A View From the Fringe – Transdiciplinarity and the Journey of the Devox

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Abstract*: The problems of today are complex and context dependant. Solutions need to be developed taking into account the individual issues that relate to each problem. There is no one size fits all solution. The complexity usually requires that the knowledge and skills of a range of disciplines are required to develop a suitable solution. The need for transdisciplinarity becomes apparent in this space. This paper gives an introduction to transdisciplinarity and its relationship to Mode 1 and Mode 2 knowledge. The three pillars of transdisciplinarity are discussed and their link to the problem space if demonstrated in the case study of safe design. The case study tracks how deviance theory can be demonstrated in the journey of the devox – the innovation virus.*

Transdisciplinarity – Not Just for now, but for the future

There can be little doubt that there is a global movement toward a Mode 2 research and learning environment, that is, a move toward socially robust, collaborative research, centred on problem solving. However, as academics and researchers, there is still pressure to conform to a Mode 1 research paradigm, that is, individual disciplinary centred research or as disciplinary researchers interacting with each other in a Mode 1 framework in a multi or interdisciplinary mode. This research takes a different path, and does not and should not; conform to the Mode 1 paradigm.

'Disciplinary' approaches are a product of our learning within a discipline, the paradigm of practice created and accepted by any given discipline. 'Multidisciplinary' and 'interdisciplinary' are terms that are not so well understood and are often used interchangeably. Multidisciplinary approaches are those where the practitioners work between the disciplines, that is, people from different disciplines work together, side by side, to solve a problem. Interdisciplinary approaches foster transference of the tools and skills from one discipline to another, the team of practitioners work across the disciplines. 'Transdisciplinarity' requires that the teams work between, across and beyond the disciplines. The teams use the skills and knowledge from each of the disciplines, involve stakeholders and often share / blur disciplinary boundaries.

The transdisciplinary approach starts with a real world problem and then draws on the expertise inside, and outside, of academia to develop mutual learning, and develop solutions to address a given problem. The team is seamless in the approach, and works in a different space to any of the traditional disciplines and knowledge domains within the team. There is an explicit commitment to a higher ideal, to sustainable outcomes. The outcome is creation of new knowledge that does not necessarily fit the traditional research outcomes of any / all of the disciplines involved. This approach is however complimentary to disciplinary approaches and offers an alternative opportunity for problem identification and solving. It is not a replacement for disciplinary research, knowledge and skills but offers an opportunity to enhance the learning from these traditional bases by promoting mutual learning. The product of transdisciplinarity is the generation of 'Mode 2 knowledge' (M2). 'Mode 1 knowledge' generation is governed by the cognitive and social norms of a given discipline, which must be followed in the production, legitimisation and diffusion of knowledge (Gibbons et al., 1994:1).

Mode 2 knowledge is characterised by its purpose and a defining set of attributes. Gibbons et al. summarise the difference between the two modes of knowledge generation by the attributes of each mode.

> *… in Mode 1 problems are set and solved in a context governed by the, largely academic, interests of a specific community. By contrast, Mode 2 knowledge is carried out in a context of application. Mode 1 is disciplinary while Mode 2 is transdisciplinary. Mode 1 is characterised by homogeneity, Mode 2 by heterogeneity. Organisationally, Mode 1 is hierarchical and tends to preserve its form, while Mode 2 is more heterarchical and transient. Each employs a different type of quality control. In comparison with Mode 1, Mode 2 is more socially accountable and reflexive. It includes a wider, more temporary and heterogeneous set of practitioners, collaborating on a problem defined in a specific and localized context (Gibbons et al., 1994:1)*

Nicolescu (2002) purports that disciplinary knowledge is produced in vitro, is objective, leads to knowing, is the result of analytic intelligence, has an orientation towards power and possession, follows binary logic and excludes values. Nicolescu asserts that transdisciplinary knowledge is produced in vivo, it involves correspondence between the external world (object) and the internal world (subject), it leads to understanding, is created from a new type of intelligence (the balance between intellect, feelings and the body), is orientated towards astonishment and sharing, follows a logic of the included middle and includes values (Nicolescu, 2002:153).

The Three Pillars

Nicolescu's (1998) three pillars of transdisciplinarity are the basis of the transdisciplinary approach. Together, these three pillars – levels of reality, the logic of the included middle, and complexity – determine the methodology of transdisciplinary research.

Levels of Reality

Henagulph (2000) describes reality as *"that which resists our knowledge, experiences, representations, descriptions, images or mathematical formalizations"*. The different levels of reality relate to realities where the same fundamental laws do not apply. An example of this is quantum and classical physics. At the Quantum level of reality, the fundamental laws are not the same as the classical laws of the macrophysical level. Henagulph (2000) goes on to explain further that the passage from the quantum level of reality to the classical level of reality can be seen in terms of a phase transition, in much the same way as a change from a solid to a liquid is a phase change. It is further explained that the phase 'transitions of Reality' can be described by the logic of the included middle as formalised by Lupasco (n.d., cited in Henagulph, 2000).

The Logic of the Included Middle

Our scientific or classical logic is based upon the following three axioms:

1. The axiom of identity is : *A* is *A*
2. The axiom of non contradiction: *A* is not *non-A*
3. The axiom of the excluded middle: There exists no third term *T* which is at the same time *A* and *non-A*.

The concept of different levels of reality, changes this, and creates the logic of the included middle, which allows for the third term *T* to exist. This third term *T* can exist in a reality which is different to the one we are currently working in.

According to Nicolescu (1998),

> *History will credit Stephane Lupasco with having shown that the logic of the included middle is a true logic, formalizable and formalized, multivalent (with three values: A,*

non-A, and T) and non-contradictory. Our understanding of the axiom of the included middle – there exists a third term T which is at the same time A and non-A – is completely clarified once the notion of 'levels of Reality' is introduced. (*Nicolescu, 1998*).

Complexity

Complexity, according to Henagulph (2000) is a system paradigm. Complex problems demand complex thought. It is a mistake in this time of chaos and complexity to attempt to reduce all problems to the most simple, and find simple solutions. It is far safer and more productive to recognise the complexity of the situation and develop different ways of thinking and problem solving. Henagulph (2000) suggests that

In order to organise the increasingly complex nature of knowledge we need to develop a form of recursive thinking. This is a mode of thought capable of establishing a dynamic and generative feedback loop between terms or concepts…that remain both complementary and antagonistic. Although this initially seems impossible, once one has comprehended the different levels of Reality, and their associated logic of the included middle…it becomes much clearer how to proceed.

Deviance and the Journey of the Devox

Following is a short description of one transdisciplinary project conducted by the "Virtuous Reality" team – the Safe Design Project.

The hero of this journey is the 'Devox'. Mathews and Wacker (2000:73) describe the devox as "an innovation virus with a voice", they go on to explain "… the devox describes how deviance … is expressed as it vectors across a fixed, linear, predictable, and measurable passage … ". In this project there was an 'innovation virus' or 'devox' that each of us brought to this common journey. It describes our thoughts, what was shaping our dreams and questions when we started this combined journey.

Prue's dream was to develop engineering graduates who understood the profession and the meaning of professional practice as opposed to simply gaining a tool box of useful but isolated technical and professional skills. This was her devox.

Yvonne's devox was the unanswered question - Who is informing design decisions about the people / system relationship in Australasian industry? And how could this best occur and what strengths, challenges, threats and opportunities would need to be addressed?

The genesis for this partnership was a casual conversation around the time that we met. The 'epiphany' laid the foundations for two deviants to recognise the value of each others devox, join forces and begin this problem solving journey.

In analysing the journey of our devox it was critical for us to understand the market positioning of this research. There were many stakeholders who become part of this 'voice of innovation' along the way. How can we express the journey of a devox as it vectors across a fixed, linear, predictable, and measurable passage? The devox takes a typical journey from the Fringe where an individual deviant defines the devox through to a state of Social Convention where the devox is no longer considered new and may not authentically reflect the ideas of the original deviant. Figure 1 illustrates the journey of the devox through the model.

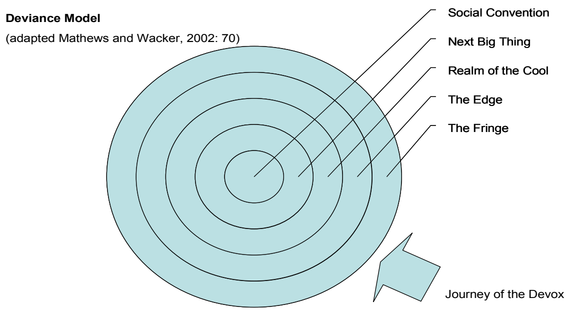

Figure 1 - Deviance model showing the journey of the devox

What was the *real* problem

We were both educators and researchers in the area of professional practice paradigms. Our problem concerned the relationship between ergonomics and engineering professional practice and education in terms of the Australasian experience. Our context with regard to engineering professional practice was design work that is performed by engineers in industrial environments where there was traditionally little interaction between the engineering designers and the professional ergonomics community (the situation that the majority of our, and other, graduates will find themselves working in).

Design induced end user error plagues sustainability of systems, artefacts and equipment - solutions address downstream answers but do not address upstream issues - what do engineers know and need to know about the people in their systems? How can we most effectively teach engineering educators and future engineering practitioners about people in their system? How can we ensure that they are prepared to understand and take responsibility for ‘good’ design? How can we ensure safe design?

The Contradictions

Within the domain of our devox, there were many issues to be addressed. Many of those issues were simply based on contradictions that must be resolved. The major contradictions that we met were:

- Engineers do safety to death, yet we have over 500 people per year die in workplaces in Australia
- We have no time to introduce more content into the curriculum, and yet technology and knowledge is increasing at a faster rate than we can teach it
- 1996 review encourages cultural change and so does the accreditation document, but the accreditation team does not
- Those who teach engineering are usually not industrially focused and yet that is what programs should be about. Many engineering educators are traditional and yet the profession is moving forward – the profession is ahead of the university – in relation to practice
- Requirement for interdisciplinary team work, and yet program does not have time, and emphasis on assessment is on the individual – issues with knowledge of assessment
- Workers are aware of the danger issues in the workplace, yet many issues are ignored (procedural problems)
- Graduate engineers must be knowledgeable about ergonomics and safety issues, yet current academic staff are not
- Courses concentrate on technical problem solving, but many real problems are people oriented
- When people are considered in the design process, the result is still not satisfactory

These contradictions had to be overcome to find a solution to the problem of how safe design can actually be implemented. Many design solutions are a compromise. This is generally accepted as the only way to achieve a practical design solution. However, the result is that safe design or designs free of 'design-induced end user error' are not achieved.

Safe Design is Not a Compromise

Kaplan and Kaplan (1998) say that human solve problems by analogic thinking. By that, it is meant that when faced with a new problem, we attempt to solve it using solutions that we are already aware of from our past experiences or knowledge. We rely on that with which we have become familiar. Much our formal education, especially as engineers, is based on learning processes and procedures for solving problems. Consequently graduates become professionals, with a toolkit of problem solving experiences, and use that to attempt to solve the problems that face them as professionals. As Kaplan and Kaplan (1998) say, *"We find, not surprisingly, that our tendency is to search for solutions in areas of technology in which we have expertise."*

As our education is based upon the knowledge base of the profession, if there exists a problem that is outside the realm of the profession, and therefore outside the realm of our own educators, there is a good chance that the ideal solution will not be found. The solution may lie in an alternative reality.

The foundational idea of transdisciplinarity is learning from and using concepts and ideas from other disciplines to help solve problems in our own. Considering the contradictions existing in our current reality, and the complexity of cultural change, could we use the concepts of transdisciplinarity to help our devox on its journey?

Codified and Tacit Knowledge

The European Commission (1997:30) discussed the different types of knowledge – codified and tacit. The codified knowledge is that which can be passed on by being transformed into information. In this way it can easily be spread by publications or more easily by the internet. Tacit knowledge on the other hand cannot easily be transferred, because *"it has not been stated in an explicit form. One important type of tacit knowledge is skill."*

The community problem has been identified – safe and usable products and systems are required. The solution is not so easy. This is because we cannot simply codify the knowledge needed for the development of safe design. If that were so, then the human factors professionals could simply transfer their knowledge into publications or processes that the engineers could digest and follow. It is the tacit knowledge that the human factors professionals have that is required as well as the codified knowledge relating to processes that is needed.

What is required is a cultural change within the professions. While the governing bodies such as the IE Aust may require its members to produce sustainable designs, if the knowledge does not exist, then the outcome is difficult. If the engineers and human factors professionals are to learn from, and work with each other, there is much groundwork to be covered. Where to start is a difficult question. It would be easy to sit on the beach like A. A. Milne's *Old Sailor*, (Milne, 1927) and do nothing but bask until we are saved, but we need to be proactive and start identifying the 'learning' gaps, and start plugging them.

How can the Problem be Solved

This journey had its genesis in our individual devox and when we started working together it could at best be described as multi-disciplinary work however we quickly made the transition to an interdisciplinary team. Even once we started to embrace 'transdisciplinarity' we were still trying to operate in the more familiar Mode 1 paradigm. However the Mode 1 paradigm could not deliver the outcomes required for this problem and was at odds with the transdisciplinary teamwork and professional practice model that we were trying to create. For this reason, we chose to operate in a Mode 2 paradigm, which enabled us to work and disseminate our findings in the environment that we believe will be the preferred professional environment of our disciplines in the future. It was not possible to solve the problem at hand through disciplinary research alone. While it is vitally important that the team draws on their disciplinary knowledge and ensures that the research authentically reflects the needs of each discipline, the problem can't be solved by a single discipline. Transdisciplinarity offers an opportunity to problem solve and generate knowledge across existing disciplines.

We needed a methodology that would allow us to explore the status and future positioning of our research to maximise the impact of any potential solutions;

- create alternative futures;
- explore the many contradictions that need to be considered when solving this problem (a problem that exists within alternate realities);
- be mindful of our audience because they would critical to the acceptance and championing of the solution; and
- explore of the context and needs of the learning economy.

The problem of achieving safe design had a number of contradictions and no known solution at that stage. If we were to truly achieve safe design, we must find the alternative reality where the contradictions become the third term *T*, and are no longer contradictory.

The resulting methodology used for this research was a transdisciplinary approach, that is, an approach that fostered joint solving of complex problems across science, technology and society - as is appropriate for our disciplines. Transdisciplinarity required that stakeholders participated from the beginning and remain active over the entire course of the project and mutual learning was the basic process of exchange, generation and integration of existing or newly-developing knowledge in different parts of science and society (Klein et al, 2001).

A major outcome, the Transdisciplinary Design Matrix, along with the full outcomes of the research can be found in the resulting thesis (Virtuous Reality, 2007)

Conclusion

A transdisciplinary approach allowed a different lens to be applied to the problem. It is interesting to note that while the original client problem was ‘Design induced end user error plagues sustainability of systems, artefacts and equipment - solutions address downstream answers but do not address upstream issues - what do engineers know and need to know about the people in their systems?’, the use of the transdisciplinary design process as a methodology actually allowed the team to refine and better define the ‘real problem’ during the course of the project. This may be why a solution was determined when typical research methodologies had not done so up to this point.

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