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MODELS FOR UNDERSTANDING CONTEMPORARY TENSIONS IN INDUSTRIAL DESIGN EDUCATION

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ABSTRACT
Traditional roles of product/industrial designers are being challenged as manufacturing decreases in developed economies. Design educators are faced with the question: for what roles should we seek to equip our students? And which stakeholders are best placed to discern this? Is it employers wanting job-ready graduates for today's positions, or educators informed by emerging international understandings of what designers may be called upon to do in the future?
This paper describes two models developed to articulate and analyse these issues:

- The Triple Axes Model, which shows the competing priority continuums along which various forms of design practice and education are situated.
- The Design Development Wave, which shows the relationship between the 'front end' and 'back end' aspects of design practice, where 'front end' aspects are seen as initial phases of problem identification, design research and design opportunity analysis, and 'back end' aspects are identified as more detailed manufacturing stages.

Both models are important in conceptualising the tensions underpinning the current ambiguities of the product/industrial design profession. They help build the key elements, shared nomenclature and theoretical relationships needed for dialogue about, and development of, new approaches to design education and design practice.

Keywords: Models of design education, design practice, industrial design.

1 INTRODUCTION

The development of the two propositional models discussed in this paper was part of a broader study of the development of Australian graduate industrial designers and the national and international forces influencing their professional roles. The study was based upon primary qualitative research which exploring the careers and practices of 15 such designers who graduated between 1995-2005 [1]. From these interviews and subsequent analysis of the graduate's experiences and knowledge, I identified a range of applications of design practice and education to the range of possible employment and professional sectors of practice.

2 DESIGN APPROACH/METHOD

The research approach was developed by exploring the current state of national and international industrial design practice and education, while reflecting upon, and comparing this with, the author's contextual environment within higher education and scholarship. The overall study was grounded in the theory of scholarship of teaching [2] and reflective practice [3]. Methods of inquiry were informed by the literature on applying design approaches to the identification and investigation – as well as the resolution – of challenges within such contexts [4] [5]. The work of Watson and Wilcox also influenced the study, for example through their recommendation that practitioners re-analyse their own work from different perspectives [6]. In this approach, knowledge is derived not just from seeking new experiences but from fresh examinations of what has already been done. Theory development and investigation of the practice of teaching is important in this context, as it offers potential to address the disconnect between evolving breadth of practice and the limitations of current course content and delivery. This research, which investigated career paths of graduates from a university course in industrial design, is a step towards this process.

Participants were selected based on purposive sampling techniques [7] and all had at least 5 years post-graduation experience at the time of interview. Semi-structured in-depth interviews were employed as the primary method for conducting the field work and data collection. The questions were developed from predetermined themes drawn from a review of relevant literature and reflections on the practice of design education.

The rich interview data was coded and analysed through iterative processes using computer software as well as more manual tools. The development of themes was based on mixed methods, including some top down as well as bottom up generation of groupings and used a combination of thematic, a priori, matrix and template approaches [8].

The models described in this paper were developed as part of this broader study. Qualitative research methods based on a phenomenological approach and individual perspectives were used both in initial genesis of concepts and in subsequent progression of relationships, testing of validity and iterative refinements.

The importance of models in communicating abstract concepts and relationships has been widely accepted [9]. In addition, the development of such models closely corresponds with the evolution of internal thinking: the process of articulating our thoughts in visual representations facilitates those thought processes [10]. As noted by Miles and Huberman, 1994, in Bazeley [11] 'you know what you display'.

3 THE TRIPLE AXES MODEL

The Triple Axes Model explains how different understandings of the role of industrial design, and consequent course structures, reflect positioning along three continuums of twinned variables:

- *Process –Outcomes*: indicating the relative importance attached to the application of sound processes and the final product;
- *Knowledge–Skills*: indicating the weighting given to theoretical, intellectual approaches as opposed to traditional skills in, for example, sketching and drawing;
- *Risk (unknown)–Safe (known):* signifying the balance between tried and true methods compared with innovation and consequent chance of failure.

The Model displays these competing priorities as continuums set on three overlapping axes (Figure 1).

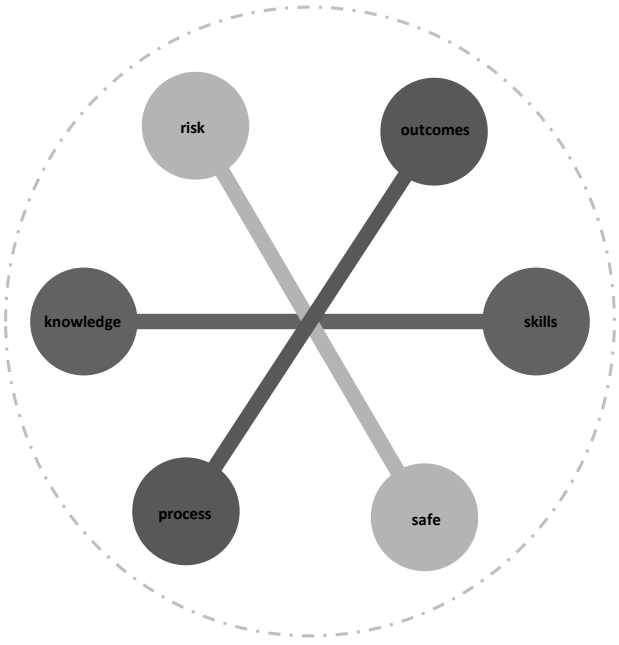

Figure 1. Triple axis model of industrial design education

While specific course content is variable, the mix and proportion of each of these six broad terms, and the point on the continuum chosen, helps to describe and analyse the various styles of industrial design education. Importantly, all paired concepts are continuums, not dichotomies. For example, the issue is not skills *OR* knowledge, but what should be the appropriate mix of both?

In educational terms, all six are necessary elements of industrial design education for the student to graduate as an industrial designer – but trying to cover all equally results in student confusion. The challenge lies in finding an appropriate blend and emphasis of each, within the time constraints of the given course of study. Each of the continuums is discussed below.

3.1 Process–Outcomes axis

The Process–Outcomes axis refers to the continuum between privileging *process* (the deliberative, exploratory and investigatory pathways we have traversed) versus privileging *outcomes* (the final destination, end point or product which results from these processes).

Process driven projects place emphasis on how a student went about the project and examined the range of tools and approaches potentially available to develop new products and solutions. Process tends to be given higher priority than outcomes in projects dealing with User Centred Design or design thinking and in sketch models. A focus on process can reward aspects of risk taking behaviour, as it recognises and values 'trying out ideas' even if the ideas ultimately do not result in a resolved outcome. Process-valuing styles can incorporate other aspects of design research that help inform both the design problem identification along with design solutions.

At the other end of the continuum, a focus on outcomes gives priority to the final result, regardless of the processes from which it arose. Projects which privilege outcomes tend to suit students with innate flair or creativity, who produce an appealing outcome, even though they may have 'leap-frogged' valid processes along the way. Such projects tend to also prioritise skills in outcomes production, such as model-making, CAD or rendering.

How educators site design teaching and learning objectives on this continuum can affect their graduates' strengths and weaknesses. Curricula focusing too strongly on *outcomes* do not promote risk taking or innovative approaches and possible outcomes, whereas those more strongly oriented to *process* can devalue actually achieving desired results.

3.2 Skills–Knowledge axis

The Skills–Knowledge axis refers to the continuum between a focus on skills (the capacity and competence to undertake learned techniques) and a focus on knowledge (theoretical understandings of concepts, strategies or histories).

Traditional industrial design was largely based on the acquisition and mastery of skills. Techniques such as drawing, sketching and model-making were the backbone of the field. Today, these are more likely to be applied in computer aided design, but similar approaches apply.

Skills such as these remain an important component of the contemporary industrial designer's toolkit. Designers must have the ability to communicate ideas and solutions to others: to peers and colleagues, to clients and to manufacturers. In some ways their skills in a design language beyond the verbal and written word are even more central in the trans-national and multi-lingual environment of global economies and manufacturing.

The concept of knowledge forms the corresponding pair for skills on this axis. While some forms of knowledge, such as manufacturing materials and processes, are long-standing aspects of design curricula, traditionally skill development was given greater priority than gaining theoretical knowledge. While these conventional areas of knowledge remain, an important focus is on building students' ability to find and apply knowledge, rather than simply acquiring a series of 'facts'. The explosion in knowledge makes it impossible for anyone to 'know everything', even about very specific subjects. More important is the fundamental approach of how to locate the relevant knowledge. Skills such as where to look, how to research, how to interpret and how to apply this knowledge are all paramount. For example, in studying materials for production, instead of retaining specific lists or attributes of many materials (which may change), it is more important for students to be aware of the breadth of available options and to master processes for determining the most appropriate choices.

3.3 Risk–Safety axis

The Risk–Safety axis refers to the continuum between risk (innovation and the corresponding chance of failure) and safety (conventional approaches which can stifle creativity). Risk is an inescapable part of developing innovative approaches to problem solutions. As IDEO thinkers for example have

explained, risk taking is necessary to break out of safe and potentially boring design solutions lacking the potential to develop innovative approaches [12].
From an educational perspective risk-taking can be difficult to promote to students with requirements to pass a subject. Finding ways to reward risk taking is possible within an educational environment, but less so within the constraints of many business models. It is noteworthy that companies such as Apple or Google which typify innovative practice have recognised risk-taking and mistake-making as part of good practice.
The opposite of risk-taking is the safe approach. Taking 'tried and true' approaches to achieve what is known to be valued – by teaching staff or by the public – can lead to a convergence of style and design solutions. This gravitation to the mean can promote 'sameness' and lack of individuality.

4 DESIGN DEVELOPMENT WAVE

The Design Development Wave was developed to provide a diagrammatic representation of design process, design education and the relationship between the two. If we take a helicopter view, the design process can be understood as a process moving from idea exploration to tangible product development (see Figure 2 *Design development continuum*).
In this schematic, the process begins with initial phases of problem identification, design research and design opportunity analysis. These phases, represented here as the left hand end of the timeline, are sometimes seen as the 'soft' aspect of the process. Design processes then develop to more detailed stages, with the right hand end representing the detailed manufacture, 'hard' or back end of the process [13].

Figure 2. Design development continuum

These elements are reflected in design education. While students are given an overview of the entire design process, the time limitations of an undergraduate degree preclude in-depth coverage of all aspects of the design development continuum. Design curriculums therefore tend to focus either on the 'soft' front end or the 'hard' back end aspects. By reflecting on my own practice as an industry based industrial designer and subsequent design education career, I have found that a traditional design for manufacture (DFM) had predominated in Australian industrial design education as influenced for example by employer bodies. This led to industrial design curriculums being generally biased towards back end processes. These different emphases are represented by Figure 3 *Curriculum comparison via the continuum,* where this focus on the back end is shown by the blue curve and the overseas focus on front end is shown by the orange curve.

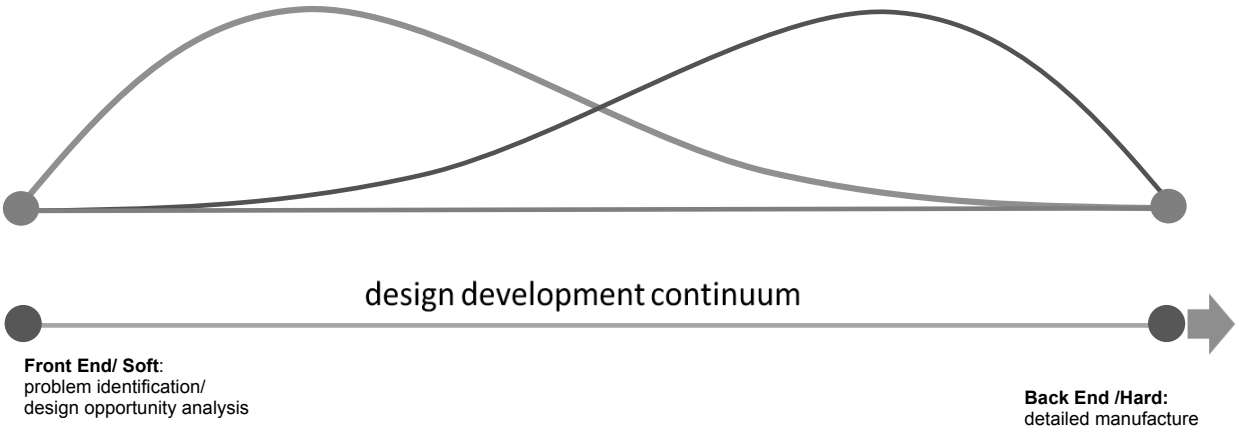

Figure 3. Curriculum comparisons via the continuum

5 INTERACTION OF THE MODELS

The relationship between the Design Development Wave and the Triple Axes Model is shown in Figure 4.

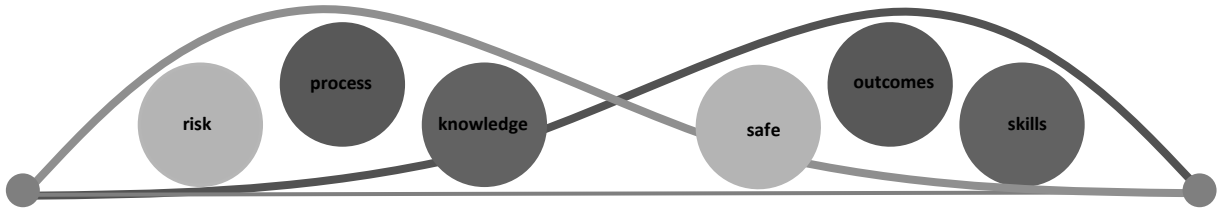

Figure 4. Relationship between the Design Development Wave and the Triple Axes Model

A focus on the back end, DFM aspects of design (right hand side dominant in the Design Development Wave) coincides with more traditional preferences on the Triple Axes Model and has a bias towards outcomes over processes, skills over knowledge and safe approaches over risk taking. Likewise, a focus on the front end, softer aspects (left hand side dominant in the Design Development Wave) aligns with the opposite, emerging patterns on the Triple Axes Model, where processes are prioritised over outcomes, knowledge over skills and innovation over safe approaches. This oversimplifies the reality of industrial design education, as in most instances, all elements are included. "However curricula place greater emphasis on one approach rather than its opposite. In the Australian context, the emphasis clearly falls on the back end, DFM aspects of design and the associated safe, outcome and skills elements of the relevant axes (Figure 5).

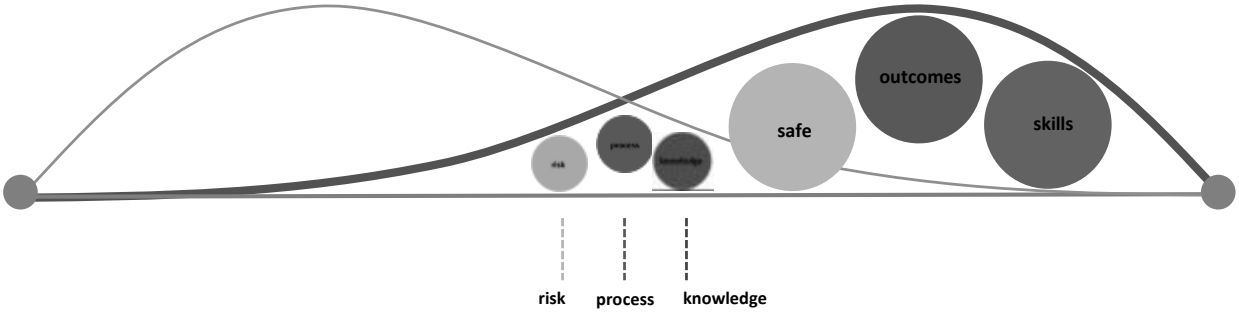

Figure 5. Relationship between the Design Development Wave and the Triple Axes Model

6 IMPLICATIONS FOR PRACTICE AND EDUCATION

As design educators, we have share responsibility for the future employment prospects of graduates. To a large extent, the toolkit of skills and knowledge students take with them on graduation will dictate those prospects. We continually face the question: how well does our course equip students to survive and prosper in the real world, whether in Australian design or overseas? What is the learning environment most conducive to achieve these outcomes, and how can we help to create such an environment?

Decisions on industrial design education and curriculum development reflect the reality that choices must be made: it is not possible to give all aspects equal weight in an undergraduate degree where priorities such as length of course, contact hours, staffing profiles, research needs, university agendas, local, national and international course foci etc. compete for space.

Course assessment structures similarly signal the priority choices made, because they reward or deter different attributes of student behaviour. Does the assessment system encourage taking a risk or playing it safe? Do our timelines for project based learning allow making and learning from mistakes, while at the same time preparing students for the realities of the commercial world with its short lead times and unforgiving deadlines?

The models proposed in this paper do not answer these complex questions. Instead, they help articulate the choices to be made, and build frameworks for informed dialogue. The language and concepts advanced by these models promote greater transparency, awareness and engagement. By providing the means to consciously guide the profession's future opportunities, they offer an alternative to less considered responses to current environmental changes.

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