholders, and co-creative processes (see Niedlich et al., 2020b). The role of committed and motivated individuals, often referred to as "sustainability champions," is also highlighted by many writers as being an evident part of university change processes towards sustainability (e.g., Lozano, 2006; Newman, 2007). Despite the plethora of emerging literature on mechanisms and attributes to drive sustainability (Leal Filho et al., 2020), there is a relative lack of literature exploring the overarching structures for sustainability governance in universities (Hoover and Harder, 2015), the impact of organisational culture on sustainability governance (Niedlich et al., 2020b), the link to organisational learning and change theory (Cebrián et al., 2013; Sylvestre and Wright, 2016), and the extent to which the resilience of sustainability governance can be leveraged for universities' transformations towards sustainability.

Resilience and Sustainability

Normative and Non-normative Concepts of Resilience in Social-Ecological Systems

The concept of resilience has been influential in the field of sustainability. Many permutations of the term exist, such as social resilience, community resilience, organisational resilience, and urban resilience. Further complicating the landscape is the colloquial similarity between sustainability and resilience which can cause the terms to become conflated. In this article, we use social-ecological resilience, "the capacity of a system to absorb disturbance and reorganise while undergoing change so as to still retain essentially the same function, structure and feedbacks and therefore identity, that is, the capacity to change in order to maintain the same identity" (Folke, 2016, p. 8). In other words, it has to do with how a social-ecological system copes in the face of stressors.

What is especially valuable in the social-ecological tradition of resilience is that it can be used in a non-normative way. In organisational governance, resilience is usually assumed to be a desirable state. This is because, if the organisation is resilient, it will better cope with stressors and therefore will continue to exist (**Figure 1A**). However, taking a non-normative approach to resilience the question may be how can the resilience of an organisation be destabilised in order to repurpose the organisation towards sustainability. Resilience can also be used as a neutral descriptor, to help us to understand how a system can be resilient in an undesirable condition. This also helps to clarify the difference between resilience and sustainability, since their aims can actually be at odds with one another (Elmqvist, 2017). Instead of focusing on reducing the impact of the stressors on the organisation as is typically the goal in organisational resilience, we might want to *increase* the impact of stressors on the university to destabilise unsustainable elements, while also enhancing the resilience of the more sustainable elements (**Figure 1B**).

Resilience of What to What?

When operationalising the concept of resilience it is important to state *what* we want to be resilient and *to what* do we want it to be resilient (Carpenter et al., 2001). In this paper, we have two foci for which we need to specify the resilience of "what to what": we want to retain the sustainable elements within the university by making them more resilient, and we want to destabilise unsustainable elements by making them less resilient. This leads to the question, what is a sustainable university? Although (or perhaps, because) many scholars have attempted, theoretically and empirically, to pin down definitions, models, and frameworks to explain what a sustainable university is (e.g., Velazquez et al., 2006; Lukman and Glavič, 2007; Sterling, 2013; Hussain et al., 2019), contestation persists.

Given the lack of consensus, we, like Sterling (2013) do not define sustainability in a prescriptive or operational sense. We see the sustainable university as "one that through its guiding ethos, outlook and aspirations, governance, research, curriculum, community links, campus management, monitoring and modus operandi seeks explicitly to explore, develop, contribute to, embody and manifest—critically and reflexively—the kinds of values, concepts and ideas, challenges and approaches that are emerging from the growing global sustainability discourse" (Sterling, 2013, p. 23). We want to enhance the resilience of parts of the university that embody these activities, through research, education, outreach, and the physical campus itself. The inverse, a university (or elements within the university) which does not seek to carry out these activities (or perhaps, even stands against these activities), is what we want to destabilise through undermining its resilience.

Sustainable elements of the university need to be resilient to stressors like the changing socio-economic (e.g., demographic changes, internationalisation, funding mechanisms), political (e.g., policy, environmental campaigns), and technological (e.g., digitalisation) factors that can pressure universities to adapt or

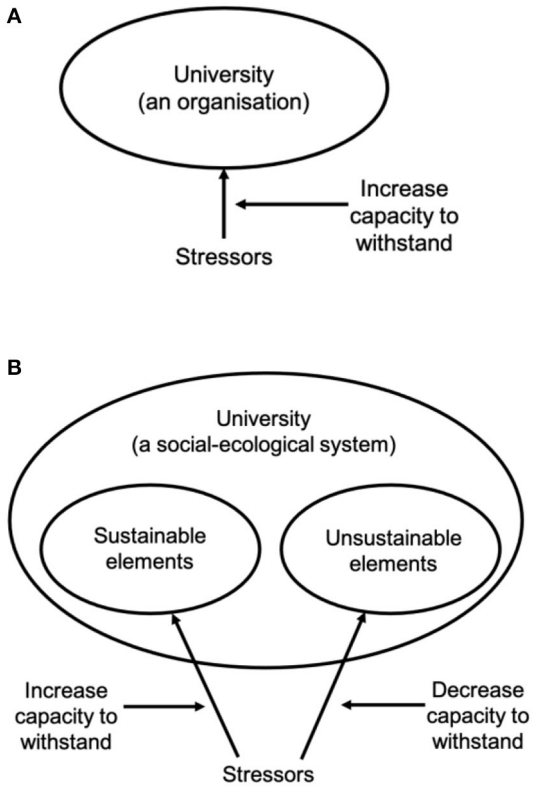

FIGURE 1 | (A) How resilience is typically conceptualised for an organisational context. Resilience is considered to be a desirable state and therefore the focus is on increasing the organisations' capacity to withstand stressors. **(B)** How resilience is conceptualised in this paper. Resilience is considered to be a non-normative construct and therefore its desirability is dependent on the subject in question. In this study, we take the stance that there should be an increased capacity of the sustainable elements within the university to withstand stressors, and a decreased capacity of unsustainable elements to withstand stressors.

transform (Pinheiro and Young, 2017). Conversely, we suggest that the resilience of unsustainable elements of the university need to be eroded such that they can be destabilised and potentially exchanged for more sustainable replacements.

Operationalising Resilience Through Resilience Principles

One of the main criticisms of the concept of social-ecological resilience is that, while it might be useful as a descriptive concept, it falls short of being operational. For over a decade, scholars have been working to operationalise the concept (Chapin et al., 2009; Cilliers et al., 2013). A recent evolution is the development of principles for enhancing the resilience of ecosystem services (Biggs et al., 2012, 2015). Biggs et al. (2012, 2015) propose seven generic, policy-relevant principles for enhancing resilience in the face of disturbance and ongoing change in social-ecological systems in the context of ecosystem services and natural resource management. The principles are split into two components: system properties to be managed (diversity and redundancy; connectivity; slow variables and feedback) and attributes of the governance system (complex systems thinking; learning; participation; polycentricity). However, when the governance system is also a component of the social-ecological system under investigation (in this case, a university), there is blurring of the *governors* and the *governed*. This can result in analyses that duplicate themselves across the principles. Therefore, Laycock Pedersen (2019) has proposed a reformulation of Biggs et al.'s (2012, 2015) principles for contexts where the subject(s) to be sustained are not ecosystem services, but rather social-ecological system(s) in which the social systems or constructs are at the fore. These principles are to:

1. Manage diversity and redundancy
   . . . with respect to variety, balance, and disparity. . .
   a. . . . including in participation in governance
   b. . . . including through polycentric governance
2. Manage connectivity
   . . . with respect to presence/absence, distribution, intensity, strength, modularity, and nestedness of connections. . .
   a. . . . including in participation in governance
   b. . . . including through polycentric governance
3. Manage slow variables and feedbacks
4. Encourage learning and experimentation
   . . . with respect to the system and its governance, complex adaptive systems, and unknown unknowns

These principles still overlap in some places, and taking steps towards one can help fulfill or undermine another. This will be reflected in the subsequent analysis of the use of these principles in the context of university sustainability governance. These principles will be explained in greater detail in turn in the section Applying Resilience Principles to Sustainability in Universities.

Previous attempts to work with these resilience principles have demonstrated that their application can become highly complex (Clarvis et al., 2015; Laycock Pedersen, 2019), due in large part to the large number of potentially relevant variables in any given context (Laycock Pedersen, 2019). Other scholars using the resilience principles have narrowed their analysis by focusing on only two or three of the principles (e.g., Kummu et al., 2020; Röös et al., 2021), which means important connectivity between variables can be missed.

AIMS

Through this conceptual paper (Jaakkola, 2020), we aim to show how a non-normative resilience lens can help understand how to adapt a university's governance so the institution can be repurposed towards sustainability. We explore the current state of (un)sustainability in universities through an adapted version of Biggs et al.'s (2012, 2015) principles for building resilience (Laycock Pedersen, 2019), identifying different examples of how these principles can help us to adapt governance of sustainability within the university.

We draw on our own experiences at universities in the UK and Sweden, and academic literature in order to explore the intersection between resilience theory and governance structures for sustainability in universities. This paper will consider each of the four resilience principles in turn. We explore how each principle could be applied to sustainability governance, and through this lens, identify how different attributes contribute to the resilience of current unsustainable systems, and/or can contribute to the vulnerability or resilience of already existing sustainability work. Through this analysis, we will identify how we might be able to adapt university sustainability governance to destabilise unsustainable systems, and create space for, enhance, and reinforce sustainability work and a sustainable purpose.

APPLYING RESILIENCE PRINCIPLES TO SUSTAINABILITY IN UNIVERSITIES

In the following section, we consider each of the four aforementioned resilience principles in the context of the sustainability and sustainability governance of universities, to identify how to enhance sustainability governance in higher education to repurpose universities towards sustainability. For each principle, we will first describe it in greater detail, and then consider a number of relevant variables and examples.

Principle 1: Manage Diversity and Redundancy

According to Biggs et al. (2012, 2015), there are three components which comprise diversity: variety (the number of different elements); balance (how many of each element); and disparity (how different are the elements from each other). Redundancy refers to the replication of elements. High levels of diversity and redundancy are important for resilience because they provide multiple response options when under stress. This is because, although limiting diversity can increase efficiency, too little diversity can result in too few response options in the face of stressors. However, too much diversity and redundancy can increase complexity, thereby "reducing the nimbleness of the system to adapt to change" (Biggs et al., 2012, p. 426). In some cases, too much diversity can also increase insularity (such as in social groups) and thereby reduce connectivity (Pemberton, 2017).

When managing diversity and redundancy, it is important to consider participation in governance and the extent to which governance is polycentric. Participation in governance should be broadened to include diversity and redundancy of actors, while paying attention to and mitigating power differentials. Polycentricity refers to a governance system in which multiple governing bodies interact within a specific area (Biggs et al., 2015). In polycentric governance systems, the level at which issue-areas are governed should reflect the size and scope of the issue (Schoon et al., 2015). By using this approach, efforts can be coordinated at a higher level, while devolved governance can allow for autonomy and integration of knowledge and practices at a local level. Polycentric governance systems involve a diversity of actors in matters that directly pertain to and affect them, increasing the number of perspectives able to offer solutions, as well as building in redundancy in the case of non-participation. The redundancies built into the modular nature of polycentric governance also means that experimentation and learning (principle 4) can be undertaken more safely. That is, experimentation that fails in one module of the system will have a lesser impact on the wider governance system, allowing governance in other modules and at other scales to continue to function.

Table 1 outlines a series of questions to enable the analysis of the role of the three different types of diversity identified by Biggs et al. (2012, 2015) and redundancy across a number of selected areas relevant to university governance for sustainability. The relevance of these different areas to sustainability governance is then explored further below.

Diversity in the Types and Topics of Sustainability Work

Covering a diversity of and balance between types and topics of sustainability work is necessary to deliver sustainability holistically. The different types of activities sustainability should be embedded in span across each of the university's domains of activity. It is also important that a diversity of sustainability topics are addressed, spanning and integrating social and environmental areas, encompassing issues as diverse as food, water, energy, health, inclusion, and social justice.

Historically, sustainability work in universities has often been relegated to operational management of the estate, with an emphasis on environmental sustainability through, for example, energy efficiency and recycling. This unbalanced approach to sustainability has meant that many actors have not "seen" a place for themselves within the sustainability agenda. Conversely, a diverse sustainability agenda provides a diverse set of entry points (Jones et al., 2010) to help capture buy-in from a broad range of actors doing different types of work covering different topics. This can be encouraged through ensuring a wide range of topics in sustainability reporting activity and a wide range of areas represented in a university-level sustainability "steering group," covering representatives leading in different areas of activity such as (amongst others), catering, procurement, events and conferencing, human resources, partnerships, research and education, alongside more traditional energy and environmental management representatives. Ultimately, this diversity can ground the agenda more deeply within the university.

Diversity in Participation in Sustainability Work and Governance

Participation from a wide diversity of stakeholders in sustainability work and governance is important. This includes diversity of staff (administration, teaching, research, operational, different disciplines, etc.) and students (e.g., degree types, levels, disciplines). It also means considering the identities of participants in question, such as gender, race, age, class, ability, sexuality, religion, and so on. Diversity of participation needs careful management to ensure that participation results in cooperation and learning rather than polarisation. For example, unspoken assumptions rooted in epistemological differences

TABLE 1 | Examples of elements of university governance for sustainability in relation to Biggs et al.'s (2012, 2015) three types of diversity and redundancy.

	Diversity			Redundancy
	Variety	**Balance**	**Disparity**	
Types and topics of sustainability work	Are there a variety of sustainability initiatives taking place (e.g., educational, infrastructural, research, student life, etc.)? Do they address different sustainability issues (e.g., social and environmental; food, water, energy, health, etc.)?	Is there a balance between the different types of sustainability initiatives taking place and the topics of the sustainability issues that they address?	How different are the types and topics of sustainability work? Are both social and environmental sustainability topics included? Is there work that falls into each of the core domains of university activity?	Is there overlap between different activities? Are there several activities tackling the same sustainability problem (but from different angles)?
Participation in sustainability work & governance	Is there participation from diverse staff (admin, teaching, research, operational, different disciplines, etc.), and students (different levels, disciplines, mature, home vs. campus based)? Are there participants with different identities (gender, race, age, class, ability, sexuality, religion, etc.) involved? Is this variety present at different levels of governance? Is there a variety of ways stakeholders can participate in sustainability governance at different levels of decision making? Does this include modes that are passive and active, in-depth and time-efficient? Is there involvement of participants in a variety of different stages in decision making?	Is there appropriate balance between students and staff involvement? Admin, operational, and teaching/research staff? Is the representation of different identities in balance? Is there an appropriate and suitable balance between different modes of stakeholder involvement?	How different are the stakeholders in sustainability governance? How different are the roles of staff involved? How different are the disciplines they come from?	Is there redundancy in participation from the most transient and/or hard-to-reach groups to ensure uninterrupted participation from these groups?
Motivations driving sustainability work	Are there different motivators that drive sustainability work? (National policies, institutional policy and priorities, key individuals within the organisation, funding streams, research agendas, etc.)	Is there a balance between different drivers of sustainability work, or are there one or only a few that genuinely motivate sustainability work?	How different are the drivers of sustainability work? Are there both intrinsic (e.g., moral rationales) and extrinsic (e.g., funding) drivers?	Is there redundancy in drivers? (e.g., if one funding stream dries up, is there another that can buffer its loss?)
Scales of activity	Is sustainability work happening at different scales e.g., cross-university initiatives and within individual degree programmes?	Is there a balance in responsibility for sustainability work at the most appropriate levels for the issues in concern (e.g., the balance between senior management decision making to enable greater roll out of sustainability activity vs. localised decision making to trial new approaches which has limited impact)?	Is sustainability work clustered at particular scales? Are there large-scale as well as small-scale initiatives taking place?	Is there overlap in scales of activity?

amongst stakeholders of different backgrounds has the potential to undermine trust and create divisions (Cinčera et al., 2019).

Considering redundancy in participation in sustainability work within the university is crucial. The role of committed individuals, often referred to as "sustainability champions" is highlighted by many writers as being an evident part of university change processes towards sustainability (e.g., Lozano, 2006). These roles require relationship building and institutional knowledge, requiring time for such a "champion" to be effective in their work within an institution. As such, a lack of redundancy (e.g., multiple "champions") can make the system very brittle with serious consequences for sustainability work if key stakeholder(s) leave. Having key sustainability champions can also make people see sustainability as the task of an individual elite (Rath and Schmitt, 2017), conditions that reduce diversity of participation.

Representation of all participant characteristics in all sustainability work and governance is not only unlikely, but probably impossible. Indeed, Biggs et al. (2012, p. 437) say that "who participates [in governance] and what they contribute are context specific and need to be continually revised throughout the policy process or adaptive management cycle." Context

specific participation and revisions to participation processes are not the norm in most universities. For example, universities often stick to a standardised model of elected student representation from Students' Unions who participate in university meetings (about for example, decisions related to development of the campus estate, educational processes etc.), representing the student voice.

While it can be helpful to consider which voices are (and are not) represented, it is also crucial to consider the quality of participation in sustainability governance. Formal university governance structures can feature participation (especially student participation) in tokenistic ways, and ways that maintain hierarchies and existing power dynamics. As such, there should be a variety of different strategies for facilitating participation by stakeholders in decisions that affect them. For example, including elected student representation on committees is a common way to ensure student views are represented in decisions. However, often these students are new to committee structures, protocols (e.g., at which points opportunities to voice opinions are invited, and how decisions are made), and language, reducing their ability to optimise their participation. It is not uncommon for decisions to be made in advance of such meetings, rendering participation in them a formality rather than providing a genuine forum for discussion. Furthermore, some modes of participation are considered more legitimate than others. For example, campus activism, student newspaper articles, and social media are all places where student voices can be heard, however, these voices are not always acknowledged in formal governance systems. Efforts should be taken to elicit diverse participation at different stages and to different degrees (see Arnstein, 1969), and for different purposes (see Collins and Ison, 2009). For example, consultation following important university decisions, such as design and placement of student residences, ought not to be the only participation elicited. Alternative participation strategies such as focus groups or questionnaires at earlier stages can allow for more diverse perspectives to be captured at early stages in decision-making processes. Alternative and unconventional approaches, such as deliberative polling and citizen juries (CIVICUS, 2020), may also be helpful to bring in underrepresented views and/or hard-to reach stakeholders.

Diversity of participation in sustainability decision-making or even sustainability activity can complicate the delivery of sustainable outcomes. The lack of diversity in senior management of universities (Croucher et al., 2020) can make decision-making less complicated because fewer views need to be accommodated and taken into account. Sustainability is a contested and ill-defined concept, so the presence of a greater diversity of voices, and especially greater disparity between the perspectives these voices offer, means that coming to agreement and working in coordination can be challenging. For example, students who study sustainability tend to have quite holistic, and, at times, idealistic ideas of what sustainability is, whereas staff who oversee the campus estate tend to prioritise environmental concerns, such as carbon reduction and waste management. This can lead to frustration from students, who perceive "the university" to be adopting a tokenistic approach, while estates staff can be frustrated that students may expect them to work with issues outside the remit of their job role. As can be seen here, diversity can result in fractures within groups of people working with sustainability, reducing connectivity and their ability to act in a coordinated way. As such, from a resilience perspective, it could be desirable to limit diversity in order to improve coordination of sustainability. However, from an ethical perspective (and a social sustainability perspective), inclusion and representation is not a matter of improving the quality of the outcomes, but a matter of rights, fairness, and justice. This tension is important to consider.

Diversity in Motivations Driving Sustainability Work

Diverse motivations driving sustainability work means that change in government policy, leadership, key individuals, funding streams, research agendas, or student demands will be less likely to derail sustainability efforts across the university. It is also important for this reason that there is more than one key driver (i.e., a balance between different drivers). Redundancies in drivers can also provide vital buffers. For example, if one funding stream for sustainability research or sustainability campus improvements dries up, proposals and applications can be submitted through another. Also, having both intrinsic and extrinsic drivers for sustainability work has the potential to create more momentum than either driver could in isolation.

An example of the need for diverse motivations and drivers for sustainability work in universities can be seen by looking at the significant changes in key sector bodies championing and supporting the role of universities in driving sustainability. These changes have implications to the motivations for and level of sustainability activity within universities. Higher Education sector bodies can have a significant role in steering university sustainability activity (Bessant et al., 2015), yet themselves are subject to shifts and changing motivations. For example, the Higher Education Funding Council for England, that was responsible for the distribution of funding to universities, in 2005 set out its vision for how universities and colleges could contribute to sustainable development, providing a clear steer for universities to embrace sustainability. In addition, in 2013 HEFCE awarded £5 million to the National Union of Students for a Students Green Fund to support student-led sustainability activity. Yet, such funding opportunities are short-lived, and HEFCE no longer exists as an organisation, removing these specific drivers. Similarly the Higher Education Academy, which supported learning and teaching activities in universities in the UK, had a strong Education for Sustainable Development strand of activity which created a whole-institution sustainability-focused change programme and provided funding for ESD activity in organisations. However, governmental austerity measures led to the loss of this focus on ESD and ultimately the loss of the Higher Education Academy itself, further removing these drivers and support for universities. These examples highlight how a diversity and balance of different motivations and drivers for sustainability are needed within a university in order to keep momentum in the face of ever-shifting external (and internal) contexts of support and motivation.

Diversity of Scales of Activity

University governance usually has some degree of polycentricity, with powers devolved to committees and working groups with specific mandates. However, there are often fairly rigid reporting and decision-making structures that require reporting to higher levels of decision-making. Often budgetary decisions are made based on this reporting. If sustainability is not formally embedded in these structures, it can be difficult to demonstrate impact and access important financial and personnel resources. However, because of this devolved structure, not all activities are "controlled" by higher levels of governance. This means that sustainability initiatives can take place at lower levels regardless of a mandate from the top (provided they do not require substantial internal resourcing). Although it is preferable for the level of governance to match the scale of the issue, this means action can be taken from a different scale if the appropriate scale presents challenges. Governance at smaller scales also creates opportunities for participation and provides a low-risk environment for experimentation (principle 4). Furthermore, the devolved university structure means that sustainability activity can continue, even if sustainability-supportive leadership (e.g., a dean or head of operations with an affinity to sustainability) changes. As such, this variety of scale "allows some of the elements to persist through particular disturbances" (Biggs et al., 2012, p. 425). This said, support from higher levels of governance for smaller scale activities can provide stability for bottom-up activities. This is especially true for activities led by students, as they are so transient (Laycock Pedersen et al., 2019). Higher-level support can also help to scale successful initiatives trialled at a smaller scale.

However, even if there are degrees of polycentricity in their governance, universities tend to emphatically eschew redundancy, because redundancy is costly, and seen as inefficient. This is largely because of the current drive for economic efficiency within the sector. High levels of redundancy can increase administrative costs, and also result in power struggles, and contradictions in, for example, goals or approaches from different groups or individuals.

Principle 2: Manage Connectivity

Connectivity within a social system refers to the "degree to which different actors and entities interact across a social landscape" (Biggs et al., 2012, p. 427), and comprises nodes and links between nodes. The structure and strength of the connectivity is determined by (i) the distribution of links between nodes, whether these are "generalist" with lots of links, or "specialist" with few links; (ii) the frequency or "thickness" of interactions between the social actors comprising the nodes, and (iii) "modularity," the mix of densely and loosely connected nodes. The strength and structure of links are not constant in time (Biggs et al., 2012, p. 429), and may reflect formal or informal changes in relationships between actors and the establishment or disestablishment of nodes. Nodes will change as individuals leave or join the organisation, or new formal or informal groupings are formed, fall into disuse, or are disbanded. The quality of the links between nodes is also important. Where nodes represent individuals or groups of people these links represent relationships, with high quality relationships characterised by trust and reciprocity. Connectivity also facilitates exchange of information or material between different components of the system (Biggs et al., 2012), and hence may play a role in establishing culture or new norms or sharing learning. Connectivity can have either positive or negative effects on the sustainability agenda and sustainability governance within universities, and ultimately the goal of repurposing universities towards sustainability. This is dependent on which nodes are present, the strength of connectivity between them, the quality of the links, and the nature of a disturbance to the system.

Connectivity Within Universities

Between Estates and Academic Domains

The different university domains (e.g., campus, education, research, outreach) contribute to the modularity (and polycentricity) of the university system. High connectivity across different domains can help develop a common purpose between different cultures that exist within different domains (Sylvestre and Wright, 2016). Typically, connectivity *within* these domains is high, while connectivity *between* domains tends to be low, meaning that sustainability work across domains can feel fragmented and unconnected. For example, it is common to have limited connectivity between the estates functions and the academic functions of a university. Where universities have started leading education for sustainable development activities from an estates-based directorate where leadership for "sustainability governance" often sits, the weak connections between campus operations and the academic functions of the university can limit the impact on the academic domain.

"Sustainability champions" are an important formally or informally-recognised aspect of university sustainability governance and change agendas (e.g., Lozano, 2006; Brinkhurst et al., 2011), and may exhibit different levels of connectivity between nodes. Sustainability champions can hold important coordination roles linking different nodes and increasing connectivity within the system. However, if a high level of connectivity is supported by a single individual, it is highly fragile. This is because connectivity will be largely dependent on the individual's ability to develop quality relationships with diverse actors across the university, making connectivity highly vulnerable to the individual leaving the organisation.

Between Students and University Administration

Another common area where connections tend to be weak or poor quality is between the university and students or students' unions. Students are highly transient, typically rotating in and out of the university community in 3 or 4 years, meaning that connections between students and staff are regularly disrupted, hindering the development of trust and quality relationships (Laycock Pedersen et al., 2019). Students' unions are typically used to help create more effective relationships between the student body and the university, and serve the purpose of representing students within the institution as well as providing a variety of services for students. These formal structures of students' union representation in university governance and decision making can be brittle as they often involve only a single

student representative. Relationships between students' unions and university management are seen to be more constructive and less adversarial than in the past (Brooks et al., 2015), improving the *quality* of this connectivity. However, if there is low connectivity between the students' union and the wider student body, then it does not serve to effectively increase the connectivity between students and university governance. Students' unions are not the only way to build connections between students and university governance. There is an increasing drive to increase connectivity through both formal structures such as programme level committees to give students a voice in curriculum development, as well as pedagogical movements such as treating students as partners in the co-creation of education and research (e.g., Healey et al., 2014; Warwick, 2016; Barrineau and Anderson, 2018). External bodies have also devised structures to improve the connectivity between university governance and students' unions and students to foster education for sustainable development, such as the UK's National Union of Students' (now Students Organising for Sustainability, SOS-UK) Responsible Futures accreditation programme (National Union of Students, 2021).

Connectivity Between Universities

High connectivity between higher education institutions can create norms that present resistance to change if unsustainable attributes are common throughout the sector. Biggs et al. (2012) state that "high levels of connectivity among actors can lead to synchronized behavior [...] or to strong barriers for changing unsustainable practices" (Biggs et al., 2012, p. 429). In social networks actors tend to have strong ties to other actors with similar characteristics (McPherson et al., 2001), which can lead to high connectivity between actors with similar perspectives, and a lack of diversity overall. Within the higher education system in the UK there are a number of different "mission groups" (such as the Russell Group) which connect universities with common interests, and promote different agendas (Furey et al., 2014). There is also a clear hierarchy in mission groups. The Russell Group ("committed to maintaining the highest standards of research, education, and knowledge transfer") is viewed as the elite group in UK higher education, therefore setting aspirations for other universities. Where there is a shift in position towards sustainability from actors in an elite mission group, this shift has the potential to influence a wider range of institutions than changes in "lower ranking" mission groups. Alternatively, establishment of a new mission group or network which connects universities with a goal of repurposing towards sustainability could increase the influence of these actors on the rest of the sector network as well as providing support for each other. The impact of this new modularity would be enhanced if it includes a diversity of institutions, including some of the "elite."

In 2011, the Higher Education Academy in the UK launched a change programme called "Green Academy" which worked with a cohort of 10 universities to initiate systemic change towards sustainability in their universities. One of the unplanned outcomes of this programme was the development of an informal, albeit short-lived, network of participant universities (McCoshan and Martin, 2012) which included universities across different mission groups (including the Russell Group). This programme also led to increased connectivity *within* organisations due to the requirement of cross-hierarchy participation, and hence through its influence on connectivity this programme is believed to have had an impact in driving sustainability both within individual institutions and across the sector (McCoshan and Martin, 2012).

Connectivity With External Non-academic Partners

In order for universities to be genuinely repurposed for sustainability, connections between universities and actors outside of the university are also important for "bringing outside perspectives and new ideas to local issues" (Biggs et al., 2012, p. 428) and producing genuinely transdisciplinary and collaborative forms of inquiry and knowledge creation (Sylvestre and Wright, 2016). Universities are increasingly referred to as "civic" or "anchor" institutions (e.g., Birch et al., 2013), given their potential to positively influence local communities and economies. Connections may be formalised through university representation on formal regional governance bodies (such as Local Enterprise Partnerships in the English context), as well as involvement in regional coalitions around different issues (e.g., place-based climate change responses). Universities can play an important role in such coalitions as "honest brokers" (Andereggen et al., 2012; Bogenschneider, 2020). Engaging with external partners not only increases universities' own connections within local networks, they are often a key node connecting other actors to one another.

Connections with external actors are also important to the educational and research domains and missions if universities are to genuinely serve a wider purpose for society. Greater connectivity with external actors can create opportunities for students to work with partner organisations on sustainability goals, providing them opportunities to work with sustainability problems in different contexts, as well as contributing human resources to different actors. University research missions also benefit from connectivity with external organisations to ensure impact of research by shaping research with external actors, while a new mission focus on "knowledge exchange" (Johnson, 2020) also highlights the shift towards increased external connectivity.

Principle 3: Manage Slow Variables and Feedbacks

Slow variables are variables within a system which change over long timescales (Walker et al., 2012). They determine the underlying structure and conditions within the system. Within a social system these can include, amongst others, legal systems, values and traditions (Biggs et al., 2012). Fast variables tend to receive more attention than slow variables because when they change, consequences can be observed with greater immediacy (Walker et al., 2012). Feedbacks are "the two-way 'connectors' between variables that can either reinforce (positive feedback) or dampen (negative feedback) change" (Simonsen et al., 2014).

Managing slow variables and feedbacks requires thinking through the influences that operate at different timescales, as well as their consequences (the feedbacks) of factors in the system. Changes in slow variables are often hard to observe because

they happen so slowly. However, changes in slow variables in complex systems can lead to sudden, unpredictable, and non-linear changes if a tipping point is reached. This can ultimately force a transformation such that the structure and behaviour of the system is of a fundamentally different character (Biggs et al., 2012). Hence, consideration of slow variables may be one of the most essential of Biggs et al.'s (2012) resilience principles when seeking to shift systems from undesirable states, such as in the case of repurposing higher education towards sustainability.

Slow Variables

Universities are historic institutions. The first institutions recognisable as universities, combining higher learning, corporate autonomy, and academic freedom, arose in Medieval Europe (Perkin, 2007). Although universities and their "missions" have continually evolved (Trencher et al., 2014), their longevity shows that these institutions are designed to endure over time, withstanding change and short-lived crises (Newman, 2007). Universities are therefore not designed to enable a quick and easy transformation towards sustainability (Newman, 2007). Academic traditions and cultures can act as slow variables, as can external socio-economic and cultural factors. These can affect the ease of repurposing universities for sustainability. In the following sections we will consider the following slow variables: (i) academic traditions and organisational culture, and (ii) national regulatory and funding body ethos and requirements.

Academic Traditions and Organisational Culture

The traditions and culture that exist within the higher education sector as a whole and within individual organisations can be seen as a slow variable. Drawing on early work by Schein (1985), Niedlich et al. (2020a, p. 375) describe organisational culture as "a pattern of assumptions shared by members of an organisation, developed over time, and transmitted through day-to-day interaction with one another." This culture is reflected in visible elements, such as structures and language (as reflected in increasing managerialist language, Sterling, 2001), as well as those that are more opaque, such as beliefs (Niedlich et al., 2020a). Organisational culture within any one institution can be seen as part of the context dependent conditions of any university (Niedlich et al., 2020a), but equally aspects of that culture emanate from historical and global academic traditions. Factors such as size, location, disciplinary scope, as well as overall political regulatory measures can all affect the cultural orientation of an organisation (Niedlich et al., 2020a).

Organisational values, attitudes and behaviours, as dictated by organisational culture, can be a key component of achieving deeper change within an institution (Niedlich et al., 2020b). This is because elements of organisational culture and academic tradition, such as authority and self-determination (Niedlich et al., 2020b), may act as mediators in an organisations' response to fulfil its role in addressing unsustainability challenges.

Some have argued that the cultural foundations of universities are an inherent part of the current unsustainability of the university system therefore repurposing universities for sustainability requires "a change in their cultural foundations" (Niedlich et al., 2020b, p. 375). This is highlighted by the recurring emphasis on organisational culture as a driver of organisational change (Verhulst and Lambrechts, 2015). As well as an organisational culture of the institution as a whole, the different domains of academic activity, education, research, campus, outreach, as well as different disciplines, are all marked by differences in cultures (Sylvestre and Wright, 2016; Niedlich et al., 2020a), even within a single organisation. For a whole institution transformation towards sustainability, organisational culture in all areas is important.

"Academic freedom" within teaching and research is a prized tradition in Western universities, but can make it difficult to "force" transformation of teaching, learning and research activities in a particular direction, including towards sustainability (Jones et al., 2010; Bauer et al., 2018). This is powerfully demonstrated by Peter Knight's vitriolic and sarcastic article in one of the UK's national newspapers, in response to the Higher Education Funding Council for England's (HEFCE, 2005) consultation document on sustainable development in higher education. In the document, HEFCE suggested that universities should promote sustainable development through the curriculum (amongst other areas). Knight (2005) called this document "pernicious, shameful and dangerous" referring to the document's "self-righteous waffle" as the "final assault on the last remaining freedom of universities." He concludes by saying:

> "The issue here is not whether sustainable development is a good or bad idea. It is about the basic rights and responsibilities of universities and the need to safeguard academic freedom. It is not the job of universities to promote a particular political orthodoxy."

However, in the 16 years since this article was written, sector bodies in the UK have become more supportive of the incorporation of sustainability into the curriculum (and the wider university). Academic freedom still remains an important tenet of higher education, but our shifting understanding of what academic freedom means in the context of rapid degradation of our life support systems and its interplay with the moral imperative of sustainability is a slow variable to be observed.

International and National Policy and Regulatory/Funding Body Requirements and Ethos

Slow variables relevant to the governance of sustainability in universities also exist outside of the institutions themselves. They may include international drivers; national policy and higher education bodies' drivers, regulation, and values; and requirements of funding bodies. These, in turn, influence different university domains and organisational culture.

In theory, slow variables at an international level are in place to support repurposing of universities. Successive United Nations (UN) Education for Sustainable Development initiatives (e.g., UNESCO, 2015, 2017, 2020) highlight the importance of education in achieving a more sustainable future. Yet, despite these international level initiatives, there are still calls for rapid structural (rather than incremental) change in global governance to bring about the needed extent and speed of

societal change (Biermann et al., 2012), as well as criticisms of a lack of significant impact. National political discourse can also deter pro-sustainability change at a university level. Unaligned national policies were amongst several national-level challenges for transforming universities identified by sustainability leaders of colleges and universities (Scott et al., 2012). Over several decades, neoliberal ideologies and new public management approaches dominating UK higher education have impacted universities' foci and culture. In England, universities have been repositioned as contributors to the knowledge and industrial economy, and this has resulted in their gradual repositioning to sit under government departments associated with business and industrial strategy (Bessant et al., 2015; Bessant, 2017). Likewise, moves to measure the "worth" of a student degree through the salaries that their graduates earn places an emphasis on particular subjects (and institutions), and encourages universities to focus on preparing graduates for the workforce, rather than emphasising the intrinsic worth of education and learning.

Increasing sustainability research can also be impeded through, for example, active discouragement of education for sustainable development research (Bessant and Robinson, 2019) and national funding mechanisms that discourage transdisciplinary research (Scott et al., 2012; Bessant and Robinson, 2019). These prevailing norms are slow variables which act as barriers to university transformation towards sustainability.

Conversely, other national research-focused drivers can also support repurposing universities for sustainability. For example, the discussion of research "impact" and transdisciplinary co-creation is increasing, and being actioned through research funding mechanisms. For example, the European Horizon 2020 funding programme emphasises multi-actor and public engagement in research and innovation in order to align "the process and its outcomes with the values, needs and expectations of society" (European Commission, 2020). Although this highlights slow variables external to the university, such as national drivers and funding mechanisms, are outside direct university control, there are signs of movement within some of these slow variables which may be critical in repurposing universities towards sustainability, and bringing attention to pro-sustainability changes in slow variables can be used to drive change at an institutional level.

Feedbacks

Feedbacks are essential in maintaining or shifting slow variables. Explicit feedback loops are built into many governance structures, for example, through monitoring and evaluation processes. Implicit feedback loops also exist within social systems, for example in the rewarding of particular behaviours or areas of achievement. Reinforcing feedbacks can more deeply entrench current paradigms and values within the university. Therefore, identifying what these reinforcing feedbacks are and identifying ways to weaken them are important leverage points for change. This section explores examples of explicit and implicit reinforcing feedbacks that are entrenching current paradigms and values as well as ways to use feedbacks to drive change.

Explicit Feedbacks: Monitoring and Evaluation Systems

Quality processes, which include monitoring and evaluation, are important to the governance of a university. However, these governance processes have been designed within the framework of the existing university system, and hence can reinforce unsustainable dominating values, goals, worldviews, and social structures. Monitoring requirements are also imposed from outside the university. For example, national government requirements for universities to report on graduate salaries can perpetuate a narrow focus on an economic mission in universities. This focus, in turn, reinforces the idea that graduate salaries are important metrics to measure.

Despite many of the negative aspects of neoliberal and managerialist control mechanisms which are used to govern universities, Bessant et al. (2015) highlight the potential for amplifying feedbacks through such mechanisms (like monitoring and evaluation) to be hijacked for a more sustainable focus. For example, interweaving sustainability into instruments which publicly measure institutional performance could influence student choice of university and degree course, and thereby amplify the sustainability agenda in universities and increase its value within the managerialist and market-led monitoring mechanisms which govern academic systems. An example of this can be seen in how the recent evaluation of education for sustainable development in Higher Education in Sweden (UKRI, 2019) has renewed an interest in the imperative to embed sustainability in the curriculum (SOU 2019:13, 2019).

The choice of what to monitor is critical to how monitoring and evaluation feedbacks function. In the UK, metrics that are monitored across teaching and research domains include student numbers, degree outcomes, research income, and "quality" of research outputs. There is less focus on long-term impact of either education or research activities. There is a tendency to use measures which monitor what is short-term (i.e., fast variables) and easily quantified, creating a myopic view of the "success" of a university. A shift in explicit feedbacks through the choice of what is monitored, to include a focus on longer-term sustainability-focused impact, could have substantial impact on shifting slow variables that enable repurposing the university. Investment in, and greater respect for, qualitative monitoring measures would also be appropriate to capture a fuller picture of sustainability in universities.

Implicit Feedbacks: Rewarding Behaviour and Communication

Feedbacks can also be implicit, such as how particular behaviours are rewarded and therefore incentivised through mechanisms such as promotions and appraisal processes, public celebration of individuals and their achievement, and formal time allocation to particular activities.

The language used within an organisation can also reinforce the dominant paradigm. This is because it is a surface-level manifestation of organisational culture (Niedlich et al., 2020a). That is, the language shapes the culture, and the culture shapes the language we use. Much of the language used in governance of HE is managerialist and that of monitoring and metrics,

rather than the purpose lying behind the metrics (Sterling, 2001). For example, a focus on grant income at the expense of the societal contribution or wider impact of research, or student degree outcomes rather than student learning and development. Therefore, actors can become focused on the short-term metrics rather than considering the larger scale purpose of activity in different domains.

Funding opportunities also provide feedback mechanisms. For example, interdisciplinary research is seen as essential for addressing sustainability challenges, but the funding and reward system has been biased against interdisciplinary research (Bessant and Robinson, 2019), potentially reducing researchers' engagement with interdisciplinary research. However, there are clear signals in the UK research system that this is changing, as the number of research funding calls explicitly requiring interdisciplinary research is increasing.

Principle 4: Encourage Learning and Experimentation

The fourth principle is encourage learning and experimentation with respect to the system and its governance, complex adaptive systems, and unknown unknowns. Biggs et al. (2012, p. 434) define learning as "the process of modifying existing or acquiring new knowledge, behaviours, skills, values or preferences." Learning can play a key role in changing worldviews and values. Consideration of the different levels of learning (i.e., single, double and triple loop learning) and change (i.e., first order change and second order change) highlight the importance of considering the "type" of learning that is necessary in repurposing universities towards sustainability and the depth and transformational extent of change (Sterling, 2001). Single loop learning, or first order change, asks us to question whether we are doing things right, leaving basic values unexamined. Double loop learning, or second order change, involves critically reflective learning (Sterling, 2001) and asks us to question if we are doing the right things, and questioning underlying assumptions. Triple loop learning, or third order change, asks us to question how we know what the right things are to do, questions our values and norms, and involves deep awareness of alternative worldviews and ways of doing things (Sterling, 2001). Hence double and triple loop learning is a requirement for the genuine repurposing of universities, yet most change for sustainability in higher education has been largely engaged with first order change (Albrecht et al., 2007; Sylvestre and Wright, 2016).

For change of a large organisation like a university, individual learning is helpful but not sufficient, hence transformation at universities calls for social learning (Sylvestre and Wright, 2016). Social learning is a process that "must (1) demonstrate that a change in understanding has taken place in the individuals involved; (2) demonstrate that this change goes beyond the individual and becomes situated within wider social units or communities of practice; and (3) occur through social interactions and processes between actors within a social network" (Reed et al., 2010). Hence social learning requires participation, which enables diverse perspectives (principle 1) and builds trust and relationships that can contribute to collective action (Biggs et al., 2012).

Placing learning in the context of complex adaptive systems (CAS) also builds resilience (Biggs et al., 2012). A complex adaptive system worldview emphasizes uncertainty and the need to "continually learn and experiment and adaptively manage uncertainty, disturbance, and surprise, rather than attempt to eliminate it" (Biggs et al., 2012, p. 432). This sits in contrast to technical, reductionist, and one-size fits all approaches to learning and solution seeking. Mechanisms of learning within a CAS include formal monitoring mechanisms (feedbacks, principle 3) and experimentation, as sits at the heart of the ethos of using universities as living labs (Evans et al., 2015). Reflection on the efficacy of processes at all levels, as well as the learning process itself, is also required to ensure adaptation of approaches, and the development of a genuine learning organisation (Senge, 1997; Hodgkinson and Stewart, 1998).

Learning for Sustainability Education: Curriculum and Staff Development

In universities, learning is both a key domain of sustainability activity and a core university mission. Therefore, the curriculum, staff development, and structures that support and govern curriculum development need to be adapted for a university repurposed for sustainability. The role of education (or learning) in achieving a more sustainable future has been widely acknowledged, and widely reinforced by myriad international initiatives. Yet, David Orr's famous quote highlights how our prevailing educational programmes and approaches can further *un*sustainability:

> "The truth is that without significant precautions, education can equip people merely to be more effective vandals of the earth" (Orr, 2004).

This highlights the need for the application of double and triple loop learning, requiring reflection upon the assumptions, norms, and values behind teaching activities and universities themselves, as well as the responsibilities of educators (and their students) to society (Robinson, 2019). How many educators truly question what learning is for?

Education for Sustainable Development (ESD) has been described in many ways, and grouped into different typologies (i.e., Scott and Gough, 2003; Sterling, 2003; Vare and Scott, 2007). Vare and Scott's simple bipartite division highlights the critical differences in thinking about ESD. Their "ESD1" relates to informing specific skills and behaviour to guide positive actions, referred to as the sort of environmental education advocated by policy makers, where there is a set of underlying values and behavioural outcomes; whereas ESD2 focuses on the development of the capacity to think critically, and the ability to analyse and question alternatives, and make sound choices in the face of complexity. Although Vare and Scott (2007) note that both types of ESD have a role, a repurposed curriculum for the "sustainable university" must ensure ESD2 is incorporated, not just ESD1, thus the curriculum itself must reflect the higher levels of organisational learning and change.

Reference to these different ESD typologies highlights that the "how" of learning is at least as important as the "what" of learning. Learning in groups, as well as different forms of experiential and active learning, are therefore essential to providing opportunities for learners to develop sustainability competencies. There is growing recognition of the importance of broader participation in the learning process by all parties involved, and a growing interest in "students as partners" in their own learning and learning design (Healey et al., 2014; Mercer-Mapstone et al., 2017). Furthermore, the role of the co-/informal curriculum in ESD is widely advocated because of the active and experiential learning opportunities that these spheres enable.

As we repurpose student learning to incorporate ESD we must also consider how educators, as key enablers, develop competence in ESD (Barth and Rieckmann, 2012). ESD-focused professional development structures have been shown to support individual staff learning and competence development as well as support organisational change towards sustainability, and hence form an essential component of sustainability governance (Barth and Rieckmann, 2012).

Learning by Doing—The University as a Living Lab

University campuses have been called "privileged space[s] of innovation" (Evans and Karvonen, 2014, p. 415) because they have potential to trial new technologies and approaches that would be difficult to undertake in other settings/by other actors. In this way they can be "living labs" for sustainability (Verhoef et al., 2020). The living lab concept, if done well can exemplify the transdisciplinary and collaborative enquiry necessary for transformation for sustainability at universities (Sylvestre and Wright, 2016), bringing together students, academic staff, campus staff, and external stakeholders to co-produce knowledge and solutions for sustainability challenges faced by the university or wider stakeholders (Evans et al., 2015; Waheed, 2017). A typical living lab approach will see researchers working with students to investigate new sustainable innovations relating to an area of the university's campus or operations or a sustainability challenge posed by an external partner, hence addressing an element of the sustainability of the university campus operations, as well as contributing to research and education missions. The university-based "living lab" approach therefore is at its heart about learning and experimentation for sustainable solutions through using the campus (or wider community) itself, while also providing active learning opportunities for students and staff.

Although universities as living labs have been viewed as a panacea for repurposing universities towards sustainability by some (see Waheed, 2017), adopting some living lab concepts or labelling activity as a living lab does not necessarily lead to effective learning, nor to repurposing a university for sustainability. The lack of connectivity between estates and academic functions of a university (principle 2) can reduce the effectiveness of this approach. Experimentation involves active manipulation of a piece of the university's processes and structures in order to observe and compare outcomes (Biggs et al., 2012). However, experimentation on inappropriate (i.e., short-term) timescales can actually lead to inappropriate conclusions and management decisions (Biggs et al., 2012). Particularly within complex adaptive systems, time lags may exist between the interventions and their impact, and therefore short-term monitoring may lead to inappropriate conclusions about the impact of an intervention. Likewise, it is necessary to consider how an intervention fits within its wider system to include monitoring of a wider range of variables to avoid unseen impacts in another part of the system. This requires the inclusion of diverse stakeholders and perspectives (see principle 1) as well as willingness and structures to facilitate reflection and double and triple loop learning. For living labs to be effective as a method of learning, the learning from experimentation and monitoring and its link to management decisions needs to be explicitly built into the design of the living lab process. This should also include monitoring and evaluation of whether learning has taken place within the governance itself (Robinson et al., 2021).

Learning for Sustainability Governance: Universities as Participatory Learning Organisations

We do not have a blueprint for a "sustainable university" and therefore we need to learn how to "do" sustainability and to implement governance structures that enable reflexive learning and inclusion of multiple stakeholders and co-creation principles (McCrory et al., 2020). Accepting universities as complex adaptive systems implies the need for a more integrated approach (principle 2, connectivity), that can be difficult to address across governance units that are usually separate (Biggs et al., 2012) and may exist in tension. Therefore, universities need to embrace the concepts of a "learning organization" with different project stakeholders working together to improve capacities and transform practice within the organisation (Senge, 1990) through continual reflexive practice embedded in the governance processes. This could be achieved by a specific regular agenda item on project learnings built into project meeting governance, and actions recorded and implemented focused on using these learnings to drive improvements within the organisation and its governance for sustainability.

The development of a community of practice for the repurposing of a university towards sustainability should not be exclusive to those involved in direct governance and decision making, but should include interaction between diverse stakeholders to develop more deliberative forms of engagement (Hammond, 2020) and integrate different perspectives. Yet power dynamics and organisational cultures can still limit the effectiveness of universities as learning organisations. For example, institutional governance systems rarely learn from academic expertise within their own organisation as university staff are typically not empowered to create knowledge on behalf of their institution (White and Weathersby, 2005).

A traditional view of governance and organisational decision making assumes a need to reduce uncertainty before taking action. This is problematic in the context of repurposing universities due to the complexity of the systems and the unknown pathways and processes required. Biggs et al. (2012, p. 433) state that "viewing complexity simply as the unknown tends to overwhelm managers and lead to gridlock and stagnation." Such a view can lead to a heavy investment in monitoring and data collection of current systems, and significant time

and resources being used in monitoring the current situation before acting. This can be seen in the number of initiatives within universities to "map" sustainability activity. Such is the urgency of the sustainability issues that our society faces and our acknowledgement of the unsustainability of many of our systems, that we argue that resources should be prioritised towards action, with monitoring and learning focused on interventions and action rather than waiting until mapping of the current situation has been undertaken.

Action to repurpose a university towards sustainability requires management experiments that support learning (Biggs et al., 2012) and the willingness to experiment and learn from action and reflection, on both the success and failures that result. Yet higher levels in university structures may provide little opportunity for experimentation, meaning that experimentation takes place at smaller scales, within individual departments. Such smaller scale experimentation may be referred to as "pilots," yet without connectivity to the wider university governance structures there may be limited opportunity for the wider organisation to learn from the success and failures of these experiments. This highlights both the important role of polycentricity in sustainability governance (principle 1) but also its connectivity (principle 2).

DISCUSSION AND RECOMMENDATIONS

How Resilience Principles Help us Understand the Governance of Sustainability in Universities

When exploring how to repurpose universities towards sustainability, much of the literature emphasises case studies of successful initiatives (Corcoran et al., 2004). This is underpinned by an assumption that replicating and learning from successful initiatives is how change is made within universities. However, these assumptions are generally left untested, and little consideration is given to understanding the processes through which institutions can (or cannot) be changed. However, in order for strategic and timely action to be taken, it is necessary to understand the pathways through which change happens. Addressing this gap, our article offers a non-normative framing of social-ecological resilience to understand how change processes happen in universities. The four resilience principles explored in this paper help us develop important insights with practical implications and a framework of questions for practitioners to ask themselves about university governance for sustainability. This section draws together some of these insights and the framework.

The Tension Between Efficiency and Resilience

In most Western countries, universities are underpinned by a paradigm of efficiency, stemming from the neoliberalisation of the university, and increasingly business-orientated models of governance (Bessant et al., 2015). Universities have been criticised for undermining their core values and the inevitable trade-offs as they embraced their position within a neoliberal ethos (Saravanamuthu and Tinker, 2002; Devaney and Weber, 2003), while others have demonstrated how neoliberal and new public management instruments can be used to help "steer" and "nudge" sustainability (Bessant et al., 2015).

This drive for efficiency has spillover effects into sustainability governance and the context in which sustainability repurposing must take place. A drive for efficiency reduces redundancy, reflected in sustainability leadership or "championing" often being restricted to one individual. Efficiency drives can also lead to overwork of these individuals, leading to simpler "doing-less bad" than more generative "doing more good" approaches, erosion of relationships (connectivity), and a lack of diversity in participation.

There is therefore an inherent tension between efficiency and resilience, a phenomenon which has been previously observed by resilience scholars (e.g., Holling and Gunderson, 2002; Golgeci et al., 2020). Efficient systems can be more vulnerable to shocks and pressures. This means that highly efficient but unsustainable systems within universities may be ones that can be most readily shifted. For example, where decisions are very "top down" and limited to a very limited number of people, recruitment of a new leader specifically with a sustainability leaning can support a more rapid shift towards sustainability. However, where there is positive sustainability action, it also means that there needs to be redundancies built into sustainability work, for example a number of individuals involved in sustainability initiatives, that although seeming inefficient at times, can ensure that the entire sustainability agenda will be less likely to be derailed in the event of a failure or collapse of one initiative. This can be achieved also through having multiple overlapping initiatives with different loci of control.

From our analysis, it can also be seen how important it is, from a resilience perspective, that sustainability work happens in many places in the system. Therefore, it is imperative that sustainability work is driven by a team. Given the lack of connectivity between university domains, having sustainability champions who work with and tend to different matters can help to ensure work is taking place in each of these different domains, and also coordinate work between domains.

The Importance of People and the Relationships Between Them

In our analysis of connectivity, we saw that sustainability work is heavily dependent on certain individuals (as or within nodes) and their relationships, both within and outside of the university. Hence even where formal structures may promote connectivity, the *quality* of connectivity is still dependent on individuals and their relationships. This focus on the quality of relationships between individuals makes the sustainability agenda vulnerable to staff leaving, making the connectivity "brittle." However, connectivity is always in flux, with strength and structure varying over time through planned changes in formal governance structures, or staff turnover. A key question is then how do we try to ensure "quality" connections, or rather, the fostering of good relationships? The answer must surely lie in valuing and developing the "soft" relationship skills of not just key sustainability actors, but all within the university system.

Connectivity is a subjective feature. Universities may be resilient to change due to limited connectivity meaning that disturbances towards sustainability do not transfer through the system, or highly connected systems may be resilient to disturbance towards sustainability, due to a strong, resistant organisational culture. However, some of the negative elements of either too much or too little connectivity, can be offset by increased diversity (principle 1) ensuring different voices are heard and that there is diversity in leadership. Within the context of ecosystem services, Biggs et al. (2012) argue that if those who use certain ecosystem services are not engaged in their management, then critical knowledge of the system's function and monitoring can be missed. The same can be said within the context of university sustainability governance, highlighting the need for connectivity to hear voices from different parts of the system.

Controversially, we question the imperative for highly connected sustainability activity. Those seeking to repurpose universities for sustainability can often be heard lamenting that pockets of good practice are isolated. Too much focus on increasing connectivity and understanding everything happening within the university can waste limited resources and also lead to "ownership" of sustainability by a small group of actors, making it vulnerable to changes in governance structure. In contrast, greater modularity in where "repurposing" activities are driven from can lead to enhanced resilience through ensuring multiple centres from where sustainability transformation can ripple.

Patiently Paying Attention to the Undercurrents

Time and temporality in higher education has come into focus in recent years through, for example, the theorisation of slow scholarship (Mountz et al., 2015) and how different members of the university experience time (Laycock Pedersen et al., 2019). The third resilience principle, monitoring slow variables and feedbacks, adds a new dimension to this discussion. While applying a complex adaptive systems lens to an organisation or even a university is not new, the third resilience principle highlights how long-term monitoring can help us identify whether we could be close to crossing a tipping point.

Paying attention to slow variables and feedbacks reminds us of the need to be patient, and not to expect our actions to have direct and immediate consequences, and the need to monitor change and variables over longer timescales. In complex adaptive systems, actions can have indirect or delayed consequences.

Bringing attention to pro-sustainability changes in slow variables can be used to drive change at an institutional level, while less favourable changes in these slow variables can alert institutions and sustainability champions to forthcoming pressure or possible shocks to the higher education landscape, giving time to prepare and plan for such situations.

Learning About Learning

Learning and experimentation are critical to repurposing the university towards sustainability, because we need to find ways to do things differently, including changing our worldviews and paradigms. Working towards sustainability is inherently uncertain and situated within complex adaptive systems, requiring reflexive approaches to governance to be able to respond quickly to threats as well as to be "creatively opportunistic" (Lichtenstein, 2000).

Learning does not only happen through success, but through failure. However, failure is rarely discussed (Harrowell et al., 2018; Holdsworth, 2020) limiting our opportunities to learn from failure. For us to unlock the value of failure, we must destigmatise it. This can be done through sharing the experience and the responsibility, as well as talking more openly about our failures (Whittle et al., 2020).

How This Paper Advances Scholarship About Resilience

A Non-normative Orientation of Resilience

This paper offers a novel contribution to organisational resilience research, as most resilience scholarship in the study of organisations or groups of people uses a normative approach where resilience is understood to be a fundamentally good thing (e.g., Evans et al., 2021). In addition to allowing us to identify ways to improve the resilience of already existing sustainability initiatives, we have shown that using resilience in a non-normative way is possible, and that applying a non-normative resilience lens to sustainability governance can help identify how to destabilise unsustainable elements of a system.

For example, we have described how a non-normative understanding of resilience can help us understand how unsustainable cultures within the highly-connected higher education sector or in a university can be disrupted. Since high connectivity can lead to synchronised behaviour, disrupting these connections, through weakening them, developing alternative networks, or reconfiguring the network's constellation, can create opportunities for experimenting and creating new, more sustainable norms.

Furthermore, Biggs et al.'s (2012, 2015) principles urge monitoring of slow variables. Keeping a close eye to cracks and fissures that may be emerging within a university's organisational culture, or those appearing in the higher education sector at large, can help sustainability change-makers know where and how to apply pressure to accelerate sustainability transformation. For example, re-orienting research language around impact to mirror the emerging impact and knowledge exchange agendas can help leverage change towards sustainability in an organisation, using external shifting paradigms.

The resilience principles themselves are value-neutral descriptors. This helps us understand how the properties of a university that has a deeply entrenched unsustainable purpose can be the same properties that a repurposed, more sustainable university will need to be resilient to the tides of change in the university sector.

Operationalising Resilience Principles in the "Middle Ground" and in Different Contexts

The literature on resilience has been critiqued for a lack of operationalisation of the concept (Biggs et al., 2012; Laycock

TABLE 2 | Questions for reflection on sustainability governance based on the four resilience principles.

Resilience principle	Questions for reflection on sustainability governance
Manage diversity and redundancy	· How diverse is participation in sustainability activity and governance? · How diverse is leadership for sustainability? · How diverse are the areas where sustainability is considered? · How are different voices within the system heard? · Are different voices heard in a way that minimises tokenism and power dynamics? · How are diverse views and approaches handled so as to maintain effective working relationships and decision making? · Is sustainability activity driven from multiple different university domains? · Is sustainability tackled from a diversity of angles covering both environmental and social sustainability? · Is there redundancy in the system? · Are there multiple 'sustainability champions'? · Are there multiple people involved in sustainability projects, able to pick up on responsibilities if one person leaves? · Is sustainability driven at different levels within the university?
Manage connectivity	· What is connectivity like across different levels of the university? · What is connectivity like across different university domains? · What is connectivity like across different disciplines? · What is connectivity like across students and staff? · What is the quality of relationships between key nodes? Do multiple people have these relationships? · How are relationship skills developed and valued? · What connectivity with external partners does the university have? · Does the university bring other actors together to support sustainability initiatives within and outside of the university? · What networks and alliances with other universities can be utilised to drive sustainability?
Manage slow variables and feedback	· What are the internal and external slow variables at play that affect sustainability in universities both negatively and positively? · How close to a tipping point are slow variables? · How can these internal or external slow variables be used to leverage transformation for sustainability? · What is the organisational culture? How does this support or challenge sustainability transformation? · How is impact of sustainability interventions monitored? · Is impact monitored over long timescales? Are indirect consequences considered? · What is the slow direction of travel internally and externally? · How does organisational communication and language impact organisational culture? · How is organisational culture affected by reward and recognition such a promotion, awards or funding? · What are the reinforcing feedbacks that impede sustainability transformation? · What long-term monitoring feedbacks could be put in place?
Encourage learning and experimentation	· Is learning from projects formally reflected on and recorded? · Is learning implemented and recorded? · Is there academic expertise in the institution that can be bought to bear on sustainability transformation? · What is the balance of resources put to understanding existing activity vs. driving action? · Is experimentation encouraged? · How are small scale pilots scaled up? What processes are there to support this? · How is learning embedded in governance? · How is failure handled? Is failure discussed openly and used for learning? · How is double and triple loop learning built into governance processes?

Pedersen, 2019). There are also critiques about a lack of studies in the "middle ground" between very general and very specific case studies. This article outlines how these principles can be applied in this "missing middle ground" and within the context of higher education institutions.

Through this paper, we have identified key variables within a higher education governance context that can be used to flesh out existing generic principles for building resilience. This is important because, although these principles themselves are valuable for operationalising the concept of resilience, their application within different contexts will likely differ drastically. As such, this research contributes to a body of scholarship applying these principles in different contexts, and furthers learning about how such principles can be used in enabling improved governance for sustainability across different contexts.

Recommendations for Practitioners

Drawing on the analyses within this paper, a series of recommendations relating to each principle can be made, to enable practitioners to further leverage universities towards sustainability, and increase the resilience of positive sustainability developments.

- Diversity should be sought in participation in sustainability, domains in which sustainability is tackled, and levels of governance where sustainability is embedded. Some elements of redundancy should be built in to ensure that the loss of individual sustainability actors does not destabilise positive sustainability improvements that have been made.
- Assessing and enhancing connectivity of sustainability actors across different system domains and levels can ensure the integration of sustainability activity into diverse parts of the

system. Key sustainability actors can act as essential nodes to connect activity. The skill sets of relationship building across diverse actors should be acknowledged and actively sought for these roles. Sustainability co-ordinating roles should not be undertaken by a single individual, which leads to system brittleness, and should be sought at different levels within the system hierarchy.

- Attention should be paid to slow variables and feedbacks. Some slow variables may be outside of an organisation's control, yet some changes in slow variables (e.g., increasing emphasis on research impact and knowledge exchange) can be co-opted for sustainability re-purposing. Organisational culture is a key slow variable, and can be influenced through feedbacks including internal communication and resource allocation, and language in line with sustainability repurposing.
- Ensuring explicit and embedded structures to support organisational learning and reflection that incorporate double and triple loop learning is essential to repurposing the university towards sustainability. This may involve critically questioning what is being measured and monitored, how such data is used in learning, as well as the willingness to experiment and to fail and to share and learn from failures.

Table 2 outlines a framework of questions structured around the four resilience principles, to enable sustainability practitioners in universities to reflect upon their governance for sustainability, and identify areas to leverage change through either enhancing the resilience of sustainability elements or eroding the resilience of unsustainable elements. Ultimately, this paper appeals to the practitioner to use these resilience principles not just to improve the resilience of current aspects of sustainability, but to question how the current system can be destabilised to create space for sustainability.

CONCLUSION

Universities have been conceptualised in this paper as complex adaptive and socio-ecological systems that require repurposing towards sustainability. We have used (Laycock Pedersen et al., 2019) adaptation of Biggs et al.'s (2012, 2015) resilience principles in a novel non-normative manner, to address how to *decrease* resilience to destabilize our prevailing unsustainable university systems, as well as seeing how these principles can help us adapt university governance for sustainability.

We have highlighted the importance of diversity in participants and spheres of sustainability activity as well as the importance of embedding some redundancy within sustainability governance structures, and the danger of a focus on maximising efficiency. We highlight the importance of connectivity between different actors within the system, mediated strongly by the quality of these connections and the strength of relationships between nodes. Slow variables such as academic traditions and organisational culture as well as national policy and regulation trends provide an important and shifting backdrop that influence universities' engagement with repurposing towards sustainability. Monitoring of these slow variables and reflecting on their influence can be important to flexible and adaptive management within sustainability governance. Feedbacks within these systems present potential leverage points to destabilize currently unsustainable university systems. Finally, we highlight how developing explicit structures and culture to facilitate learning, that critically reflect through double and triple loop learning and engage with failure, are at the core of a university genuinely working towards repurposing towards sustainability.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

All authors equally contributed to the article and approved the submitted version.

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