

Paper Title:**Solutions That Integrate: Re-Invigorating the Potential of Silos**

Dr Jenni Goricanec, PhD, MSc, GradDipCommSys, GradCertM, BEng (Honours), Director – The *Wicked* Innovation Practice; Facilitator and Academic Board member at oases Graduate School, www.thesustainabilitything.com.au

Dr David Young, PhD, BComm (Honours), MA (Honours), Inaugural Sally Birch fellow in Cancer Control; Cancer Council Victoria, Independent Consultant

Abstract

This paper treats sustainability as a broad set of concerns (not just those of the natural environment) and as a sociotechnical systems concept; it is thus integrative rather than exclusive.

A case study of this type, that is, about sustaining a sociotechnical system, is used to provide insight into the issues of concern for those trying to implement sustainability more holistically in engineering practice. An example of moving from products to solutions within an international telecommunications supply business is described. The question “what needs to be done” is considered. Rather than the traditional addition of another functional unit, The response described here is to introduce a process based on deliberations by cross-functional coalitions; coalitions that spanned organisational boundaries from marketing to maintenance, entitled the “Delivery Network Architecture” (DNA). This process worked alongside the existing organisation leaving its structures and resources intact.

This type of response to issues of sustainability provides an integrating mechanism for adapting to further changes in an organisation’s ecosystem (system-in-its-environment). Further it embeds in the eco-system a set of values that are broader and more inclusive, thereby providing a broader base to sustain the engineering practice.

1. Introduction

The focus of this paper is on sustainability. However we intend to apply this word to a broader set of concerns than is usually the case, while maintaining that our application in no way undermines the concerns that are traditionally associated with sustainability. In this paper, “sustainability” is applied to the whole set of practices and systems that make up an engineering concern, not just the sustainability of the raw materials that provide the inputs to engineering practice and/or the physical environment. For example, rather than seeing sustainability as the responsibility of a group of specialists who apply their skills after “business as usual”, we see sustainability as an attribute of all aspects of practices and systems within the concern, thereby “doing good” rather than “doing less bad” (McDonough & Braungart 2002). The concept therefore becomes a synthesis, fusion, integration, or union that applies to the whole (which includes the environment in its broadest sense; not just the natural environment). In this sense sustainability is a sociotechnical concern, aimed at sustaining the pattern of interactions between people, tangible (material and financial) and intangible (ideas,

authority, capability) resources and, most importantly from this paper's perspective, the products and services produced by the engineering system.

As a consequence this paper deals with the sustainability of human-technological systems in context. We highlight the need to establish methods that re-integrate across and between the various distinctions and separations that have accumulated over the last 200 years. A result of these separations is that professionals have been educated/trained to focus their attention within their disciplines and then further they are encouraged by the systems, processes and institutions within which they practice to work within the silos of their organisations. With the coming of ideas like the Triple Bottom Line it has been recognised that it is necessary to work across the social, and the environmental as well as making money. However, it is not clear how to go about this – methods are lacking. This paper reviews through the case study some methods that do this.

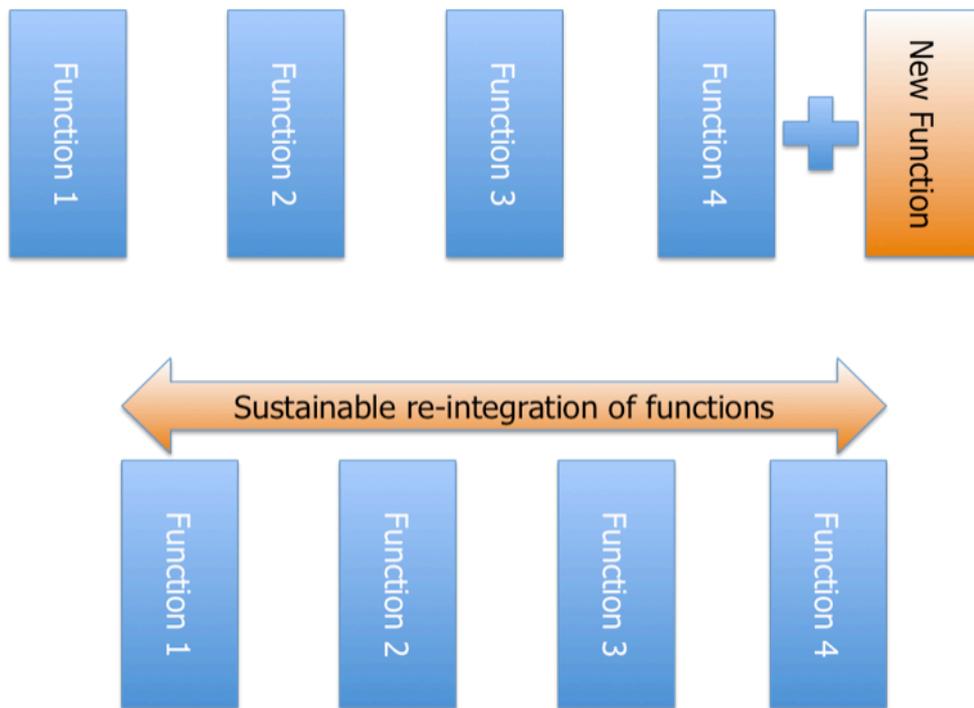
Of particular interest, in this conference setting, is "environment", which is frequently conflated with sustainability. It is the rule that industry, business and daily living separates "environment"; the environment has been treated as an "externality", excluded literally and metaphorically. An example, close to home, is within Engineers Australia: the Society of Sustainability and Environmental Engineering was initially set up to test the viability of a College. When enough people joined a College of Environmental Engineering and a distinct environmental sub-discipline of engineering were established: it should be noted though that sustainability remains within the Society rather than embedded in the rationale of the College.

In this paper, we will use the example of an international telecommunications supply business going through major change brought about by shifts in the external environment and highlight the sociotechnical systemic approach that was used to respond. It is the recognition of the synthetic, integrative, "sociotechnical systemic" nature of sustainability that allows for the direct connections exposing the lessons that can be gleaned from this example for sustainability in general.

This major change required re-thinking what constituted an appropriate response. The "normal" organisational response to issues like these was/is structural; to re-organise by setting up a new unit (sometimes with a new management model to deal with the new business), see top of Figure 1. The consequence of this response is that resources are mobilised from within the organisation and from without. This undermines the sustainability of the system as a whole; not only in the obvious sense, but also because the development of new functions intrinsically threatens the status quo, e.g. as managers seek to understand the potential changes to their powerbase.

The paper will demonstrate a different model of management via a case study; a model that offers a range of capabilities and knowledge such as deliberative skills, contextualisation, and boundary-spanning leadership, that go beyond traditional classifications. These provide a framework for power sharing that enhances overall control and sustainability as in the bottom image of Figure 1: it is not derived from position, status or expertise, it is derived from the ability to get things done, that is, to achieve outcomes (for clients as well as suppliers and service providers).

Figure 1
Traditional Response versus Sustainable Adaptation



Further, we would argue strongly that there is a message for the project management of large-scale sustainability initiatives here. We believe such projects must be maintained/sustained as a system of relationships through a carefully designed and implemented feedback system, so that not only the individuals but also the whole systems or organisation can learn. It is also critical that the responsibility for adjusting behaviour basis on the feedback rests with project and line management during the lifetime of the project and by line management once implemented, and not with a coterie of "performance management" specialists.

2. Setting The Scene

It was 1999; the era when the dotcoms arose and the big information and communications companies were responding to a radically changed competitive environment. ICT suppliers were dealing with massive changes in requirements; from requests for products for large fixed or mobile networks to Internet Service Providers' solutions that spanned a range of technologies, also building, operating and maintenance services, as well as financing arrangements.

Within this context we were consultants working in an ICT supply business but on opposite sides of the fence: one within the company operating as an Inside Partner and the other with a boutique consulting practice. The Inside Partner had recognised the difficulties the organisation was having with both the sustainability of the product design, development, and delivery processes and the specified functionality of the product/service systems themselves, in the face of these changes. The external consultant was engaged to provide the requisite process expertise.

This product development process, which flowed from product/solution design to system/solution installation, and ongoing maintenance, had become stymied by internal complexity and stalemate (Gloster 1999). There was a clear and unambiguous intervention from the external environment in the form of falling orders, massive increases in installation costs and a directive from headquarters to address the issue. This directive was accompanied by the appointment of a new CEO, whose brief was equally unambiguous – develop a sustainable solution, in competition with other regional locations, and the successful solution would be adopted globally.

3. The Design

The mission of the organisation was to deliver products efficiently and effectively, however in practice the first criterion had higher priority. The resources required to deliver products and associated services were located within the mainstream product-process units (i.e. telecommunications design, production, sales, marketing, distribution/ installation, maintenance, as one product-process stream, and internet protocol as the other).

Solutions for newer businesses (e.g. Internet Service Providers (ISPs)) required the bundling together of products/services and the associated capabilities from across the company and more. These new bundles also had to be combined in novel ways and required re-packaging. The capability to design, develop, deliver, build, operate, maintain and finance newer hybrid technology bundles was scattered throughout the organization and its affiliates with varying levels of knowledge and skill.

The objective of the project was to design an end-to-end delivery process to handle both the standard and the newer more customised businesses. Subsequently this delivery process was re-badged as the Delivery Network Architecture (DNA). Development of the DNA occurred in three stages; the first designed the technical sub-system (i.e. defining the work processes, and how they were to be linked), the second designed the social sub-system (i.e. defining people's roles with respect to the work processes, and how they were to be linked). Finally, the two sub-systems were integrated as a sociotechnical system for the DNA. This design process was characterised by high levels of conceptual and cognitive complexity.

4. The Implementation

While the implementation process was not envisaged to be as conceptually challenging as the design process, we already knew it would be far more politically challenging. The reasons for this were twofold. First, the DNA was intimately concerned with knowledge work and, while all work has a political (power and access to resources) dimension, knowledge is power, and the personal networks that underpin knowledge work constitute the most potent personal power base within a modern work organisation. The introduction of sustainability criteria into organisations is, of necessity, political in that it not only challenges the existing distribution of knowledge throughout the organisation it also creates new categories of valued knowledge, and new opportunities for ambitious managers.

Second, the designers of the DNA had developed a number of new roles and they signified a redistribution of power within the organisation. These challenges demanded an inclusive and integrated approach. In order to “rise above” factional politics, implementation had to be driven at a corporate level, and the “sustainable customer focus” of the DNA needed to be strengthened (for example, by consulting with customers during implementation). The ability to identify, understand and help deliver sustainable outcomes that customers valued was to provide the over-arching criterion against which all changes were to be tested. “Balanced Scorecard” and other indices of sustainability also represent a redistribution of power and need to be addressed in the same way.

In addition, we were aware that one of the key determinants of the success of complex project implementation is the effectiveness of the supporting information system(s). Therefore we recommended that such systems should be designed with as much rigour as the DNA itself. The key criteria (which would apply with equal force to any sustainability project) and the associated performance measures, were:

- A dedicated database that was, nevertheless, to be linked to interdependent systems.
- A glossary, which defined both the way words were to be used within the project, and the intent behind each label (e.g. the real intent behind “strategic marketing”).
- Universal, standardised access.
- Learning capability to be designed into the system.
- Ability to access communications as well as information/data.
- Suitable for the management of deliberations as well as actions.

The key strength of the DNA lay in its corporate, “whole of company and beyond” scope. Within this scope, the specific DNA process for any given client (in a given market) would be as large or as small as it needed to be, in order to manage (which includes sustain) the internal and external relationships relevant to that client (e.g. standard, sole supplier relationships versus non-standard, multiple partners & suppliers relationships). It is important to stress that the DNA was not like this for arbitrary reasons - it was designed to be so, in order to address the criteria established by analysing the company’s strategic position.

The implementation process had to reflect the same criteria. The DNA had to be implemented in context, by the people who were to own it, and whose future (i.e. their own sustainability) depended upon it. The top-level coalition for the implementation project was to be both corporate, and senior (i.e. it had to map the full range of knowledge and values in the company’s delivery network; no less, and no more). The values of this top-level coalition represented all the outcomes required to deliver and sustain customer value (from highly specialised and sometimes abstract professional values, to the more pragmatic and highly situated values associated with “putting a deal together”). Figure 2 below reflects the span of values required.

Further, the more detailed implementation was to be carried out by cross-functional teams, or coalitions, who had a tangible, shared interest in “getting it right”. The testing of implementation decisions was via real cases that had been identified in the design workshop. In this way, the implemented system mapped the internal and

external interests which it had to serve and, at the same time, it avoided “capture” by functional interests acting to sustain their own silo, rather than the system-and-its-clients as a whole.

It had to be accepted from the start, that implementing new processes inevitably requires ongoing design and redesign to ensure that the outcomes being sought are, in fact, produced. It is clear that this requirement is analogous to the practice of research (i.e. a hypothesis is formed about how best to produce an outcome, and this hypothesis is tested and refined by application).

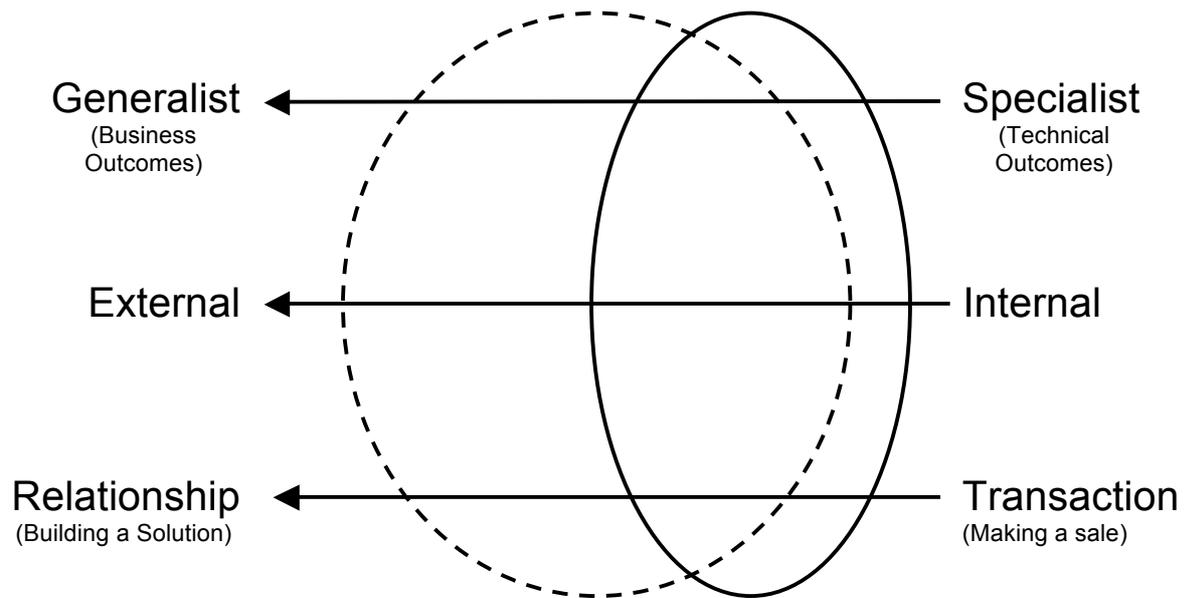
As a consequence of the implementation process, several issues arose that needed to be addressed as part of the ongoing sustainability initiative even though they were conceptually far removed from the “stuff” of sustainability. However, the issues are typical of the kinds of problems that will inevitably emerge in any attempt to introduce such initiatives and, as such, we deal with them in detail. Sustainability is not the problem; everyone readily agrees that it is a “good thing”. The underlying problem is the cultural shifts that are required in order to embed sustainability in its broadest sense into the day-to-day practices of any system.

5. The Issues

One of the key issues that was indicated in the design criteria was the shift in values required for this new regime. While the simple picture displayed in Figure 2 could be extended through the use of techniques like multi-dimensional scaling, the more superficial analysis represented here reflects the self-admitted and consistent bias towards valuing internal considerations, specialised expertise and a focus on “the transaction” (i.e. making the sale). This bias had to be addressed as part of the implementation process, since the sustainable delivery process represented a move toward placing more value on external considerations (e.g. key technological trends), less specialisation and a focus on building sustainable relationships (both internally and externally).

In many ways this was just the tip of the values “iceberg”. The degree of alignment of values between organisations, and between organisations and their (potential) customers is highly correlated with success. The best-documented example of this phenomenon was the VHS versus Beta battle. The alignment of Matsushita’s values with those of software suppliers, distributors, retailers and potential customers completely enveloped, and then stymied, Sony’s offering. Sony’s Beta technology represented only one clear value – early technological sophistication, and while some “gear-heads” were early adopters, they were overwhelmed by the alliance of values represented by VHS, and the cascade of positive feedback (e.g. via economies of scale) which this set off. The VHS product/service was sustainable precisely because of the broad values base it was built on.

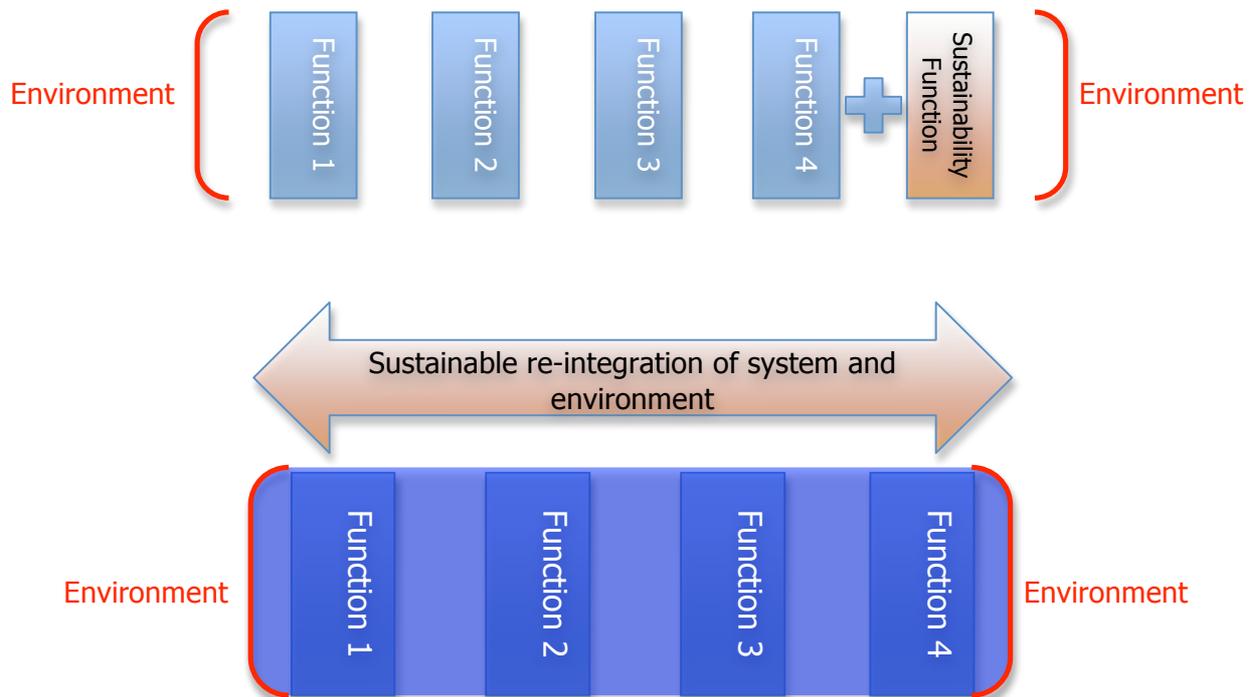
Figure 2
Qualitative representation of DNA values:
existing distribution (shown by the ellipse) together with
the change in values being sought (shown by the dotted oval)



The ICT Company's traditional strengths were based to some degree on its alignment with key telecommunications players, and more importantly with their values – represented through international standard setting bodies such as the CCITT. However, the trends identified in the external environment were forcing the company further away from this safe haven, and it was entering an arena that required the co-option/alignment of a far more diverse set of values to achieve sustainable competitive advantage. We therefore recommended that our client experiment with the use of values analysis in its deliberations about Strategic Marketing and Solution Development. Marketing decisions/choices could then be framed in terms of the set of values represented (including the [potential] customers' values), and strategies could be developed that extended and balanced the range of values so as to leave the competition "out of the picture".

Any attempt to introduce sustainability, either in the more narrow traditional sense, or the broader sense being used here, requires the integration of such concerns (generalist, external, relational) with other valid organisational values (e.g. like return to shareholders). To the degree that sustainability concerns remain outside the prevailing values they will be addressed as an afterthought, if at all, and usually they will be merely "ticked off" in a superficial display of compliance (as in the top image of Figure 3).

Figure 3:
Traditional "Sustainability" versus Sustainable Adaptation



Before dealing with the issues that arose from the implementation process, it is necessary to reiterate the important outcomes that the DNA implementation was intended to produce, and the policies with which it needed to be consistent. The implementation of the DNA was intended to be transformational; it was to be implemented and managed as a whole system, and it had to be capable of being used pro-actively, to manage relationships between the company and its customers, partners, suppliers and competitors and to position the company strategically. As we have already stated, the DNA had to be able to cross external boundaries as well as internal ones. In terms of policies, the DNA was to be implemented in a way that produced enhanced customer focus, and it was to be implemented through the business so learning would be inbuilt. Therefore, as in the second design in Figure 3, we are talking about the sustainability of a whole eco-system, not merely an isolated organisation, or as in the case of supply chain management, the organisation and its suppliers.

The following section identifies the issues that may emerge during implementation of sustainability (in both senses of the word) initiatives, and which will therefore need to be confronted:

Issue 1: Implement as a whole eco-system:

Under the pressure of time and power, the focus of activity can easily shift onto specific components, rather on the eco-system as a whole. The focus is easily seduced by the so-called "management" components of the design at the expense of operational components, and on those design features that are within peoples "comfort zone" (e.g. information in and out). This would be at the expense of critical

features that represent new ways of working, and not just a new lexicon; “talking the talk” is almost ubiquitous, but “walking the walk” is rare.

Issue 2: Enhance Customer Focus

Another common distortion is when the focus moves to system components that are relatively distant from the customer. This reflects the widespread bias toward internal concerns and criteria. All too often, the introduction of sustainability concerns is more about internal “accounting” procedures, meeting regulations and the organisational obsession with internal politics, rather than behaving differently towards the environment (e.g. in terms of supply chains, customer satisfaction and/or waste management).

Issue 3: Coordinate Across Internal and External Boundaries

The full breadth of internal and external interests needs to be represented in all phases of sustainability initiatives to ensure coordination of values. As we have already pointed out in the first issue, the agenda setting power of management can easily weaken the level of internal coordination, and allow particular managers to bias the whole process to consolidate their own position. Ensuring sanction for obtaining the kind of customer, supplier and partner information necessary to improve coordination, provides another hurdle and this is a critical issue for sustainability initiatives. Introducing such initiatives necessarily involves access to supplier and partner information and moreover, requires that the behaviour (e.g. supplier inputs) of these actors is aligned with the organisation’s sustainability objectives. In the absence of such alignment, any claims of sustainability are likely to be more rhetorical than substantive.

Issue 4: Implemented Through the Business

There is usually real resistance to the employment of “live” examples to test sustainability initiatives and this reflects a desire to design to the personal criteria of senior management networks – not the business. Again, the lessons for sustainability are clear. In the absence of formal performance standards for sustainability that are integrated with the business (and not a separate “sustainability” performance standard as in the top half of Figure 3) there is no way of establishing the commercial implications of the initiatives.

6. Summary of Lessons for Sustainability & the Environment

- i. Because sustainability necessarily involves both internal coordination (i.e. across functions and disciplines) and external coordination (i.e. across organisational boundaries – from supply chain and regulatory authorities to customer networks and closed loop waste management), it requires managing across both internal and external boundaries. In addition, we are not talking here of a structural solution; e.g. “a manager”, but of the function of management. This case study makes it clear that this distinction is non-trivial.
- ii. However, the focus of this boundary-spanning management is the capability that exists within each function, and in the external environment. This means new models of management must be developed and applied since the variety of skills and knowledge being engaged far exceed that which traditional engineering managers could be expected to demonstrate. The functional silos though remain;

they are though re-invigorated through the stronger linkages within the eco-system-in-its-environment.

- iii. The case study demonstrates that boundary-spanning management requires an awareness of the lateral coordination involved and the skills/knowledge. Only coalitions/teams with “joint and several” authority can guarantee the requisite level of capability.
- iv. Our experience with this case and others in engineering education, public (i.e. roads) and private (i.e. construction) sector civil engineering, military engineering, water management, and a range of telecommunications settings has indicated that:
 - Over and above management and capability *per se*, the successful application of coalition/team management requires leadership, because stepping across internal and external boundaries cannot be managed in a structural sense – it has to be led.
 - Managing across boundaries for sustainability and with full cognisance of the environmental implications of action, necessarily challenges existing power relationships within any organisation. Specific techniques have to be applied to construct new goals that are non-zero sum, and/or amalgamate disparate goals that can encompass cross-boundary loyalties and/or balancing the goals valued by different actors (including actors outside organisational boundaries).
 - A long-term issue with most engineering practice is how to access and manage the expectations of external stakeholders in a project (e.g. user groups, clients, the public) and internal expectations. The answer lies in new forms of power sharing that enhance overall power. This is not power that derives from position, or experience or expertise – it is about the power to achieve goals, not the power to order that goals be achieved (which in a sustainability context can merely serve to entrench the positions of those that are a priori in opposition).
 - All of this means that sustainability in practice is a multi-layered process:
 - Not only must the individual practitioner sustain their skill level through ongoing education,
 - But also, the coalition/team responsible for a project must sustain their identity and cohesiveness through continual interaction with common tasks (which ideally is facilitated),
 - And the project team and the external actors (e.g. suppliers, clients) must sustain their relationships in order to guarantee alignment, predictability and hence trust,
 - Also the product/service must retain it’s integrity/sustainability within a flexible envelope that adapts to meet the demands of the changing environment,
 - Further, the system of relationships established to manage the project must be sustained as a whole. That is, beyond the specific strategies designed to sustain the elements as outlined above through a carefully designed and implemented feedback system, so not only the individuals concerned guarantee their own sustainability via learning, but the system as a whole can learn – because the individuals will in all probability change.

7. Conclusions

In this case study we have used the issues and associated learnings that arose from our work on a project with an international ICT company to set out the key requirements for developing an effective sustainability framework without producing yet another organisational redesign. The key observations are that, first, the process is intensely political and that as such the political system in the organisation must be tightly coordinated with the change process. The key to this is values alignment, and the use of inter-departmental coalitions to plan the process.

Second, and in so far as implementation is concerned, there are two critical take-home issues. Coordination across organisational boundaries and integration of sustainability performance indicators into the business outcomes being sought are necessary pre-requisites for meaningful success. As we pointed out above all the critical issues raised place the spotlight on leadership, and the deliberate avoidance of the "business as usual" managerial approaches that, unfortunately, tend to dominate the field. Managers "manage" the existing system; they cannot be expected to lead across the organisation to create a new system.

Thirdly, the system of relationships established to manage the ongoing eco-system must be sustained as a whole (that is, beyond the specific strategies designed to sustain the elements as outlined above) through a carefully designed and implemented feedback system. In this way the individuals concerned guarantee their own sustainability via learning, and the system as a whole can learn.

8. References

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