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Discussion Document
Introducing Metrologies:
**Initial reflections on grower responses to audit measures in
the NZ Sustainability Dashboard project**

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The New Zealand Sustainability Dashboard project Research Partners



Executive Summary

The development of a sustainability dashboard is essentially an exercise in generating metrics – providing a suite of measurable indicators that enable comparison and benchmarking. This discussion paper provides the basis to initiate discussion within the New Zealand Sustainability Dashboard (NZSD) research team regarding the implications of such an implementation of metrics as a mechanism to promote improved practice in the primary sector. The discussion draws on the concept of ‘metrologies’ as developed in the social science literature. The main points of discussion include:

1. Metrics have enormous potential to restructure practice, orienting best practice to the improvement of a selected suite of indicators.
2. Past research in the ARGOS project demonstrated that metrics can facilitate improved practice in terms of social, economic and environmental criteria.
3. Metrics have, however, also been shown to adversely impact practice by narrowing the focus of management, thereby obscuring the impact of processes or dynamics for which indicators do not exist.
4. In terms of achieving sustainability, further critique of metrics raises the issue of whether sustainability is ‘measurable’ and the extent to which sustainability can be sufficiently defined such that appropriate metrics are identified and implemented.

In the paper, we orient discussion around the influence of metrics on production systems. We propose that metrics play at least three roles in the management systems where they are applied: a) as pure measures that are subject to interrogation in regard to their legitimacy and accuracy; b) as tools employed by more powerful actors in the systems in order to control and direct the practice of other participants; and c) as agents which influence and order the practices of all participants within the system beyond the expectations or intentions of those who implement the metrics. These aspects of metrics are explored in three case studies.

Kiwifruit

1. The introduction of metrics into kiwifruit production systems in New Zealand was largely as pure measures (e.g., pest counts, economic cost-benefit analyses, etc.) relevant to IPM (Integrated Pest Management) practices developed in response to crisis in the sector.
2. The success of the initial metrics facilitated further metrics related to quality control and, later, sustainability criteria that were used as a tool to homogenise production and fruit quality across the sector.
3. In the process, the metrics created an environment within which new social relations among growers, pack houses, ZESPRI, suppliers, labourers, etc. developed. This later dynamic demonstrates the agency of the metrics in the sector.

Wine

1. For the wine sector, metrics were introduced as part of a strategy to position New Zealand wine in export markets – and thus were implemented as a tool to organise production and to introduce uniform quality standards.
2. The strategic introduction of metrics (and labelling) created the necessity for accepted and scientifically verifiable measures which were drawn from a variety of existing, emerging and novel sources.
3. As the result of these efforts, there is evidence of the agency of metrics in the wine sector as well, including the relationships between growers, suppliers, winemakers, labourers, councils, etc.

Indigenous branding

1. Efforts to introduce metrics into Māori production systems are examples of the agency of metrics in society extending into non-western cultures at their intersection with Pakeha society and economy.
2. Māori corporate entities have strategically utilised the emerging influence of metrics to both communicate Māori cultural values (and attach these to products for consumption) and to translate western management concepts for the benefit of decentralised tribal control structures.
3. Considerable effort has been placed in the development of measures that are legitimate in terms of western business management standards while conforming to Māori cultural understandings.

In the Discussion and Conclusion, we argue that it is imperative for projects such as the NZSD to remain aware of the variety of roles played by metrics as they are introduced to the primary sector. In particular, it is essential to recognise that a sustainability dashboard cannot be viewed as a neutral and unbiased intervention to production and management systems. Furthermore, the metrics selected will produce unexpected and potentially undesirable changes that are likely to change the terms and objectives of the original project. This indicates that a sustainability dashboard should not be conceived as achieving a finalised (and perfect or optimal) structure, as the emergent nature of the social and environmental relationships within which the metrics operate will generate new and unexpected challenges to sustainability.

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Introducing Metrics

Report aims and structure

The underlying rationale of the New Zealand Sustainability Dashboard (NZSD) is that sustainable practice can be encouraged through the broader diffusion of information about the social, environmental and economic impacts of existing primary sector management. Because the intention is to facilitate the interpretation of such knowledge through comparative analysis (or benchmarking) of an individual's or a location's performance relative to that of peers, the process necessarily involves the defining of sustainability through measurement. The result is a scientifically defined quality that can be attached to individual primary sector operations and which allows those with management responsibility to choose an appropriate response to the data provided by the NZSD. The NZSD is, therefore, an attractive proposition as a tool that can facilitate best practice through individual learning and awareness as opposed to regulation or financial incentives that are considered more expensive, less acceptable (to either producers or consumers), or less efficient means to promote sustainable practice.

The structure and nature of the NZSD does, however, raise some issues of concern as well. The most obvious question involves the extent to which the resulting array of sustainability criteria represents the research team's own understanding of what sustainability 'should' be rather than a more objective assessment. To address such concern, the development of the NZSD has demonstrated both rigour and transparency in the selection of criteria for inclusion in the dashboard (see, for example, Hunt et al. 2014). But additional questions regarding how the measures that underlie it are *translated* by users of the NZSD also require similar rigour and transparency in their discussion. This discussion paper uses the concept of metrologies – that is, the dynamics inherent to measures or metrics as these redefine and change social practice – to develop a framework by means of which we can critically engage with the potential for initiating change through the NZSD, including unintended and unexpected change that frequently emerges beyond the targeted practices. Those issues of particular relevance to the elaboration of metrologies centre on whether the contexts in which users interpret metrics (as numeric representations of social, environmental or economic processes) result in different meanings and, perhaps, point to different outcomes than anticipated. Part of the answer to this question (beyond constant observation of the emerging response and use) lies in our understanding of how metrics impact on social relations. The following discussion provides the basis for an engagement with the 'agency' of metrics (how they contribute to social-environmental relations and dynamics, independently of the intentions of those implementing them), especially as these might inform the ongoing design of the NZSD and the expectations of its impact on the practice and the mind-set within the targeted primary sectors.

In addition to the framing of metrics in this paper, any discussion of current activities within the NZSD project will be more fully informed through reference to work conducted in the kiwifruit sector (reported in Hunt, 2014), Māori reporting frameworks (Reid et al. 2013) and the wine

sector (Sautier et al. 2015). These additional documents provide empirical 'flesh' to the theoretical 'skeleton' presented in this paper. Ideally, the discussion initiated in this document will facilitate a new, cross-project engagement with the empirical reporting which opens understandings within the project team of the potential of metrics (both for achievement and contestation of sustainable practice) within the NZSD development.

Measuring Sustainability and the need for Metrology

One of the greatest challenges in the pursuit of agricultural sustainability, and a regrettable characteristic of many recent scientific endeavours, has been a frustrating inability to bridge the gap between aspiration and outcomes. Despite a growing array of ideas, strategies and policies associated with emerging scientific insights into sustainable processes, new technologies to intervene into systems, ambitious policy claims and targets and personal intentions, the widespread realisation of sustainable transitions has failed to eventuate. In an effort to address this failure, some researchers have shifted their focus of inquiry from the basic question of **what must be done** to achieve more sustainable outcomes for socio-ecological systems to the more complex question of **how might we translate** aspirations into outcomes. One element of this recent shift has been an increasing interest in the capacity for sustainability-related standards and measures, audit systems, indices and benchmarks to enable sustainable transitions (Campbell et al. 2012). New technologies of audit have been assembled around networks of producers, consumers, retailers, scientists and other actors to create dense webs of measures and standards which are increasingly influential in organising the practices of food producers (and consumers) around the world (Busch and Bain 2003; Le Heron 2003; Marsden 2000; Mutersbaugh 2005, 2008; Hatanaka et al. 2005; Giovannucci and Ponte 2005). In an arena beset by failure to enact change, technologies of audit have become established as something that arguably do re-order economic and social practice. However, even as the power of new audit systems is being recognised, we need to better understand whether the measures that sit at the heart of such audits are strictly neutral elements or they introduce new possibilities and challenges. In order to develop such understanding, this discussion paper will introduce the new critical/historical study of measures – metrology – to the debate around the significance and impact of the new audit-based approaches to achieving greater sustainability.

The need for a more nuanced approach to theorising the seemingly neutral world of measures (and the grades, standards, protocols, thresholds and sanctions based upon them) is demonstrated by the recent discussion around the potentially negative or positive outcomes of pursuing sustainability via measurement. Bell and Morse (2008: xvii) exemplify a strongly negative critique arguing that any attempt to measure sustainability is a “futile exercise of measuring the immeasurable”. They further claim that quantifying sustainability has not succeeded as an approach to achieving it, noting that quantification has merely resulted in “measuring things that can be measured and not things that should be measured” with the result that sustainability becomes “defined by the parameters that can be measured rather than the other way around”. This critique poses some important questions about any attempts to engender more sustainable practices via measurements, benchmarks or standards.¹

The opposite argument – that outcomes of sustainability measures might not be entirely negative or, at the least, should not be simply dismissed – can be drawn from prior research by this group of authors in the ARGOS project (Campbell et al. 2012). While this research was not directed at exactly the same kind of sustainability indicators that Bell and Morse (2008) critique, it did consider the ways in which performance measures might influence the uptake of sustainability audits and practices. The ARGOS work was based on a longitudinal study of over

¹ The argument that measuring sustainability is an inadequate proxy for actually delivering sustainability is not the only potential critique of metrics in farming systems. Jay (2007) identifies metrics in the New Zealand dairy sector as being the catalyst that are actually driving unsustainable productivist approaches by dairy producers.

100 farms and orchards in New Zealand which included an overt focus on new sustainability indicators and audits and their relationship to different aspects of farm and orchard performance (see www.argos.org.nz). ARGOS directly examined an expanding array of sustainability audits (like Certified Organic or Global G.A.P.) being deployed by industry groups and related networks with the expressed intention of shifting farm and orchard practices to meet new market demands for sustainably produced products (Rosin et al 2007a, 2007b). What became clear in the wider ARGOS analysis (as argued by Campbell and Rosin 2011) was that most of these new audit systems were established around specifically negotiated and implemented sets of measures. Put simply, the sectors studied by ARGOS were elaborating 'metric-centric' approaches to auditing sustainability and thus they represented useful sites for examining the positive or negative effects of trying to achieve 'sustainability via measurement'.

After 9 years of collecting data on different dimensions of farm and orchard activity, ARGOS results were used to evaluate the outcomes of taking the audit pathway to sustainability. The findings suggested that: 1) market audit systems were becoming the dominant mechanism by which both government and industry sought to change on-farm practices and to underwrite market claims around sustainability (at least, such was the case in a highly export-oriented country like New Zealand) (Rosin and Campbell 2009; Campbell et al 2012), 2) that the audits themselves were implicated in observable differences in on-farm management practices, social dynamics and ecological outcomes (differences that were, however, clearly co-produced with other dynamics like individual subjectivity/agency and wider industry culture and strategic change) (for the social dynamics of this see Campbell et al (2012). For more economic or ecological results see www.argos.org.nz) and, 3) that such differences were relatively modest, representing, when viewed optimistically, a means for incrementally shifting mainstream production from established on-farm practices – but, realistically, falling some way short of the kind of step-change needed to induce more systemic-level redesign of farming systems, practices and cultures (for more discussion of this see e. g. Moller et al. 2015).

Returning to the question posed at the outset, ARGOS demonstrated that in the New Zealand setting, market audit schemes based around a set of metrics act as one modestly effective means of translating sustainability aspirations into on-the-ground action within farming systems. Consequently, rather than dismissing all such exercises in 'measuring the unmeasurable' as being incompatible with achieving sustainability outcomes in both industry and policy settings, it is worthwhile considering more deeply what kinds of dynamics are animating (or muting) the kinds of changes that ARGOS observed.

More specifically, in this discussion paper we want to undertake a re-framing of the usual way of approaching social scientific studies of the social processes, institutions and dynamics around sustainability; that is, the kind of approach which focuses on the different pathways and outcomes that are achieved between state regulation, industry actions, voluntary protocols and codes of conduct, formal market-audit mechanisms, individual voluntarism or community governance. While all of these are worthy of social scientific consideration (and the ARGOS project is an example of exactly this manner of framing pathways to sustainability), we argue that taking the next step in understanding the translation of sustainability aspirations into the re-organisation of actual social and economic practices requires us to embrace a turn toward the material by examining the way in which metrics rather than institutions potentially organise action. Such an approach recognizes that within the process of establishing measures of sustainability, metrics assume authority by setting the parameters for appropriate practice.

Following the work of Barry (2002), Callon et al. (2007) and Mitchell (2002, 2008), a metrology approach re-centres analysis of networks of economic activity towards understanding the way that metrics order or structure behaviours and practices – in effect, creating a framework to which people and things adhere. This effectively reverses the usual causality that implicitly informs social scientific analysis that places the human or institutional actor as the sole agent of all action. In an insightful example of this alternative approach, Henry and Roche (2013) describe how, in the context of the recent history of the New Zealand meat industry, the creation of meat standards, genetic measures of stock ‘quality’, as well as the creation of a global standard for Wagyu beef production all became central features in re-organising the production, processing and ownership of elements of the meat industry. Another example is that provided by Cooper (2015) in his analysis of the metrologies of carbon emissions trading (or failure thereof) in New Zealand.

Our application of a metrological approach extends beyond the rising interest in metrologies to provide, we argue, greater understanding of how sustainability measures translate into action in some contexts. There is also a parallel (and not unrelated) set of questions posed by the rapid elaboration of new media, technologies and platforms for mobilising sustainability concerns. In a world where sustainability claims are increasingly made via websites, using iterative tools, models via online interface and real-time intrasectoral benchmarking, assessment of the extent to which metrological processes order outcomes is highly relevant. Thus, in centring metrologies in this analysis, we are not only responding to the emergence of new theoretical questions around the organising power of metrics, but also seeking to inform the way in which new process technologies and platforms should be designed. This is of particular relevance at this stage of the development of the NZ Sustainability Dashboard.

Understanding Sustainability and Market Audits through Metrology

For the purposes of this paper, we will examine existing engagements with metrics of best practice (mostly addressing sustainability issues) in the context of three economic settings in New Zealand where attempts have been made to deploy the kinds of metric-centric approach to sustainability reported by the ARGOS project and now being deployed in the NZSD: kiwifruit, wine and indigenous branding. In order to understand the metrological processes that have influenced each of these cases, we need to interrogate numerous aspects of the development of sustainability metrics like: how indicators are selected, the underlying logics of the metrics, or the extent to which metrics re-order the organisation of worlds of economic activity. To get some insight into these kinds of metrological dynamics, this paper will examine the operationalisation of sustainability measures that took place within New Zealand primary sector production: 1) the evolution of the GlobalG.A.P. audit and subsequent revisions to its metrics within the kiwifruit export industry, 2) in the wine export sector where the industry has developing a local protocol for positioning New Zealand wine at the premium end of the world table wine market and, 3) attempts by tribal groups of New Zealand's indigenous Māori to experiment with brand demarcation and management of commercial products that attempt to delineate both measurable and non-measurable qualities.

Taking a metrological approach to understanding the creation and implementation of particular cases of sustainability auditing requires us to reflect on a series of key questions about the processes and decisions (and materialities) behind the ways in which particular metrics became important in the operationalisation of specific audits. Two dynamics are particularly relevant:

1) How indicators are valued, selected and operationalized. Taking a metrological approach requires us to ask questions as to how particular values are 'fixed', indicators are selected and then embedded into wider audits of sustainability. In the context of New Zealand's agri-export sector, two of the following cases demonstrate the degree to which particular indicators were selected based on international market requirements rather than as part of an endogenous assessment of actual sustainability dynamics in New Zealand. To what extent, reflecting Bell and Morse's (2008) critique, were metrics adopted because they were measurable rather than due to their relevance to the actual questions about the sustainability of sectors? Using a metrological approach also requires us to consider measurement itself as being the product of stabilisation of a range of actors and dynamics that must act together to co-produce a stable outcome. This can be partly driven by scientific knowledge production, partly by social convention, and, importantly, partly by the materialities of networks of action. Some metrics, as the following cases demonstrate, become important not just because they are worth measuring, but because changing practices and technological innovation actually enable a measurement in the first place.

2) The potential of metrics to re-order economic networks and worlds. A metrological approach requires us to re-focus our enquiry away from the traditional focus on specific policy initiatives and platforms, or from particular institutional actors like industries, firms, farms or individuals and rather to examine the potential for metrics to become the mechanism for re-ordering economic worlds. Henry and Roche (2013) demonstrate that three different sets of metrics effectively re-ordered large elements of the economic world of meat value chains in New

Zealand. In a similar way, metrics in the case studies tend to indicate that ordering is happening specifically around the value chain that links farm and orchard-level practice, through various intermediaries and eventually to destination retailers, locations and institutions. This provides an important transition in our assessment of sustainability metrics from simple categories of good or bad towards a more complex understanding of metrics as enactive and constitutive of particular realms of action that may or may not facilitate the elaboration of alternative forms and networks.

The following case studies will examine how these two dimensions of the emergence of particular sustainability metrics have evolved, been negotiated, contested and enabled, within particular industry and other groups in New Zealand. Each case demonstrates different dynamics that reveal the way in which often highly contrasting social and economic dynamics have nevertheless embedded a metric-centric approach to sustainability and consequently re-ordered networks and social practice within those economic worlds. The following cases reveal that the establishment of metric-centric approaches to sustainability has had enactive qualities – actually enacting new networks and modes of actions rather than just reflecting the preferences of specific institutions and actors.

Case Study: Kiwifruit

The New Zealand kiwifruit industry has been extensively studied as a notable case of the adoption of more sustainable practices via audit mechanisms and associated metrics within a relatively large, export oriented agriculture sector. Prior research has documented a major transformation of the sector during the 1990s from the bulk export of kiwifruit as a commodity to the more targeted export of quality-audited and marketed kiwifruit that eventually captured the top end of the world market (Campbell and Rosin 2008). Interest has commonly centred on the actions of Zespri as an unusually configured and highly successful actor in facilitating this transition. In this account, however, we want to highlight the integral contribution of metrics to this success. In other words, while the transformation of the kiwifruit sector is attributed to multiple strategies and policies, we argue that the impetus for the 'metric centric' condition of the sector lay in the normalisation of IPM practices. This normalisation was achieved through the implementation of the KiwiGreen scheme as part of the sector's response to complaints issuing from the European market regarding 'pesticide residues' in fruit in the early 1990s (Campbell et al. 1997). Thus, as a solution to the residue issue, compliance with the IPM protocols introduced the metrics of insect and disease counts as a whole of production chain responsibility.

The first element of a more specifically metrological analysis of the transformation of the kiwifruit industry in New Zealand requires us to look more closely at how particular measures were selected and operationalised. In the case of kiwifruit, this process is integrally linked to the development of objective and credible measures that legitimised an alternative set of pest management practices.

Introducing metrics as measures

Prior to the early 1990s, kiwifruit metrics were relatively simple. A pest-free status was achieved through a heavy regime of pesticides, and fruit was graded according to size and visual qualities. The most notable metrics involved the grading of the single variety (*Actinidia deliciosa* – or Hayward Green) into Class 1 (Export), Class 2 (Domestic) and, after 1991, Certified Organic. Apart from organic, the key criteria for demarcating Class 1 and Class 2 were visual appearance and size. Kiwifruit had to be blemish free and of uniform shape to grade as Class 1, while different export markets were identified as having specific size requirements (e.g., Japan tending towards larger fruit and Ireland towards small fruit) (Campbell et al. 1997).

Beginning with the crisis that emerged around pesticide residues in New Zealand kiwifruit being exported to Italy in the early 1990s, the sector experienced a rapid escalation in the number and complexity of metrics. The danger of rejected export shipments undermined the legitimacy of the practice of calendar spraying as a means to eliminate pests. Integrated pest management offered a viable solution, but the elaboration of scientific knowledge around pest thresholds and acceptable 'targeted' pesticides was restricted to a small group of scientists working with the similarly small group of certified organic kiwifruit producers. Campbell et al. (1997) documented that the combination of market crisis, industry insolvency and the collapse of commodity-style exporting of green kiwifruit suddenly elevated the work of a minority of scientists and organic growers to the forefront of a new industry strategy. The new measures and metrics were urgently needed to re-secure entry into the lucrative European market.

The IPM related metrics that were operationalized under the KiwiGreen scheme through the mid-1990s were an initial step in the revitalisation of the New Zealand kiwifruit sector. They are not, however, a sufficient explanation for the metric-centric practice that currently organizes practice in the sector. The continued predominance of metrics was hugely influenced by the emerging requirements of European supermarkets and food co-ops. The formation of the Euro-Retailers Working Group: Produce (EUREP) – with the direct involvement of Zespri – situated New Zealand kiwifruit production at the centre of early negotiations within technical standards committees in EUREP about crop production protocols in the resulting EurepGAP standards for kiwifruit production (Campbell et al. 2006).

Not only did this create an initial level of legitimacy for the auditing scheme in New Zealand, but it also provided Zespri the leverage to negotiate reduced emphasis on criteria that elicited the most contestation from orchardists. As a result, what could easily be interpreted as an excessively detailed audit has been adopted within the sector with relatively limited objections (Rosin et al 2007a, 2007c). It is also evident that such auditing has resulted in both greater awareness of environmental and social impacts of practice as well as improved outcomes while not negatively impacting the financial viability of the sector (Rosin et al 2010, Campbell et al 2013, Saunders et al. 2009).

The emergent character of metrics as a tool

The specific metrics that became embedded in this process involved the solidification into concrete measures things that were previously the subject of abstract scientific enquiry or marginal experimentation. Particularly, this involved the establishment of ‘thresholds’ for the presence of the major kiwifruit pests along with a selection of pesticide application intervention levels and doses in alignment with the HACCP-based protocols of the EurepGAP audit alliance. In the hands of Zespri and EUREP, the metrics also became a tool for ensuring greater homogeneity across the supply chain, a characteristic that Zespri has used to ensure price premiums for New Zealand growers. Commencing with an urgent priority on creating ‘residue-free’ fruit, the audit also created the framework for elaboration of a number of new measures such as brix and dry matter levels (as indicators of taste).

The GlobalGAP audit placed these specific measures within a three-tier system of audit alliance with specific management actions being ranked as ‘Major Musts’, ‘Minor Musts’ and ‘Recommended’ and each orchard audited to meet particular metrics of compliance with each tier. At the level of kiwifruit orchardists themselves, the new metrics were rolled out through the KiwiGreen manual which listed both the HACCP compliance points and indicated how kiwifruit producers could ‘measure up’ to the requirements of each compliance point (Rosin et al 2007a, 2007b). The end of this process was a shared set of measures, with fixed values, that were enabling multiple parties to participate in the same ordering of economic action.

Metrics and the Re-Ordering of Economic Worlds

To this point our examination of the emergent centrality of metrics in the kiwifruit sector varies only in focus from more traditional analyses of the revitalisation of the sector in the 1990s (eg.

Campbell et al. 1997). A metrology-influenced approach, however, also allows a more critical reflection on the established narrative that Zespri was the empowered actor that initiated and consolidated new, successful strategies for the sector while re-centring the focus of our examination on the re-ordering enabled by the new metrics that created entirely new networks of action and established the field of action into which Zespri later arrived and was able to consolidate.

Much of the success in the implementation of KiwiGreen was the product of the relevance of its metrics to many of the actors in New Zealand. Prior to its introduction, the IPM protocols – based around both the identification of critical infestation thresholds on vines and the establishment of minimum effective pesticide interventions - had been developed and verified by HortResearch scientists for whom the programme was a vindication of population ecology theory. For Zespri, the metrics provided a means to control and to communicate the limits inherent to that control. The kiwifruit packhouses are able to ensure the quality of fruit by maintaining the technical experts who assessed the severity of insect and disease threats reported by supplying orchard owners and managers (using the values being fixed by scientists as indicating such thresholds) and regulated the ability to spray (again using newly fixed values and categories of ‘safe’ and ‘unsafe’ spraying). The shared acceptance of pest control based on metrics of projected damage calculated with reference to existing populations coupled with the successful revitalisation of the New Zealand kiwifruit sector thus established an environment within which metric-based management criteria became a normal element of production. The metrics at the heart of the KiwiGreen IPM system thus established and coordinated action between multiple parties in the local industry and up the value chain.

The initial focus on the rationalisation of pesticide usage was very successful both in re-ordering industry activity and later facilitating more extended metrics to include a diverse range of measured fruit qualities and audited management practices (via the broader elaboration of the KiwiGreen programme and retailer-driven best practice audits) which enabled a differentiated engagement with the high value markets that reward such qualities. The marketing success associated with these practices strengthened the role of Zespri by reinforcing the value of its marketing knowledge to the orchardists. As a result of these achievements, Zespri was able to assume a leading role in the development of best practice criteria for a grouping of European food retailers that eventually became GlobalGAP (Campbell et al. 2006).

While the dynamics that became bundled under Zespri are interesting for the way in which they reveal the re-ordering and network building role of metrics, there was an associated set of developments at the level of orchard practice and grower activities. The initial response of growers to new metrics and a broader scope of audit was less than receptive; however, the emerging metric-centric orientation of orcharding practice (what prior analysis described as a new ‘spirit of farming’ (Rosin 2008)) had sufficient momentum to limit the impact of those challenges. This process was reinforced by the relatively positive economic outlook for the sector, although this was beginning to deteriorate in the 2000s with competitive price pressures on the green kiwifruit. Zespri attempted to alleviate the financial challenges to viable green kiwifruit production by introducing three new varieties (one green and two gold). The introduction of these new varieties had a two-fold effect: 1) raising hopes for greater profitability based on experience with the initial success of the existing gold variety; 2) concerns regarding the uncertainty of best management practice and the potential fruit quality of the new varieties. In

other words, there was no certainty that the usual practices would achieve metric-compliant fruit with the new varieties.

Further challenges to the established metrics in the kiwifruit sector have emerged with the crisis surrounding the arrival of the PSA vine disease. The susceptibility of the vines to the disease has temporal correlation with practices (i.e., girdling) that met specific fruit quality metrics (dry matter) by 'stressing' the vine. The debate regarding the value of the girdling practices demonstrates the power of metrics in altering relationships between orchardists, their colleagues, their vines and the rest of the value chain.

In summary, the success of audit metrics in KF is the product of the shared acceptance (relevance) across the value chain – i.e., growers attained greater certainty through proven practices and positive feedback from local communities and markets; contractors were required to 'up-skill' but also received greater recognition of their importance to the sector; packhouses retained regulatory control over some on-orchard practice through spray assessments while also getting greater consistency in supply relationship with ZESPRI; ZESPRI was able to rely on consistent and higher quality production and also create a narrative that sold in international markets; retailers had safe, high quality product; consumers found a responsive producer/supplier of desirable fruit with verified social and environmental practices.

Case Study: Wine

The New Zealand wine sector shows some parallel development toward the acceptance of metric-centric regulation of practice, especially as evident in the emergence of the Sustainable Winegrowing New Zealand (SWNZ) labelling scheme in 1995, with commercial implementation in 1997. Initially, SWNZ audit criteria focused exclusively on vineyard practices, with best practice criteria for wineries added in 2002. As with the kiwifruit case, concerns regarding market access and positioning provided the rationale for the introduction of best practice metrics for wine (albeit without the same extent of crisis). In this case, the emphasis was on the maintenance of a premium market position and proactive diversion of environmental concerns for an export product that represented a relatively small proportion of global trade. Further notable distinctions include the voluntary nature of the SWNZ scheme (although the fact that it is a requirement for participation in New Zealand Winegrowers events including the New Zealand Wine Awards helps to raise compliance to 94% of winegrowers and wineries) and the lack of a similar ability to demonstrate its value adding capacity given the unique marketing relationships for wine. Most relevant to the examination of the role of metrics, however, is the fact that the introduction of metrics was largely predicated on their influence as a tool as opposed to objective measures.

A metrology in search of metrics

Whereas the introduction of audited practice in the kiwifruit sector was predicated on the development of objective measures necessary for integrated pest control, the SWNZ scheme began with a firm conception of a mechanism that would help coordinate production and lead to a more consistent export product. The actual metrics therefore reflect the shared elaboration of sustainability criteria within the wine commodity chain more generally rather than a response to a specific local crisis of the sort faced by New Zealand kiwifruit in the 1990s. For example, the International Wine Organisation (OIV, an intergovernmental organisation) and the International Federation of Wine and Spirits (FIVS, an industry interest group) have both identified sustainability as a key aspect of the viability of the wine sector. The latter group produced the Global Wine Producers Environmental Sustainability Principles in 2006, parts of which were incorporated within the Guidelines for Sustainable Viticulture resolution adopted by the former in 2008. The relevance of sustainability labelling for wine exports is further reinforced by the attention it garners within the World Wine Trading Group, where schemes in seven countries are tracked in order to avoid the potential that these emerge as trade barriers.

The objective of the SWNZ scheme is therefore to project a credible image of sustainable production without addressing a specific threat in terms of market access. As a result, it is not surprising that many of the metrics employed by the scheme have direct relevance to shared conceptions of good vineyard management. For example, there is a strong emphasis on soil management – an important practice for the protection of soil physical and biological properties – that is rationalized within the scheme on the basis of the ‘special relationship’ between the winegrower, the vines and the soil. Many of the specific soil measures comply with both commonly recognized environmental outcomes as well as the interests of winemakers (and wineries) in sourcing grapes from controlled yields. In this case, the New Zealand producers benefit from verifying their adherence to environmental practice while simultaneously incorporating the argument that the character of the grape is more fully realized when it is

exposed to the 'limitations' of the soil and climate in terms of nutrient and water availability (what is frequently referred to as 'terroir'). Further recommended practices extend these conceptions of soil management to more scientific measures of nutrient applications (and run-off potential), soil copper levels (for biodiversity implications) and undergrowth management. Such metrics begin to shift the focus of vineyard management toward aspects that do not directly impact on grape quality or yield quantity.

Other metrics focus more specifically on the environmental expectations of consumers and the use of best practice in the sector. For example, the scheme imposes constraints on the application of chemical controls for disease and pests, the management of water and irrigation, the treatment of by-products, impacts on the atmosphere and energy use. In each of these cases, the position of SWNZ is that they involve necessary aspects of wine production and the focus of the scheme is on greater efficiencies. The point of these measures is to demonstrate positive trends towards the rational use of inputs and to communicate a narrative of environmental stewardship to concerned consumers. These metrics create an environment in which relative usage and application become targets of practice and lead, in some cases, to contestation of their 'fairness' in comparative situations. For example, Hawkes Bay vineyards are faced with more pest and disease friendly climates and, thus, have generally higher chemical application rates. Similarly, energy use is likely to be higher for regions requiring higher levels of frost protection.

Energy and water use have received more focused attention within the scheme. This is, in part, a reflection of the relative ease of measurement of these inputs which already had metered flows, especially within wineries. The advantages of more efficient use of such inputs were also already apparent to participants; and the ability to benchmark practice relative to the reporting of a majority of colleagues allowed many to achieve cost savings. In addition, efficiencies achieved in terms of such inputs also provided cost savings for producers and winemakers.

Re-ordering of economic worlds?

Whereas there are obvious parallels between the impact of the respective kiwifruit and wine sector audit schemes, the SWNZ metrics do not appear to establish the same level of coordination of the sector's economic worlds. A major influence on the implementation of metrics in the wine sector involves consumer expectations regarding the quality of wine and their ability to distinguish between producers. In comparison to kiwifruit, which is largely differentiated by size, shape and firmness at the point of consumption, the wine from an individual winery can be distinguished by branding and is subject to the taste preferences of the consumer. As such, the value of an audit based on practice can be considered secondary to the marketing of a wine label. Evidence of the secondary nature of sustainability labelling is found in the inconsistent use of the SWNZ logo by registered winemakers.

A frequently more prominent feature of labelling involves reference to recognised assessors of the tasting qualities of a wine. The selling of wine is promoted to a great extent by recognition of its quality among experts who rate the quality of wine according to preferred tasting profiles. This process occurs either through participation in wine judging competitions or in the tasting notes of noted wine tasters which are then often translated into metrics that are deployed at the point of sale. The most notable competitions in New Zealand are the Air New Zealand Wine

Awards and the Bragato Wine Awards, but New Zealand wineries will participate in international wine shows as well in order to establish 'verified' recognition of quality. An important means of increasing sales is to garner a good review from the likes of Oz Clark (in the UK) or Robert Parker (in the US). Such expert evaluators have a strong influence on preferences in markets. This is especially important for emerging wineries or varieties that lack the brand recognition to generate sales. In several cases in New Zealand, market breakthrough overseas came with the awarding of a '90+' Parker score.

A further limitation to the re-ordering capacity of metrics relates to the more individualized access to markets for wines. The wine sector has no direct equivalent to Zespri as a single desk exporter, with the New Zealand Wine Institute acting largely in promotion and setting quality standards for export. In this context, wineries will be the primary agents for marketing wines to international distributors. Given the dispersed negotiations, it is difficult to establish the added value of SWNZ certification and, even more so, to translate this into terms that are relevant to growers and contractors. The extent to which the metrics are used to integrate economic worlds depends, thus, on whether a given winery perceives benefits in making the sustainability claims an essential element of their marketing narrative. Wineries who are less inclined to refer to SWNZ certification in the marketing often portray their compliance as a proactive effort to divert strategic challenges from competitors.

The agency of metrics in the New Zealand wine sector is apparent in their capacity to extend influence beyond the anticipated rationalisation and homogenisation of production and winemaking practices. The enrolment of metrics within the wine commodity chain also involves a reorganisation of relationships between winemakers and consumers (and by extension exporters, wholesalers and retailers) with the potential to exert greater control over the production of grapes supplied by contract growers. Because sustainability metrics are more directly linked to internal vineyard management, they enable greater scrutiny of practice and establish the basis for verifying compliance throughout the chain.

Case Study: Indigenous Branding

To this point, we have discussed case studies in which the novelty of the introduction of sustainability metrics involved the expansion of existing cultural practices (i.e. the acknowledgement of economic and science-based logics of best practice) to new aspects of commodity production (i.e., environmental sustainability). The apparent beneficial contributions of metrics – as agents – to the economic viability of economic practice (both in New Zealand and internationally) has also promoted their enrolment within culturally distinctive contexts, namely as a means to translate and eventually integrate Western market conceptualisations of sustainable practice within Māori economic development. This suggests that, in the case of indigenous branding, the agency of metrics was already in evidence prior to the overt adoption of metrics as measures and tools within Māori production frameworks and a desire to grab onto the potential agency of metrics was a driving motivation behind their deployment.

Response to re-ordering economic worlds

The unique cultural context of the emerging set of metrics inherent to the development of indigenous sustainability reporting systems within Māori tribal authorities provides an insightful contrast to the kiwifruit and wines sectors. To understand this indigenous approach to auditing, it is necessary to explain the drivers, motivation, and context underpinning its development. This narrative starts with Ngāi Tahu, one of New Zealand's largest Māori tribes. Following the settlement of Treaty of Waitangi grievances with the New Zealand government in 1996, Ngāi Tahu used capital they received to establish a number of successful tribal enterprises in the forestry, farming, fishing, and tourism sectors under the umbrella of its corporate body, Ngāi Tahu Development Corporation. To date, Ngāi Tahu has grown its asset base from \$178 million in 1998 to \$880 million in 2013, while distributing \$280 million in development funds to its communities.² Similar success has been realised by other post-settlement tribes, giving rise to the term 'taniwha³ economy' to refer to the rapidly growing tribal business sector (Sharples 2012).

This economic success also raises challenges, both external and internal to Ngāi Tahu, related to the sustainability of the enterprises involved. After many years of fighting 'rear guard' actions against the New Zealand government in pursuit of social justice and greater environmental protections, Ngāi Tahu and other tribes are finding ways to align their emerging business and political interests with their environmental ethics and worldview (Reid and Rout 2015). In fact, in order to maintain credibility, the high environmental and social standards that tribes once demanded of those in positions of power are now the default standards by which tribes must abide by in their own business activities (Reid et al 2013). The tribal authorities are aware of the growing demands for sustainable products from discerning consumers internationally and the premiums such consumers are willing to pay. Furthermore they are cognizant of the increasing sustainability standards under development in the areas of food and fibre production. Consequently, there is recognition of the risks to their business of losing quality markets from

² New Zealand dollar figures.

³ A *taniwha* is the Māori term for what would possibly be translated as a 'water monster' or dragon, but in the Māori usage, the term conveys both threat and also potential power. Thus, the Taniwha Economy is an unrecognised source of economic power that may be big and have unexpectedly large influence.

failing to keep-up with developing standards, as well as losing potential opportunities in premium markets demanding products that are sustainable.

In addition, Ngāi Tahu and other tribes find themselves in the somewhat unnatural arrangement of having their assets consolidated within tribal corporations. Tribal members are elected to a council to act as Trustees over corporations, protecting and growing tribal assets for the benefit of current and future generations. This arrangement is in stark contrast to traditional configurations in which rights and governance are within the domain of the extended family and sub-tribe. As a result, a degree of political tension exists between the central governors and managers of assets and their beneficiaries, the latter ultimately perceiving that their tribal corporations control what should be an asset of their family or sub-tribe (Barr and Reid 2014). Consequently, pressure is placed upon tribal governors to assure constituents that assets are being managed responsibly and capably. In addition, tribal entities struggle to populate their commercial bodies with tribal members due to shortages in technical capabilities within their communities. As a consequence, these commercial entities are primarily managed by 'outsiders,' which creates some tension between governors and management. In particular, there are concerns of management 'takeover' and the failure of corporate arms to comply with the cultural and environmental values of their tribal parents.

It is in this context that the need for a sustainability reporting systems emerges. Ngāi Tahu and other tribal authorities must meet both their cultural and environmental, as well as economic imperatives. Tribal governors are under increasing pressure to communicate, and provide assurance, that their assets are being responsibly managed in terms of these imperatives. Furthermore, governors desire assurance that their own management are behaving in a manner that complies with cultural values. Consequently the need for some sort of auditing and reporting system has become obvious to tribal governors, first as a means of assessing and encouraging improved sustainability performance of their corporate entities; and second, as a mechanism for reporting on that performance to both governance and tribal members.

This is particularly challenging given that tribal corporate interests are heavily involved in the primary sectors of farming, fisheries, and forestry, all of which are increasingly exposed to environmental scrutiny. A recent large-scale conversion of forest lands to dairy farms by Ngāi Tahu has received significant media attention expressing concern over the ecological impacts of dairying on water quality.⁴ This concern also exists within the tribe itself, as the negative effects of intensive dairying on streams and rivers threatens traditional Ngāi Tahu hunting and gathering – a cornerstone of Ngāi Tahu culture.⁵ Consequently, there is emerging tension between the economic imperatives of the tribe driven from its commercial operations and its cultural and environmental imperatives, driven from its grass-roots families and communities.

Ngāi Tahu is also aware that there is consumer interest in products that have unique indigenous stories behind them (Barr and Reid 2014; Reid and Rout 2015). This led to the development of two indigenous branding initiatives by Ngāi Tahu to test market interest for such products: Ngāi Tahu Pounamu; and Ahikā Kai. Ngāi Tahu Pounamu is a business focused on producing

⁴ Alan Wood, 'Ngāi Tahu drive for \$1.5b farming assets' The Press, 02/04/2014; 3 News, 'Ngāi Tahu eyes 'sustainable' dairy farming' 3 News, 6 Jan 2011; Hamish McNeilly., 'Big Dairy Plans for Ngāi Tahu' Otago Daily Times, 6 Jan 2011.

⁵ Te Karaka, 'Mana whenua approve pilot dairy farms', Sept 15 2013, (Te Rūnanga o Ngāi Tahu)

traditional jade jewellery, while Ahikā Kai is a business offering traditional wild foods. Both have the same approach of marketing products based on indigenous authenticity, sustainability, and traceability. Despite each initiative being shown to be commercially successful, there has to date been a lack of any formal reporting systems to assure consumers of the actual sustainability of their business practices.

Selecting and operationalising metrics

In response to these drivers for sustainability verification, Ngāi Tahu – in collaboration with other leading tribes – has developed a reporting system, referred to as Te Pātaka Mātauraka Putaiao (PMP). The predominant effort in this process involves the identification of indicators and assessment criteria that adequately account for the measurement concerns of consumers and regulators while also conforming to Māori cultural expectations and ethical demands. This compromise is achieved in selecting metrics that track recognised measures of sustainability, but assessing these in terms of process and trajectory. The intent of this strategy is to provide flexibility in terms of incorporating external measures within a culturally acceptable tool.

The PMP includes the development of an online dashboard to support sustainability self-auditing for Māori tribal enterprises in forestry, fishing and farming. In regards to metrics, PMP can be contrasted to the examples in Kiwifruit and Wine in several aspects. The focus of the system is not on single output measures (e.g. yield, water quality, or dry matter), but on the metrics of behavioural change within tribal organisations and businesses. This approach reflects the tribal institutions' need for practical tools to assess the compliance of business practices with indigenous values as demanded by tribal communities and their governors. The result is an audit system focussed on learning and capability building and intended to drive positive behavioural change, which (it is anticipated) will correspond with positive changes in system output. Consequently, rather than using output measures to drive behavioural change, behavioural change (in line with values) is primarily the focus.

The PMP attempts to achieve this outcome by identifying best practices across the components and elements of its tribal organisations and enterprises. The model places a strong emphasis on good governance and leadership, in an effort to ensure that best practice sustainable operations are implemented. Furthermore, emphasis is placed on learning processes with the intention that staff, governors, and managers are accessing up-to-date information regarding technologies and practice related to sustainable management. Other components are tailored to needs specific to the farming, fishing, and forestry sectors including, for example, a module developed for best dairy farming practices, which details current thinking around best practice from both respected practitioners and technical specialists.

Overall the indigenous sustainability audit system assesses hundreds of practices, across different parts of tribal organisations and businesses, to verify the extent to which (using numerical metrics) these comply, or are in line with indigenous values and ethics. The focus is not on an overall measure of practice-based performance, but on representing the richness and diversity of behaviours required for compliance. The intent is to reduce 'gaming behaviours' designed to raise single measures of performance and provide a more nuanced understanding of the organisation's complexity. Reliance on self-assessment remains a limitation of the system making it liable to manipulation by those reporting on their own practice. Nonetheless, the result

of the assessment is an automated report that details the practices that can improve sustainability performance, with links to resources to assist in this learning process. In this manner a deficit reporting approach is avoided, in favour of a continual improvement process as a means of mitigating the limitations of self-assessments.

Although many international sustainability assessments align with the PMP approach in terms of being practice-based assessments (e.g. organics, SAFA), these are challenged by growing consumer and regulatory expectations of science-validated 'hard' sustainability measures. These expectations are in contrast to an indigenous approach centred on values-guided practices that encourage reflexive learning and continual adaptation. Despite apparent discord as hard metrics can undermine reflexivity and drive behaviours that are motivated by the metrics as ends in themselves, output measures can also be seen to reveal the consequences of behaviour. For example the health of a stream is likely to be the consequence of land use practices. Therefore hard metrics can complement practice-based assessments, given that causal relationships between practice and outcome can be better understood. In fact, such a process could well improve reflexivity and adaptation. However, it is also clear that many tribal businesses, particularly at family and subtribe scales, have neither the capability nor the financial means to undertake detailed measuring and monitoring of outputs. Consequently, the drive toward hard measures by markets and regulators has the potential to exclude small and medium sized enterprises that cannot afford compliance burdens.

Discussion

The case studies summarised in this article illustrate three modes of action attributable to metrics within actor networks: pragmatic (in terms of measures or representations), strategic (in terms of tools to organize or coordinate actions of other actors) and vital (in terms of an independent agency). The pragmatic and strategic actions of metrics conform to the most commonly addressed aspects of metrics as addressed in the literature on sustainable practice, namely as indicators used to verify outcomes of applied best practice and as elements of industry programs intended to promote consistency of practice across suppliers. The vital actions of metrics, identified in the case studies as the unintended (and unexpected) alterations of social and environmental relations, are less commonly addressed in the literature, but are nonetheless strongly evident. Furthermore, the comparative analysis demonstrates that, despite the distinct point of enrolment in each network, metrics escape their intended roles and engage with other actors via all three facets of action. Thus, no matter the context, metrics do measure, they do organize and coordinate, and they do re-organize according to their own nature.

The New Zealand case studies (and their increasing appearance in scholarly literature) also suggest that metrics are becoming an integral feature of contemporary networks of production, especially in the primary sector. In so far as they are enrolled within these networks simple representations of a product's quality, the impact of metrics extends well beyond the expected or anticipated. By introducing a novel basis for valuing product, practice and actors, metrics also contribute to the emergent ordering of production as a social ecological process. As with all forms of coordination, the long term impact involves not only a heightened certainty of production outcomes, but also the potential to constrain flexibility or limit resilience by narrowing focus on the measurable and the accountable.

The kiwifruit case study is a clear demonstration of the potential benefits of a more metric-centred set of production practices. The initial introduction of pragmatic measures to verify the acceptable levels of pesticide residue on fruit and associated metrics of pest management on orchards facilitated the eventual introduction of a more comprehensive set of practice and outcome metrics oriented to perceived consumer demands. The economic success associated with such metrics reinforced the legitimacy of both further metrics and the social and hierarchical relations within the commodity chain and enabled their strategic use as a tool to coordinate and homogenise fruit characteristics. The emphasis on consumer perceptions and demands has, however, arguably constrained the capacity of the sector to respond to other pressures such as climatic variability and pest incursion. As new forms of metrics are introduced in response the PSA outbreak, the vital agency of metrics is apparent in the resultant shifts in the relationships between Zespri, packhouses and kiwifruit growers.

The development of the SWNZ audit and labelling scheme shows the potential for the strategic introduction of metrics as a tool for collaborative positioning of wines in higher priced niches in international markets. The success of such a scheme remains dependent, however, on the pragmatic capacities of measures to verify product characteristics in export markets. The SWNZ case study shows that the result is a negotiated set of measures that represent what is readily measured (and informs aspects of efficiency and production on vineyards and in wineries) as well as more challenging metrics of importance to targeted markets. The efforts to homogenise

production practices around shared qualities has also altered the governance of the sector and the subjectivities of individual growers and producers, exposing the agency of the selected metrics. Despite the strongly individualised and independent nature of winemaking, including the recognition of quality in wine competitions or by renowned tasting experts, compliance with the SWNZ audit involves a collective enterprise to gain recognition for New Zealand wine as a whole. In the process, participants in the sector must willingly submit to oversight that facilitates benchmarking and reduces the mystery of winemaking and terroir.

In the emergence of best practice auditing in Māori enterprises is, at its basis, an example of the agency of metrics. The first important point is that Ngāi Tahu deliberately sought out metrics for their audits in clear recognition that these might have transformative agency. What happens with these metrics is not unintended consequences, it is the direct result of political and economic choices. The reason why the agency of metrics to enrol and reorder is so useful for Ngāi Tahu is that they are situated as a key node in networks of economic activity (or the aspiration to HAVE networks of activity) and face, in some ways, in two directions simultaneously. In one direction lies the market, and measures of sustainable activity by Ngāi Tahu in the production of indigenous products create a semiotics of product quality that can be understood by consumers. In the other direction are actual member of the tribe and their small-scale enterprises. At this level, soft and systems based evaluations of cultural practice within sustainable production and manufacture of indigenous products can operate according to cultural values or a consensus around what is appropriate practice. Conversion of these into metrics can then translate these activities to wider market networks. The metrics both translate and also discipline indigenous production practices. They point (and translate) inwards as well as outward and it is this particular quality that makes them attractive to tribal managers.

Implications for the NZ Sustainability Dashboard

The enactive ability of metrics beyond their actions as mere passive measures or proxy tools for other actors, as demonstrated in the case studies, necessarily changes our understanding of the capacity of an intervention like the NZ Sustainability Dashboard. In introducing this article we suggested that the search for sustainable alternatives has become as much focused on processes for transition as it has on the destination state of systems. A stated objective of the Sustainability Dashboard is to facilitate learning and awareness of the implications of common agricultural practices with the expectation that this will promote such transitions. In this conclusion we argue that the pursuit of transition demands careful attention be paid to the role of numbers or metrics as elements of that transition.

If we see metrics as no more than measures or proxies, then the dashboard – which is inevitably built around and communicates via agreed measures – will act in the same way. The dashboard becomes an information ‘clearing house’ associated with degrees of dynamism reflecting the extent to which individual users engage iteratively with the feedback it provides. In this context, the potential to encourage change ultimately relies on the dashboard as a neutral site where decisions taken by industries, other organisations, producers, retailers or consumers might be negotiated. The assumption is that how society and individuals interpret and respond to measures of environmental and social impact can be a purely objective decision, without recognition of the ethical underpinnings that support the valuation of social equity, biodiversity, soil health, among other measured factors.

However, if we engage with metrics as *actants* as well as simple proxies/tools, then the dashboard also has the potential to be *enactive*. In being enactive the dashboard can be a more powerful agent as the worlds of economic action reorganize. The evidence from the case studies suggest that there are certain conditions, network circumstances and contexts in which metrics achieve their own agency. In the kiwifruit case, the combination of new threshold metrics for pesticides and the technologies of audit subsequently enabled via EurepGAP, contributed to the re-organisation of wider networks of activity within the industry. In New Zealand wine, the emergence of SWNZ shows signs of a similar form of coordination. Finally, attempts to develop indigenous branding appears to be integrating with new forms of intertribal governance that are supported by culturally defined metrics. Looking at these moments of enactive re-organisation retrospectively means we can see when these transformations happened and the active role of metrics in that process.

The challenge for those hoping to benefit from the vibrancy of metrics is to develop strategies and means to recognize and harness such actions as they occur as well as to look at future metrics and see how they might work in similar ways. The Dashboard is an attempt to do this, an objective that is obvious in its collaboration in the Māori sustainability reporting design. The awareness of the vibrancy of metrics must be planned and framed in ways that translate to the perspectives of stakeholders. Part of that translation involves articulating the uncertainty and continuously changing dynamics enacted by human and non-human actors, factors that inhibit the establishment of ultimate or optimized endpoints. Whereas acceptance of the vibrancy of metrics removes a strong sense of control over socioeconomic networks, it is in facing and engaging with such uncertainty that transformative change is more likely to occur.

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