Understanding the community: getting engineers on track

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***Abstract**: It is vital for engineers to develop an understanding of the community or industry they are working in or with and its values. Engineers seeking to be involved with communities without awareness may not create successful outcomes. This research reflects on work within the rail industry and how that culture resists the adoption of simulator technology. The paper details how using a theoretical framework for understanding culture can elucidate why any culture adopts a technology successfully or not.*

Introduction

Engineering solutions are not isolated from the social world. All solutions developed, designed implemented and maintained by engineers are the products of social interactions and are used by people within society. The technological solution, the outcome of engineer involvement in a problem, can be greatly influenced by the society or culture using it.

This is recognised in the graduate attributes of engineers:

> *PE2.2 Understanding of social, cultural, global, and environmental responsibilities and the need to employ principles of sustainable development.*
>
> *a. Appreciation of the interactions between technical systems and the social, cultural, environmental, economic and political context in which they operate, and the relationships between these factors.* (Engineers Australia 2006)

This paper presents an example of these interactions and also provides one possible framework for understanding culture.

The diffusion of technologies has been observed empirically in many different social environments with different technologies. Five key factors greatly influence the diffusion of technology. These are: trialability, observability, complexity, relative advantage and compatibility (Rogers 1995).

- *"Trialability is the degree to which an innovation may be experimented with on a limited basis".*
- *"Observability is the degree to which the results of an innovation are observable to others".*
- *"Complexity is the degree to which an innovation is perceived as difficult to understand and use".*
- *"Relative advantage is the degree to which an innovation is perceived as better than the idea it supersedes".*

- *"Compatibility is the degree to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopters" (Rogers 1995, p.15).*

Three of these, complexity, relative advantage and compatibility, are not inherent properties of a technology; rather they are perceptions of that technology by the people using the technology.

The focus of this paper is on the importance of the perceptions users may have of the compatibility of any technology. Values, norms and beliefs of a group of people can be described as culture (Handwerker 2001). All groups of people, including industries and professions, have culture, as long as there are shared values, norms and beliefs. This means that engineers, regardless of whether they work in Australia or abroad, will need to take account of the ways in which compatibility can influence the diffusion or acceptance of a technological solution.

This paper presents evidence of cultural influence on the diffusion of technology. In this case the technology is the type of simulator used by the Australian rail industry. Simulators are used for training train drivers, but are not well regarded and are poorly utilised. This research uses concepts developed by Pierre Bourdieu (Bourdieu 1984; 1992; 1998; 2005) to analyse the culture of the rail industry and explain how that culture impedes the uptake of simulators for training.

Theoretical Framework

To analyse the culture of the rail industry requires a theoretical framework. The theoretical concepts of *habitus*, *capital* and *field*, developed by Pierre Bourdieu underpin the framework chosen for this research. These concepts are particularly useful for understanding the value, in the economic and ethical sense, of a technology, practice, group, subgroup etc. within a community.

Habitus is a Latin word, used to describe the sum of the experiences and history of an individual. The habitus is more than just habit, it is internalising of the external world. Even though each individual will have a particular set of life experiences and history that have created their habitus, that habitus will be very similar to others who have had similar life experiences (Bourdieu 1992). This is due to the sameness of the external world, the rules, institutions, language etc. which will shape all individuals in much the same way. Therefore habitus is a shared disposition, a template for thought and action shared by individuals. For example in the rail industry, it is believed that the ultimate responsibility for rail safety is with the train driver. This influences what technologies are adopted, how safety is managed and how accidents are investigated. This is a part of the habitus of the rail industry and the habitus of train drivers.

Capital is resources that have value to individuals and it becomes visible by the competition for those resources. As long as there is competition to create value and scarcity, nearly anything can become a form of capital (Bourdieu 2005). The most obvious form of capital is economic capital, which can include wages, money, investments etc. Some form of economic capital is competed for in nearly all social situations (Bourdieu 1992). In the rail industry, economic capital is evident and so is safety capital. That is, objects, practices or ideas that contribute to safety are competed over and competed with. Fatigue management is an example of an idea that is competed over and with both safety and economic capital. Fatigue is measured in terms of its affects on safety and thus has to be managed appropriately however, longer work hours for drivers produce economic benefits.

Field is the concept which describes the context where social interactions happen. A field can be differentiated from other fields by the capital being contested within the field. What is capital in a field defines and limits that field (Bourdieu 1984). Each field, in addition to having particular capital, will also have particular habitus (Bourdieu 1992). The habitus tends to reproduce the field as practical thoughts and actions tend to result in relative positions within the field being maintained. The career progression within the rail industry is guard to driver to manager and thus most workers in rail have had experience in multiple different occupations within the industry. This similar experience shapes rail workers so that they all have a similar habitus regardless of what position they now occupy within the industry. Further, the habitus then reinforces the field particularly the occupational progression. As soon as guards become drivers they make jokes about guards. This joking reinforces the superior position within the field of the driver over the guard.

These concepts in combination produce observable practices (Bourdieu 1984). In this case, the limited adoption of simulators within the rail industry is the observed practice. Identification and clarification of the influences of capital, field and habitus in producing a perception of the lack of compatibility of the simulator with the field of rail transport will explain why the simulator is not used.

Methodology

Because of the theoretical framework used here there is a need to generate data on daily practice and participants' value sets. Two methods were used to gather data: interviews and observations. Interviews gather data pertaining to participants values, while observations gather data about the practice of those values in action.

These methods have been used to gather data for capital, field and habitus in many different situations (Wacquant 1995; Bourdieu 1988; Abramson and Modzelewski 2011). Interviews can generate rich data about all three concepts, in language used, in identifying competition and in identifying structural elements of the field. 32 hours of interview data with managers, trainers and drivers were transcribed and coded for the concepts above. Observations of 16 training sessions in a variety of contexts (in the classroom, in the simulator, and on the train) were also undertaken to generate further data relating to capital, habitus and field.

Results

Observations and interviews clearly show that the simulator is not used intensively within the rail industry, with the simulator commonly in use for at most a few hours each week. From interviews, the general attitude to simulators is dismissive; drivers and trainers have stated that the simulator could be useful but it isn't. This is the observed practice of simulator use within the rail industry and there must be components of habitus, capital and field which explain this practice.

A key form of capital in the rail industry is safety. This can be seen by the safety statistics that are published by the Australian Transport Safety Bureau and used to assess rail in Australia. Safety issues are also prominently displayed in the form of posters, memos and the like within the rail industry workplace. Finally, safety is the key opposition to economic decision making. Decisions to improve productivity are weighed up against safety considerations.

> **Driver** *They contradict themselves, right. They put you through all this rubbish, and then what do they do, they put on part time drivers. They have no idea at all about how the railway works and they're bringing them in, and putting them through this crash course, and then they're going to put them out of main line, and I think that's dangerous. That is 100% dangerous, and yet, in the same breath, they're telling you to be safe. It's all money isn't it; it's all in the name of money.*

The simulator was introduced to the rail industry via accident investigations. The rationale behind simulator adoption was that the aviation industry used simulators for training for safety reasons (Salas et al. 1998), and so it was assumed that the simulator would also embody a high amount of safety capital in the rail industry:

> *What has been regarded as essential for the airline industry should be regarded as essential for the rail industry* (McInerney 2001, p.124).

Trainers and students dismiss the simulator and this attitude could be counterproductive to any possible learning to be had from the simulator. This leads to the simulator having a low safety capital.

Further, the simulator is very expensive to purchase and maintain relative to traditional training methods.

> **Driver** *Yeah, well, I looked at it and thought, that's quite (?) and they spent all this money, and yet they couldn't put on the* <rail> *network that we're going to be driving onto the simulators.*

While the simulator has capacity to relieve revenue earning trains from being requisitioned to training duties and thus increase the simulator's immediate economic return, it is not used systematically to do this. As a result, the simulator embodies low economic capital.

The field itself has various structural elements which have resulted in the perception of incompatibility with the simulator. In the rail industry formal training is lowly valued. This is because training is performed as part of the job, that is, a person (usually a guard) applies for the driver position, gets the position, then for the next 6-12 months is paid to learn how to be a train driver. This training is generally conducted by the operating company who have identified a need for a number of new drivers. After training some of these drivers then go and work for other freight operators for significantly increased pay. Training is then an expense to the operating organisation, during training and after the training, while the fact that the trainees are paid to do it reduces its importance to them. Training has low value, particularly economic value.

Senior operational safety manager 1 *We have a lot of people out there now, talking to some drivers while doing the CA* <competence assurance> *- they're young - their attitude is that this is going to be a five year job, I'm going to make as much money as I can, and then in five years time, I'm gone, I'm out of here..*

Interviewer *Right, and you assume that they are going?*

Senior operational safety manager 2 (S2) *A lot of them are using it as a stepping stone for moving over to Western Australia for the iron ore railways as well, and they use this as a cheap way of getting their qualifications.*

Interviewer *That must have been affected a bit by the GFC?*

S2 *Not especially, we've still had a steady stream of defectors.*

Interviewer *I was just observing some training for drivers on the coal fields up in North Queensland, and they're all, 'wow, we're going to rake it in.'*

The habitus of workers within the rail industry also influences the perception of the simulator. The rail industry is staffed primarily by older workers of whom nearly 50% have been in the industry for at least 15 years (Australasian Rail Association 2006). These older workers learnt to drive on the job and they perceive formal classroom training and education to be of low value.

Driver *Because there's two people on the locomotive, we took up the second person's duties, which was not obviously driving, it was the second person as they called it, and you weren't thrown into driving straight on.*

Interviewer *So you knew about the network and all of that?*

Driver *Yeah, yeah, we learnt all that kind of thing. It was all gradual over time, it wasn't sort of straight into the thick of it straight off, and then we started having driving tuition by the driver. He'd put you in the seat, and show you gradually, and it wasn't a scary thing or anything.*

Interviewer *So that's a more traditional sort of route.*

Driver *Yeah, it was going back a long time ago. Well when I started the school to do the electric trains I actually was permitted to drive the trains I was catching to go to the college from where I lived at home...*

This tradition of the industry has implications for how training is to be viewed and indeed lowers the value of training compared to on-track experience.

Trainer *I'm a little bit old school. I think that you can't teach experience, you know, you can teach out of a book, but you can't teach experience, and train driving is a lot about experiences with different scenarios that you strike out on track, that it's pretty hard to capture on paper day to day things.*

The habitus of workers within the rail industry is to be always comparing training to the real job and this also applies to training in the simulator. The simulator is compared to the real world of driving a train.

> **Driver** *They've gone, well ok, we'll take this little section of this track here, and this little section of track from here – from the real world – but we'll join them up and make it difficult. What's the point of having a simulator that doesn't actually even simulate our own network?*

Drivers routinely complain about lack of the "feel of a train" within the simulator. Most drivers and trainers would prefer to learn on the job on a real train.

> **Driver 1** *See, the only contact with simulators I've had was – I'd already been driving for well over 10, 15 years – it was only 5 years ago or something that we had a go at the simulators. I didn't find the simulators very helpful, I suppose they are to a degree, but it's just chalk and cheese from simulator to actually being out on a real train.*
>
> **Driver 2** *There's no weight, is there?*
>
> **Driver 1** *No, no, you've got no sensation.*

Discussion

Understanding culture is reflected in graduate attributes for engineers and is a requirement for good engineering practice. An evaluation using a Bourdieusian framework has shown how the culture of the Australian rail industry is incompatible with the use of the simulator for training train drivers. Various aspects of habitus, capital and field of the rail industry combine to lower the perceived compatibility with the simulator. These include the low value of economic and safety capital ascribed to the simulator, the low value placed on training (i.e. the main purpose of the simulator) in the industry, and the frequent comparison of the simulator to real on-the-job experiences which are more highly valued.

This Bourdieusian framework for assessing culture is not the only framework available. Other theoretical frameworks may reveal different facets of rail culture that may influence simulator uptake and use. The use of a framework to analyse culture maybe beyond the brief of engineering projects, but engineers should be aware that culture can affect engineering practice as per the graduate attributes.

While these concepts can be difficult to identify in practice, being able to understand a cultural theoretical framework has benefits for engineers. Being able to analyse the potential diffusion of a technology in these terms would assist in designing the most appropriate technology for an industry or community. Even being aware that culture can influence technological adoption is an important step for engineers.

This example from the rail industry demonstrates that culture is influential in any industry and that engineering solutions which are incompatible with culture are unlikely to succeed. It also illustrates the usefulness of the concepts of habitus, capital and field for examining the underlying reasons for technological incompatibility with a culture. The concepts allow for an examination of the rationale behind practices. An understanding of the concepts can assist engineers in designing appropriate technological solutions for specific contexts.

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