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DESIGN WITH ATTITUDE: A KEY WORLD CLASS METHOD

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Engineering Designers, Attitudes, Professionalism, Ownership, Responsibility, Team player, Discipline, Tenacity, Self-Reliance, Self-Learner.

1 Introduction

World Class Design by implication can best be achieved by adopting world class methods. ICED conferences continue to disseminate methodologies to help make designers and design teams more effective and efficient. At ICED 95 we introduced our PAKTS model (Figure 1.) which identified the total educational needs of young engineering designers [Robotham 1995]. The five key elements of the model are Processes, Attitudes, Knowledge, Tools and Skills. Of these elements, the least developed in terms of methodologies is that of "Attitude". This paper will give further consideration to this element and identify the qualities that a designer must develop to be world class. These qualities would include: professionalism, ownership, responsibility, team player, discipline, tenacity, self-reliance, and self-learner. We would hope that this paper will form the basis of a "Design with Attitude" method, that would sit alongside all other world class methods, because we firmly believe that World Class Design cannot be achieved without the designer adopting a "Design with Attitude" approach.

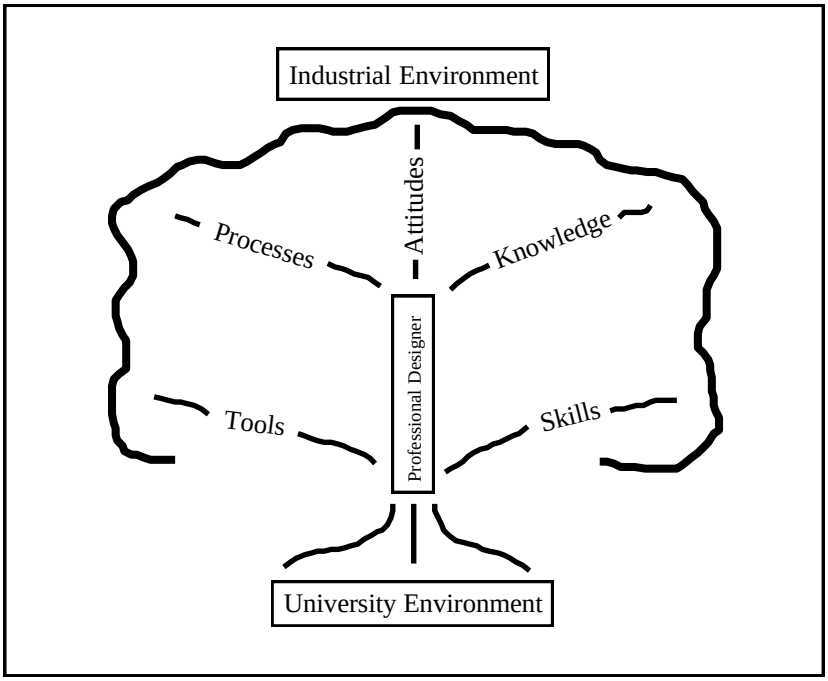

Figure 1. The PAKTS model of Design Education

2 The “Design with Attitude” method

The concept of World Class Design is a goal for engineering design practise to aspire to and work towards. The identification of best practices, development of systematic approaches, creation of methodologies and utilisation of tools is usually focused upon the design activity and the design team [Eder 1995]. Whilst these practises, methodologies and tools inform the engineering designer on how to work, when to carry out specific tasks, with whom to work, why specific tasks are necessary, and what they are trying create, little has been said of the qualities required of engineering designers to be successful in this activity.

The Design with Attitude method is focused on the engineering designers themselves. It provides the guidelines for the personal qualities and characteristics required of engineering designers. It is not a method that focuses on the product design activity itself and product being created, but upon the human elements of the process; the element that is argued to be the most significant in the process [Robotham 1997]. It develops further the Attitudes branch of our PAKTS model for Design Education, the sub-branches discussed here being:

- Professionalism
- Ownership
- Responsibility
- Team Player
- Discipline
- Tenacity
- Self-Reliance
- Self-Learner

The Design with Attitude model, we believe is an essential element of any engineering design activity. Whilst it is supported by other design methods and approaches, we believe that the successful implementation of world class methods can only be achieved if the engineering designers utilising these methods do so with a world class attitude of mind. It is the attitude of mind that this model sets out to define.

At this stage of its development, the method is based upon our combined experiences of over thirty years of teaching and educating engineering designers at degree level. We believe the rigour of our method requires formal validation by research, but funding for this type of activity is scarce and difficult to obtain. However, our belief in this aspect of the formation of young engineering designers is borne out by employers of our graduates. We are continually hearing from employers and professional bodies of the need for engineering designers with the attitudes and personal qualities that will enable them to be successful in a commercial environment. The Design with Attitude model is our attempt to define that method of working.

3 The Elements of the Design with Attitude model

In this paper we will consider eight elements of the Design with Attitude model. These are not independent elements, and drawing upon our analogy of a tree in the PAKTS model, the overall attitude of mind of the engineering designer is a complex intertwining of these sub-branches and world class attitude results from successful growth in all sub-branches.

3.1 Professionalism

The UK Engineering Council describes professionalism as 'competence and commitment' [Engineering Council 1994]. Competence in a technical sense was discussed in our paper to ICED 95 [Robotham 1995]. Attainment of this ability is the traditional objective of engineering education. Commitment on the other hand is not an outcome from most University curricula. We shall develop how commitment may be addressed through encouragement of responsibility and ownership later in this paper. A further characteristic of professionalism is integrity: the quality of being completely honest, objective and accountable so that the designs produced can be justified or defended in all aspects whatever the purpose of the scrutiny. In addition to the functional needs of the design, integrity also requires that such issues as risk assessment, morals and ethics are considered.

Risk assessment methods are covered in a number of texts, e.g. [Pahl 1995], and can be handled in a structured way. However much of the value judgements are about the risk to profitability and the moral questions about the cost of safety are not often discussed, although product liability laws have increased public awareness. It is not to engineering designers' credit that product liability laws have been necessary. In 1992, the Engineering Council defined a Code of Professional Practice on Risk Issues [Engineering Council 1992].

Other moral issues that may cause conflicts of interest between the designer, his employer/client and his society are often left to the individual to resolve personally. Although environmental questions are now in frequent public discussion [Engineering Council 1994], peer guidance for the engineering designer on other moral questions (for example weapons work, sex aids and abortion equipment) is not available.

This leads to a debate about ethics. Some texts, notably Ertas & Jones [Ertas 1993], discuss ethics at length and present a code of ethics for engineering designers. The Engineering Council expects its members to follow its Code [Engineering Council 1992], and disciplines those in breach of it. Ethics in these contexts refers to the personal behaviour of the individual in an honest way. It is however uncommon for this to be included in a University engineering curriculum.

3.2 Ownership

A defining characteristic of the engineering designer is their holistic approach to product design [Robotham 1997]. This approach recognises the need for the engineering designer to provide products that satisfy the requirements of a broad range of internal and external customers. External customers, for example, include the end-user, the purchaser, service and maintenance, and society at large. The requirements of the external customers will be generally different from those of the internal customers such as the manufacturing organisation itself, industrial designers, specialist engineers, suppliers, manufacture and assembly, dispatch. The overall quality of the product will depend upon how well the engineering designer has been able to satisfy each and every customer. To be successful in this respect, the engineering designer must be appreciative of the requirements of each customer and own the design problem as if they were that customer. Ownership of the design requirements by the engineering designer ensures that the "voice of customer" is fully represented in the design activity.

The engineering designer must also own the product and be responsible for ensuring that the product has the features and qualities necessary to satisfy all customers. In a commercial environment, where there will be competition for resources, it is the engineering designer who must be able to justify the allocation of design and development resources necessary to successfully achieve the required performance goals. The engineering designer must have the desire and pride in their craft to create product designs of the highest quality.

3.3 Responsibility

Responsibility was earlier included as one aspect of commitment. Within any set of relationships, an individual has to account for their actions. The engineering designer has a responsibility to society, to the family, to the employer and to work groups or teams. This plurality of responsibilities will almost certainly sometimes create conflict. Guidance in handling such conflicts is needed by the individual. An outcome of this responsible attitude is reliability: delivering what has been promised. It is possible to educate and train designers to be responsible through exposure to a series of successively more complex situations.

3.4 Team Playing

An internal responsibility within a work group requires team working skills. There have been considerable studies in this area by behavioural scientists, so that roles and group development are well understood. At Coventry University, the seminal work by Belbin [Belbin 1993] and an exercise produced for NASA are used to give a basic understanding. The essential need is to generate an ability to co-operate so that the synergistic effect of team work is used.

3.5 Discipline

The responsible approach to delivery as promised, including to time needs a further attitude: discipline. This ensures that the design is produced in a rigorous and defensible manner so that it will perform to specification and survive for all its life. It means that the designer will ensure that he or she has a working knowledge of what is accepted to be current best practice in the field of the product being designed and of course that this is followed when designing! A disciplined attitude will need a structured and methodical process through the design task. Discipline leads to a clear minded working that separates objective and subjective decisions in a controlled way. Sometimes it is necessary for project control for the designer to have a discipline of blinkers: a focus on the specific objectives of the design brief that prevents wasteful, confusing and possibly detrimental side-tracking.

3.6 Tenacity

The iterative nature of the design process demands repetition of design tasks and a continued search for improvement in the solution. The ability to maintain the enthusiasm and energy to carry out design tasks to their conclusion is an essential quality of the engineering designer. The engineering designer must be capable of reviewing their previous work, verifying that previous results and conclusions continue to be valid as others emerge. The search for alternatives approaches to accepted practices results from a commitment to create new products which embody significant improvements over previous solutions.

3.7 Self-reliance

Professional engineering designers must be competent in their craft. But this competence must be consciously recognised by themselves and the limitations of their capability and expertise understood. In this way, the engineering designer can perform their tasks with confidence, skill and in an effective manner. Where the design task requires expertise and knowledge beyond their own domain, the need for assistance can be readily identified and sought by them. Being able to identify from the outset the skills, knowledge and expertise required to undertake a design task enables the engineering designer to identify the contribution they can truly make to the activity . This will ensure that the design activity is carried out by the most effective and appropriately skilled designers, that it progresses with a high level of confidence and reliability, and that it is concluded in the shortest possible time with the most effective use of resources.

Being consciously aware of the limitations of their competence, allows engineering designers to perform their tasks with confidence, rigour and skill. They will have a self-belief in the significance of their efforts to the overall design task and will be able to present the results of their efforts with pride and certainty, knowing that they have crafted effective and rigorously engineered solutions.

3.8 Self-learning

The professional engineering bodies now require practising engineering designers to demonstrate a continuous development in their expertise and skill. The range of personal development activities that is accepted in a Continued Professional Development (CPD) programme is broad, e.g. learning a foreign language, attending a conference, writing a journal paper, reading articles, meeting with other engineering designers. However, CPD programmes are self initiated and planned. Therefore, the engineering designer must be able to identify their self-learning needs and ensure that CPD activities are chosen appropriately.

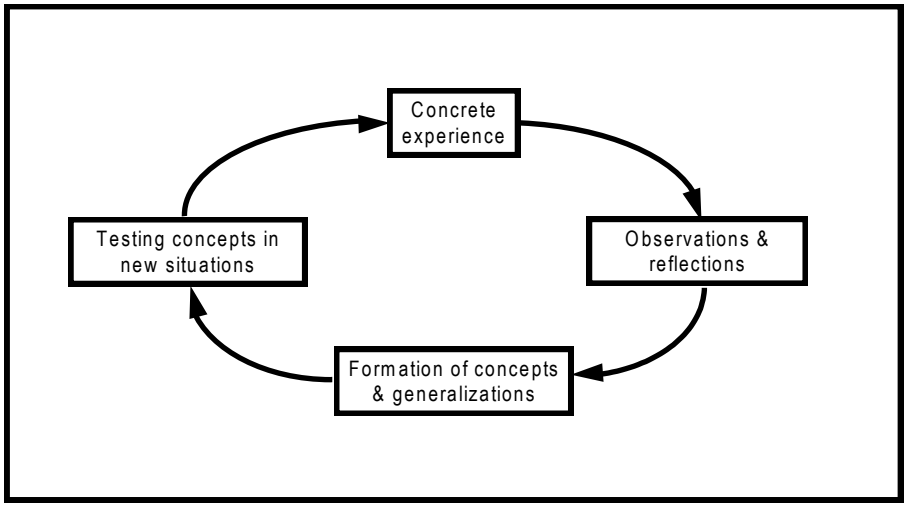

Figure 2. The Kolb Experiential Learning Cycle [Kolb, 1984]

The ability to reflect upon previous experiences, to develop an understanding of the knowledge, processes, tools and skills required to be successful, and to establish action plans for continuous improvement is an established approach to self-learning (Figure 2.). It is a discipline that can be instilled in young engineering designers during their formation and become a life-long approach to continued personal improvement.

4 Conclusions

- Design with Attitude is an important part of the formation of professional engineering designers
- The aspects of Design with Attitude addressed in this paper form a methodology for achieving the required personal qualities
- The PAKTS representation can be expanded to include the requirements of Design with Attitude as sub-branches within the tree structure
- A training and education programme for engineering designers must include Design with Attitude alongside Design Science
- Funding sources should be persuaded to enable the methodology to be developed as a essential contrasting complement to technical developments

References

Robotham, A.J., Perks, R., Jones, R.M. and Blount, G.N., "Design Practice in the UK Car Industry: How Coventry University is Addressing the Needs", Proc. 10th Int. Conf. on Engineering Design, ICED 95, Praha, Czech Republic, August 1995, Vol. 1, pp 203 - 204.

Eder, W.E., "An Appropriate Structure for Design Science", Proc. 10th Int. Conf. on Engineering Design, ICED 95, Praha, Czech Republic, August 1995, Vol. 1, pp 3 - 8.

Robotham, A.J., "The Role Of The Designer In World Class Design: A Celebration Of The Human Element Of Design". Proc. 11th Int. Conf. on Engineering Design, ICED 97, Tampere, Finland, August 19-21, 1997.

The Engineering Council, "Competence and Commitment - A New System of Engineering Formation and Registration". The Engineering Council, UK, 1994.

Pahl, G. and Beitz, W., "Engineering Design - A Systematic Approach". Springer-Verlag, 1995.

The Engineering Council, "Engineers and Risk Issues - A Code of Professional Practice", The Engineering Council, UK, 1992.

The Engineering Council, "Engineers and the Environment - A Code of Professional Practice", The Engineering Council, UK, 1994.

Ertas, A. and Jones, J.C., "The Engineering Design Process", Wiley, 1993.

Belbin, R.M., "Team Roles at Work", Butterworth Heinemann, Oxford, 1993.

Kolb, D., "Experiential Learning", Prentice-Hall, London, 1984.

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ABSTRACT

DESIGN WITH ATTITUDE:
A KEY WORLD CLASS METHOD

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At ICED 95 we proposed a model for Design Education [1]. The PAKTS model identified the total educational needs of young engineering designers with the five key elements of : "Processes", "Attitudes", "Knowledge", "Tools" and "Skills".

Whilst it can be argued that World Class Design can best be achieved by adopting World Class Methods, can we be sure that we have identified what all those methods might be? For example, what is the World Class Method for "Attitude"?

This paper will further develop our PAKTS model by considering in depth the "Attitudes" element. The paper will draw upon our experiences of developing new engineering design talent with our understanding of how these people fare in the industrial environment. The paper will identify the qualities of attitude that a designer must develop to be successful. These would include, amongst others:

- professionalism
- ownership
- responsibility
- team player
- discipline
- tenacity
- self-reliance
- self-learner

We would hope that this paper will form the basis of a "Design with Attitude" method, that would sit alongside all other World Class Methods, because we firmly believe that World Class Design cannot be achieved without the designer adopting the appropriate "Design with Attitude" approach.

1. Robotham, A.J., Perks, R., Jones, R.M. and Blount, G.N.: 'Design Practice in the UK Car Industry: How Coventry University is Addressing the Needs'. Proc. 10th Int. Conf. on Engineering Design, Praha, Czech Republic, August 1995, pp 203 - 204.