

# Appendix 2: Research questionnaire

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Online supplement for “The Making of an Expert Engineer” by James Trevelyan

Whenever possible, the interviews were conducted in the participant’s workplace. Several valuable accounts were obtained by recording observation notes about interruptions, casual conversations before and after the interview, and conversations with other people in the workplace.

The interview commenced with a brief explanation about the purpose of the research and each participant was asked to sign a consent form, a copy of which is included at the end of the interview questionnaire.

The questionnaire commenced with demographic questions on the individual (education background, locations for education, years of experience) and estimates of the numbers of engineers and other employees in the organization. Some “warm-up” qualitative questions on the individual’s education experience preceded the main interview questions below. Not all questions were asked in every interview, sometimes because of time constraints and sometimes because they had already been answered in earlier responses.

*Response Identification No:* \_\_\_\_\_ *Interviewer:* \_\_\_\_\_

*Interview Location:*

\_\_\_\_\_ *Date:* \_\_\_\_\_

*Basic Information on Subject:*

*Q1) Age:* <25    26–30                  30–40                  40–50                  50–60                  >60

*Q2) Years since first engineering qualification:*

1-2                  3-5                  6-10                  10-15                  16-20                  20+

*Q3) Years of professional engineering experience: (allow for career breaks such as teaching)*

1-2                  3-5                  6-10                  10-15                  16-20                  20+

*Q4) Country of birth:* \_\_\_\_\_

*Low income country    or    Developed Country?*

## **Education**

*Q5) Locations (Country, city if known)*

*Primary:* \_\_\_\_\_ *Rural*                  *City*

*Secondary:* \_\_\_\_\_ *Rural*                  *City*

*Give details of years:*

1940-1949    1950-1959    1960-1969    1970-1979    1980-1989

1990-1999      2000+

**Q6) Tertiary Qualifications:**

*Diploma                      Bachelor's Degree                      Masters                      PhD*

*Give details of years:*

1940-1949      1950-1959      1960-1969      1970-1979      1980-1989

1990-1999      2000+

*Some engineers may have first completed trade or apprenticeship qualifications, and then proceeded to degrees later in life with scholarships, if possible identify the source of the funding – private/government, which government or scheme (e.g. Colombo Plan).*

*First Engineering Degree or other professional qualification (institution):*

\_\_\_\_\_ ( \_\_\_\_\_ )

*Scholarship funding from (list source and country):* \_\_\_\_\_

*Higher Degree 1 (institution):*

\_\_\_\_\_ ( \_\_\_\_\_ )

*Scholarship funding from (list source and country):* \_\_\_\_\_

*Higher Degree 2 (institution):*

\_\_\_\_\_ ( \_\_\_\_\_ )

*Scholarship funding from (list source and country):* \_\_\_\_\_

**Comments on Education**

*Tell us about the good features and the deficiencies, as you now see them, of your studies at university or college for your first engineering qualification (degree, diploma, trade certificate).*

*Tell us how you now rate the quality of your studies at university or college - in comparison to other colleges or universities that you have heard of (either in your own country or other countries).*

*Tell us about the costs of your education, if you can (cost of tuition, living expenses, tools, materials, books, computers, etc. )*

*Tell us why you chose engineering work in the first place. (Tell us if the prospect of working in another country influenced your choice of education, and what difference this made.)*

The next three questions produced long responses (with appropriate probes such as “Could you explain a bit more about \_\_\_\_\_”) and often took up to half of the interview time. The responses were often the most interesting and informative.

*Please tell us about your career so far.*

*Year; firm (& city, country); Position; Responsibilities*

*Please tell us about your current position: (your role here, and your responsibilities).*

*Tell us about the technical aspects of your duties in your current position.*

Depending on the kind of work being performed, and the responses to the first three questions, many of the following questions either had already been answered or yielded relatively short responses.

*Tell us about any planning or estimating work that you have to do.*

*Tell us about any marketing or sales promotion work that you do.*

*Tell us about any fixed procedures that you are expected to follow, such as purchasing, design change control, defect reporting, etc.*

*Who do you report to, and for what? Do you have to report to more than one person, and if so, for what?*

*Who, if anyone, reports directly to you?*

*Tell us about any supervision responsibilities you have from time to time.*

*Tell us about work that you do with drawings, either reading them or creating them. Which software tools do you use. (e.g. CAD packages, Microsoft Visio, etc.)*

*Tell us about any subcontract responsibilities: work that you are responsible for that is actually performed by subcontractors.*

The responses to next few questions were also very informative.

*Tell us about any financial responsibilities that you have in your position.*

*Tell us what you enjoy about your work.*

*Tell us how do you decide what to do each day? How much does your boss decide for you?*

The following questions had often been answered already, but were asked if necessary.

*Tell us about the most demanding aspects of your role here: when you have to work hardest.*

*Which part of your job makes you work hardest?*

*Tell us what your typical working day or week involves: how much time (in a relative sense) is spent on each aspect.*

*Tell us how you obtained this job: how did you apply and what did the selection process involve?*

*Tell us about your job security – tell us about any guarantees of continuing employment you have been given.*

*How does your pay compare with people in other firms or industries at your level?*

*Tell us what you know about your organization's performance. How you get to know about this? How much do other employees know and how do they get to hear about it?*

*Can you give us a broad indication of the price of the services or products your organization provides or makes? (e.g. construction cost levels, price for product, hourly rates etc.)?*

*How do you calculate your labour costs – what are the principal components of your labour costs?*

*What are the lasting effects of your work? (the contributions which will remain after you leave)*

*Tell us how your performance is evaluated here? Tell us about the important aspects of your personal performance in the job?*

*Tell us some of the new things you have learned (that are related to your job) in the last six months or so.*

*Tell us about any conferences, workshops, seminars, training courses or formal education you have attended in the last two years, including commercial trade shows, product presentations etc. Tell us if who provided these opportunities (employer, self, other).*

*Tell us about any courses you have attended on non technical skills such as supervision skills, conflict resolution, mediation, face to face communication skills etc. Tell us if who provided these opportunities (employer, self, other).*

*Do you regularly use the new skills for which you received training in this job? Which ones?*

*Tell us how your company or employer organizes teams or small work groups. Which levels of employees work in teams?*

*Tell us how (if at all) you get to choose the people you work with, and about appointment or recruitment activities you participate in.*

*Tell us about the current job market in your area: if this job terminated tomorrow for any reason, where would you start looking for a new job?*

*Tell us about your role in training other people. Tell us about your contributions and how you evaluate their needs and progress.*

*What skills do you think new graduates have to learn on the job, that they don't have when they graduate? Can you provide some examples from your recent experience supervising graduate engineers.*

*Tell us about any new products or services you have heard or learned about in the last one year or so. (Tell us how you first heard of them, and whether you have actually tried using them.)*

*Tell us about engineering products or services that you “buy”, in the sense that you are the main person who decides or recommends who or where to buy the products or services from.*

*Tell us how you evaluate these products or services: how you decide which is the best? (Tell us how you evaluate the costs and benefits of each product or service.)*

*Tell us who you think you are working for (your clients).*

*How do they know what to ask you for? (To what extent are they aware of engineering issues?*

*How do they constrain your work? What kind of budget or financial limits do they set?)*

*Who else do your clients turn to for advice or similar engineering products or services? (Who are your competitors?) How do you rate their services in relation to yours?*

*Tell us about any occasions in which your clients have required you to update your working knowledge or introduced you to new techniques.*

*Does your salary depend on how well your company/organization is performing? Roughly what proportion of your pay depends on this?*

*How do you participate in decisions that affect the way your work is conducted?*

*Tell us about status distinctions between employees at different levels. Do you take meals with employees at different levels?*

*Tell us about any special systems or techniques that you regularly use in your work, e.g.*

*Value Engineering? Safety Case? Hazop Analysis? Risk Management? Quantitative Risk Analysis? Total Quality Management? Critical Path Project Management? 6-sigma Quality Control? Taguchi Methods? RAMS – Reliability Availability Maintainability, Safety? Reliability Centred Maintenance?*

*Tell us about the information resources you use: texts, libraries, internet, in-house resources, commercial resources etc. Where did your reference books come from (if mentioned)?*

*Tell us about special tools or techniques that you use, and that would not be available (or would be expensive to buy) if you set up your own business or moved to another company that did not have them.*

*Tell us about checking procedures in your company that help to prevent you from making a major mistake?*

These three additional questions were used in studies focusing on design review checking.

*How do you make sure that they are actually working?*

*Tell us what are the kinds of mistakes that you pick up when you are checking documents?*

*How would that be approached differently on different company projects that you know about, or in different organisations?*

The next four questions were only asked if time permitted, or there were earlier issues raised that suggested certain questions would yield further interesting information.

*Tell us what you think is important for promotion or pay increase here? How else does your boss show his/her appreciation?*

*Tell us how your work affects, or could affect the environment? Tell us how environmental constraints or laws affect your work.*

*Tell us how you see the way you (and other people) work in this kind of organization, in this country, in relation to the ways that other engineering people work in other organizations or countries that you or close colleagues have experienced.*

*Do you think in imperial/US units (feet, inches, pounds) or metric units? Why?*

The next three questions often provided interesting and revealing responses and were included in as many interviews as possible.

*Tell us if you return to your completed projects some time later to evaluate the client's satisfaction some time after final completion, and what kind of issues have arisen from this? (2 – 3 years later)*

*Tell us about the impact on your work of dishonest behaviour by people. How do you work with these human "weaknesses". If you can, please tell us how you make allowances for this in planning or cost estimation.*

*Tell us if we have missed something interesting....*

The same questionnaire framework was used by most of the research students collaborating in this project. However, each student varied the questionnaire to suit the purposes of their particular research questions and the time that they had available. Since the responses to the first three main questions often took up 30% – 50% of the interview time, a substantial proportion of each transcript provided comparable responses even though the remaining questions may have been different from other interviews.

The following sets of questions were only included for certain interviews, some with engineers responsible for sales and others with engineers and technicians responsible for maintenance.

### **Sales engineering questions**

*Tell us about the products or services you are responsible for selling.*

*Please tell us how your products or services relate to competing products or services, and how you present your products to clients in the best possible light.*

*Tell us about the levels of support do you receive for product marketing from the manufacturers or their agents?*

*Tell us about the kind of services you need to supply, perhaps at zero or subsidised cost, in order to market your products effectively. For example, training courses, web site information, seminars etc.*

*Tell us about ways that you distribute information about your products to engineering students in Universities or Colleges (if applicable). Can you evaluate the success of this strategy?*

## **Maintenance engineering questions**

*Tell us about the computer maintenance management system and how it affects the way you work.*

*Tell us about some of the things that make your work unnecessarily difficult.*

*Can you tell us about times when you notice that there was insufficient allowance made for human factors, either in design, construction, commissioning, operations or maintenance.*

*Can you tell us about some interesting problems you have encountered in commissioning new equipment that could have been avoided by better organisation, design, or whatever.*

*What is your role in keeping the workspace clean, organised and tidy?*



**THE UNIVERSITY OF  
WESTERN AUSTRALIA**

*Achieving International Excellence*

**Professor James Trevelyan**  
**School of Mechanical Engineering**  
**Mechatronics Discipline Group**

35 Stirling Highway  
Crawley 6009

T +61 8 6488 3057

F +61 8 6488 1024

E [James.Trevelyan@uwa.edu.au](mailto:James.Trevelyan@uwa.edu.au)

[www.mech.uwa.edu.au/jpt/](http://www.mech.uwa.edu.au/jpt/)

CRICOS Provider Code: 00126G

Fairway Entrance 3

#### INFORMATION SHEET FOR THOSE PARTICIPATING IN SURVEY OF ENGINEERS

A qualitative survey of people involved in engineering work is being conducted to provide a better understanding of the ways in which people make engineering decisions in their work. This research may lead to an improved understanding of engineering practice, improved training and education, and improved efficiency.

The survey will constitute interviews with approximately 100 engineers from a range of countries in both the public and private sector. Participants will be recruited via informal contacts.

During each interview the participant will be asked a range of questions relating to their responsibilities, technical work, education and training.

All information provided in the interviews will be treated as strictly confidential and will not be released by the investigator unless required to by law in the country where this survey is being conducted. All information that could identify the respondent or his/her employer will be housed securely and participants will only be identified by number. Participation in this survey does not prejudice any right to compensation, that participants may have under statute or common law.

During the interview the participant is free at any time to refuse to answer certain questions or to withdraw consent to further participation without prejudice in any way. It is not necessary to give any reason or justification for such a decision. In the case that consent is withdrawn, the record of the interview will be destroyed. Each interview is anticipated to take up to two hours and will be conducted by Associate Professor James Trevelyan. In some cases, with the permission of participants, up to four students working on related research topics will also attend the interviews. The students (if any) will be required to keep the interview strictly confidential (they will be bound by a confidentiality agreement) and ensure that no information that could identify participants will appear in their written work.

Once all interviews have been completed the responses will be analysed and the results published. Each participant will be offered a copy of project publications. We wish to assure participants that in the publication no identifying information will be used. When all the analysis has been completed all transcripts of the interviews will be destroyed.

The Human Research Ethics Committee at the University of Western Australia requires that all participants are informed that, if they have any complaint regarding the manner, in which a research project is conducted, it may be given to the researcher or, alternatively to the Secretary, Human Research Ethics Committee, Registrar's Office, University of Western Australia, 35 Stirling Highway, Crawley, WA 6009 (telephone number 6488-3703). All study participants will be provided with a copy of the Information Sheet and Consent Form for their personal records.

If you have any questions about this research or the above information then please contact

Professor James Trevelyan





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