Selecting and Forming Design Teams

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Abstract: This paper explores the use of aptitude tests for selecting students for Design Engineering programmes. The latest ideas and theories are then explored regarding the usefulness of personality type instruments such as the Myers-Briggs Type Indicator (MBTI) and the Keirsey Temperament Sorter II (KTS II) as tools for forming balanced Design teams. The popularity of 'Design' programmes in the UK and overseas has been matched by the difficulty in recruiting to conventional 'Engineering' programmes. This has led to the explosive growth of programmes such as Engineering Design, Product Design and Design Engineering, which seek to exploit this demand. It is concluded that both Engineers and Designers have similar personality types, and a methodology of using personality type indicators to select and form design teams is postulated.

Keywords: Selection, Keirsey Temperament Sorter, MBTI, Personality Type, Design Team Formation.

1. INTRODUCTION

There are two main areas where design educators can make a great impact on the quality of their programmes:

- By selecting students who are most suited to their programmes.
- By forming teams which will work well together.

Of these two, the recruitment cycle is well known and utilised – sometimes the bane of academics – it is the backbone of most departments. However, the question should be asked, is your recruitment process delivering the goods?

Quality in ⟶ **Quality out**

Some of the most prestigious design schools in the world, namely Cambridge University, Stanford University and The Royal College of Art have little trouble attracting high quality applicants. However, this is not the case for the vast majority of other educational establishments.

2. THE PROBLEMS WITH HIGHER EDUCATION

We have all experienced the frustration of spending 90% of our time on 10% of the student body; dealing with people who are not suited to the area of study and should not have been recruited to the programme. Unfortunately, for both parties, this situation re-occurs year on year for three to four years.

In the UK, this situation is exacerbated by the drive to recruit ever more students, particularly from minority groups (widening participation) and furthermore to increase student retention and progression rates.

As stated by The Higher Education Academy [1]:

"Non-completion rates amongst students in UK HE are currently running at around 17%." *[1]*

Some of the reasons put forward for this are:

- Academic failure.
- **Wrong course of study.**
- Personal problems (health, finance, etc.).
- Inadequate study skills and advice.
- Lack of student support.
- Increasing class sizes.

To some extent, some of these are unavoidable, due to the UK government's target of 50% of 18-30 year olds into higher education by 2010. Currently the figure remains stagnant at 43% and has been for several years.

3. APTITUDE TESTING FOR DESIGN ENGINEERING

Clearly, a way forward would be to select only the most suitable candidates for a particular programme of study. Within Middlesex University's Product Design and Engineering department we have developed an aptitude test for our MSc Design Engineering programme, which rates applicants on a series of ten components, these being:

[1] Verbal Analogies

[2] Arithmetic Reasoning

[3] Word Knowledge

[4] Maths Knowledge

[5] Mechanical Comprehension

[6] Block Counting

[7] Table Reading

[8] Drive Belts and Gears

[9] General Science

[10] Parts Assembly

This test battery was developed over several months with reference to tried and tested tools such as the Bennett Mechanical Comprehension Test® (BMCT), the Wiesen Test of Mechanical Aptitude® (WTMA) and The US Air Force Officer Qualifying Test® (AFOQT).

Each section contains five questions with five possible answers, and the total test duration is fifty minutes. To date, the test has been taken by 54 applicants; the results are as follows:

Table 1 – Aptitude Test Battery results (n=54).

Test	1	2	3	4	5	6	7	8	9	10	Mean Score
Overall Results	195	**144**	176	**94**	**142**	177	259	176	183	**145**	63%
Base Scores	135	135	135	135	135	135	135	135	135	135	*SD=14%*

From the results of the aptitude testing, it is clear that most of the applicants found the 'Maths Knowledge' (Test 4), 'Mechanical Comprehension' (Test 5), 'Arithmetic Reasoning' (Test 2), and 'Parts Assembly' to be the most difficult, as expected. Conversely, they found the 'Table Reading' (Test 7) and 'Verbal Analogies' (Test 1) the easiest. The individual scores ranged from 86% to 24%, with a notional pass mark at 40%.

Over the last three cohorts, the mean score for this test has been 65% *(SD = 13%)*, 61% *(SD = 16%)* and 61% *(SD = 12%)* respectively.

To date, one cohort has graduated, and by using a Pearson correlation coefficient, r, between the Aptitude Test Results and the Overall Exit Grades of the programme, the result was:

$$\text{Pearson, } r = -0.949 \qquad (1)$$

This indicates that there is a very strong inverse correlation between the test results and the final programme grades (the negative sign relates to the final grading on the 20 point scale, where 1 is the highest grade). The significance of this result is given by the Pearson look-up table which shows that this result has a ($P < 0.001$).

This testing method has provided the course management team with another useful indicator of the students' ability to convert from the 'Design' discipline to the 'Design Engineering' discipline and has provided a clear differential between the best and the worst candidates.

The next logical step will be to cross-reference success (as measured by exit classification) and retention rates, with the test battery results for all cohorts, and if proven, role this out to other programmes.

4. PERSONALITY TYPE AND TEAM FORMATION

Many research teams over the last 20 years have come to realise that significant improvements can be made simply by selecting teams based on judgment rather than luck, as is the case in the majority of university departments [2-6].

The application of personality type, using either the Myers-Briggs Type Indicator [7], the Keirsey Temperament Sorter II [8] or other web-based unregulated pseudo-type indicators is well known. Applications in almost every area of education have been reported [9-20].

The work of Prof. Douglass Wilde at Stanford University stands out, due to his method of adapting both the MBTI and KTS II, formulating his own method of team selection [21-28].

This has proved to be a highly successful strategy in terms of the annual National Lincoln Prize awards [27]:

1. No selection strategy (27 % of awards).

2. Preference information guidance (57 % of awards).

3. Creative roles used (73 % of all awards).

Further work (Phase III) is ongoing at Stanford to develop this system into an even more effective tool.

4.1 Personality Type Selection Methodology

The question is now raised as to how much have Engineers got in common with Designers? The answer is, much more than you might suspect. Both groups design, develop, validate and manufacture products and services for use by people.

By analysing the standard MBTI type table and its associated type profiles of practicing Engineers, we have concluded that there is a range of types best suited to both Engineering and Design. From analysis of the 16 personality types it has been concluded that the following eight types in Tier 1 would be the most suitable for Design Engineers. If further selection is needed then we suggest moving on to Tiers 2, 3 and 4 respectively.

Table 2 – Choice sets for the selection of Design Engineering teams.

	Guardians	Artisans	Idealists	Rationals
Tier 1	ISTJ – Inspector ESTJ – Supervisor	ISTP – Operator ESTP – Promoter		INTJ – Mastermind INTP – Architect ENTP – Inventor ENTJ – Field marshal
Tier 2	ISFJ – Protector ESFJ - Provider		INFP – Healer ENFP - Champion	
Tier 3			INFJ – Counsellor ENFJ - Teacher	
Tier 4		ISFP – Composer ESFP - Performer		

4.2 Personality Type in Practice

The Myer-Briggs type table for the current cohort of MSc Design Engineering students is shown in Figure 1 below.

ISTJ (0%)	ISFJ (11%)	INFJ (6%)	INTJ (6%)
ISTP (0%)	ISFP (0%)	INFP (6%)	INTP (0%)
ESTP (0%)	ESFP (0%)	ENFP (0%)	ENTP (11%)
ESTJ (11%)	ESFJ (22%)	ENFJ (17%)	ENTJ (11%)

Figure 1 Myers-Briggs Type Table (MSc 2006 cohort).

Analysis of the type data in (Figure 1) shows that 39% of the students fall into Tier 1, a further 39% fall into Tier 2 and the final 22% fall into Tier 3. There are no students in Tier 4. This would be regarded as a reasonably good result. The fact that there are no students in Tier 4 is to be welcomed, and also the fact that the minority of students are represented in Tier 3 is beneficial. Of course ideally we would want higher percentages in Tier 1, however, a mixture of personality types represented on design teams is a useful thing.

E	72%	I	28%	
S	44%	**N**	56%	
T	39%	**F**	61%	
J	83%	P	17%	Overall this cohort is ENFJ.

The cohort should therefore exhibit an outgoing nature (good for presentations), an intuitive aspect (good for design and creative problem solving), a strong sense of feeling (passion and emotion), and lastly a high judgemental quality (good for on-time delivery, command and control).

Teams would be selected based on a coherent and complimentary blend of personalities, and lead by one of the preferred types in Tier 1, i.e. ISTJ, ESTJ, INTJ or ENTJ.

5. CONCLUSIONS

The Myers-Briggs Type Indicator has over sixty years of developmental research within all areas of education. It has been estimated that 3.5 million tests are conducted worldwide per year. It is the authors' belief that the combination of rigorous selection and team formation strategies, based on personality types is the way forward. There has been strong published research evidence of the success of using team type selection at Stanford University [29]. There is clearly much more research to be conducted before stronger claims can be made. During the next 3-5 year period we intend to gather further research data to support this hypothesis and welcome collaboration with other Design departments.

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