Optimising Employability: The transition from university to industry for engineering graduates

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Abstract

Employability is analysed for the specific case of engineering education. A conceptual model is developed of the processes of transition, using a system-engineering method. This model embodies a proposed causality whereby identified factors result in successful outcome, i.e. meaningful employment with a good fit. The theory suggests that the employer's tacit expectations are important in evaluating candidates. It is shown that graduates can anticipate these organisational expectations, consider the implications for personal fit, and write better job-applications for those jobs where they deem the match to be good. Other implications for graduates and their mentors are identified. The model also provides a framework for further research.

Keywords: employability; job application; resume; curriculum vitae; system model
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1   Introduction

Tertiary education exists for a purpose, which is to enlarge the knowledge and skills of those who engage. However it is not, except for a minority, the end goal, but rather a means to attain a better life experience outside of the academy, and in particular better employment prospects. Governments, as primary funders of education, also have a strong interest in employability of graduates, seeing this as a measure of productivity of the whole education process. As tertiary education has transitioned from being a special experience for an elite, towards a service for the population generally, so education has come to consume large proportions of national budgets, and accountability has likewise increased. Employability has become an increasingly urgent policy issue (Green, Hammer, & Star, 2009) because governments want to see employability outcomes for their investment in education (Bridgstock, 2009). In some jurisdictions there are financial penalties for institutions, e.g. the gainful employment provision in the US (Adams, 2011). However, even where there is no policy pressure, educational professionals have a natural commitment to their students and want the best possible outcomes for them after graduation.

Therefore *employability* is an important consideration in the design and delivery of almost any tertiary education programme. There are many factors that affect employability, and the purpose of this paper is to explore the transition from university to employment. We analyse this from a process perspective, using a system-engineering method. The particular area under examination is the engineering sector.

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2   Perspectives on Employability

There are several dimensions to the debate about employability of graduates. In general, the overall approach is to determine the required graduate attributes and then design the academic programme accordingly. The various facets of this are briefly described below.

Market supply and demand

The data-driven approach is to quantify job prospects, employability and starting wages (Griffith & Guthrie, 2007, 2008), supply-and-demand projections (Cabrera, Vries, & Anderson, 2008; IPENZ, 2007a), and unemployment (Kraak, 2010; Naess, 2004; Pitcher & Purcell, 1998; Scurry & Blenkinsopp, 2011; Trbanc, 1995). Sometimes these employment statistics are collected by the profession, and available to members only.

Graduate experiences

Another empirical approach is based on studying graduate pathways, often in specific national contexts. The studies are generally cross-sectional, though there are also longitudinal studies (Handy, French, Corum, & Rodriguez, 2007; Nystrom, Dahlgren, & Dahlgren, 2008; Prince, 2005). These report on actual graduate experiences in employment, often reported by country (Allen, Boezerooy, De Weert, & Van Der Velden, 2000; Arnesen, 2000; Bockerman, Hamalainen, & Uusitalo, 2009; Cabrera, et al., 2008; Efendiev & Balabanova, 2010; Garcia-Aracil & Velden, 2008; Gray & Murray, 2011; Johnston, 2003; Kellermann & Sagmeister, 2000; Kivinen, Nurmi, & Salminiitty, 2000; Kraak, 2010; Menon, Pashourtidou, Polycarpou, & Pashardes, 2012; Moorman, 2011; Mora, Garcia-Montalvo, & Garcia-Aracil, 2000; Moscati & Rostan, 2000; Naess, 2004; Nicolescu & Paun, 2009; Paul & Murdoch, 2000; Pillai, Khan, Ibrahim, & Raphael, 2012; Richard & Renee, 2005; Schomburg, 2000; Trbanc, 1995; Tui & Margaret, 2011; Vermeulen & Schmidt, 2008; Vila, Garcia-Aracil, & Mora, 2007; Woodley & Brennan, 2000). There is also a line of research into how special groups fare in employment: disabled (Madaus, Ruban, Foley, & McGuire, 2003), gender (Einarsdottir, 2002; Roksa, 2005), age (Bellas, 2001), over-educated (Barone & Ortiz, 2011), societal class background (Greenbank, 2009).

Employer's needs

Generic lists of competencies are available (Garcia-Aracil & Velden, 2008). Specific skills that emerge as important include: critical thinking skills (Berrett, 2011; Manathunga, Pitt, & Critchley, 2009), numeracy (Durrani & Tariq, 2012), communication (Dean & Campbell, 2010; Gray & Murray, 2011), planning and organising (Garcia-Aracil & Velden, 2008).

There has been a large amount of work done determining the extent to which graduates in a particular field have skills that match the employment prospects. Hence also identifying factors that enhance employability. Specific professions treated in this way include: accounting (Dean & Campbell, 2010; Gray & Murray, 2011; Jackling, De Lange, & On, 2007; Wells, Gerbic, Kranenburg, & Bygrave, 2009), engineering (Schuurman, Pangborn, & McClintic, 2008), geography (Hennemann & Liefner, 2010), hospitality (Rick, Stephanie, & Conrad, 2005), ICT (Debuse & Lawley, 2009; Qi, 2011), journalism (Claussen, 2011), liberal arts (Koc, 2010), librarian (Fialkoff, 2011; Genoni & Smith, 2005; Heazlewood, Pymm, & Sanders, 2006), mathematics (Bourner, Greener, & Rospigliosi, 2009; Wood, 2010), nursing (Hayes & Scott, 2007; Rydon, Rolleston, & Mackie, 2008), outdoor studies (Prince, 2005), postgraduates (Griffith & Guthrie, 2008; M.

Lindberg, 2005; Manathunga, et al., 2009; Monastersky, 2007; Neumann & Tan, 2011), psychology (Nystrom, et al., 2008; Provost, et al., 2004), tourism (Zehrer & Mossenlechner, 2009), vocational (Koivisto, Vuori, & Vinokur, 2010).

Programme design

Using employability factors it is possible to determine what content to include in a degree (Arrowsmith, Bagoly-Simo, Finchum, Oda, & Pawson, 2011; Litchfield, Frawley, & Nettleton, 2010). This line of action tends to focus on the explicit learning outcomes for a specific qualification. However the usefulness of taught courses for enhancing employability has sometimes been found wanting (Cranmer, 2006; Mason, Williams, & Cranmer, 2009), and a challenge to the culture of universities (Green, et al., 2009). It has also been argued that optimising programme design for employment-need may be a detriment to students and scholarship (Boden & Nedeva, 2010; Moreau & Leathwood, 2006).

Development of tacit graduate attributes

If one line of action is to tweak the curriculum to meet employers' needs, the other is to focus on the tacit graduate attributes, and the skills rather than the knowledge learned. In some ways this seems the more important outcome, given that many of the employers' needs are attitudinal rather than a requirement for theoretical knowledge per se. For example, some suggest that student-community engagement can be useful in developing the skills and attitudes that will be useful in employment (Bourner & Millican, 2011). This approach often also considers the delivery form, e.g. scenario-based learning (Errington, 2011), project-based classes (Hennemann & Liefner, 2010), work-experience (Bourner & Millican, 2011; Mason, et al., 2009). The professions tend to be specific about the graduate attributes they require. The attributes common across all professional societies have been found to include ethics, communication capacity, teamwork, creative problem solving, and critical thinking skills (Litchfield, et al., 2010).

Managing the transition

A different perspective, unlike the others, looks at the transition from university to employment, and sees this as a significant processes in its own right. By comparison many of the other perspectives tend to assume, simplistically, that employment is determined only by market demand and fit between industry-needs and graduate-attributes.

One line of investigation here is into the psychological issues faced by graduates. The transition can be stressful (Berrett, 2011) and even depressing (Koivisto, et al., 2010). Under- and un-employment are also stressful (Cassidy & Wright, 2008), or at least wasteful (Rick, et al., 2005). Topics that have enjoyed some research attention include own career management (Bridgstock, 2009), lassitude (Education, 2007), indecision (Scurry & Blenkinsopp, 2011), expectations and ambition (Jackling, et al., 2007; Johnston & Elton, 2005; Moorman, 2011; Nystrom, et al., 2008), disposition and agency (Tomlinson, 2010), mental preparedness (Chen & Hu, 2008), self-efficacy (Dacre Pool & Qualter, 2012) and resilience (Murphy, Blustein, Bohlig, & Platt, 2010; Tui & Margaret, 2011). Research suggests managing the transition (e.g. through employer involvement in design of courses) is important in getting graduates into employment (Cranmer, 2006), so this activity is not disconnected from the above approach based on 'employer's needs'.

Useful activities that a university can provide to enhance employability are courses or guidance on curriculum vitae (CV or resume) writing, career guidance, making effective job applications (Cranmer, 2006), extra-curricular activities (Vermeulen

& Schmidt, 2008; Watson, 2011), work-experience (Sagen, Dallam, & Laverty, 2000; Schuurman, et al., 2008) especially supervised and relevant work-experience (Bourner & Millican, 2011), university-based contacts for obtaining work (Giret, 2011), and mentoring of graduates in employment (Hayes & Scott, 2007; Peter & Dominic, 2008). However some results suggest that university career services are ineffective (Tui & Margaret, 2011).

Career advice

There is literature giving practitioner advice for graduates (De Back, 2011; Fialkoff, 2011; Smith, 2012). This material is the least academic, being found in magazine articles rather than journal papers. It may be less rigorous, but is perhaps more likely to be read by graduates themselves, and is therefore important. These articles tend to be of a speculative nature, covering graduates generally, and are evidently written to motivate students to action.

Employers' selection processes

Another perspective is that of the selection processes: the reliability of recruitment decisions, and the processes thereof. This literature is from the perspective of the employer, and the objective is to ensure that the employer makes the best appointment. Many of these studies use human-resources or psychology methods (Anderson, 1991). Topics of interest include impression management and fairness (Berggren, 2011). The interview has been identified as the key deciding factor (Briggeman & Norwood, 2011). It also seems that older graduates have fewer job offers but achieve better jobs and higher salaries (Bellas, 2001), which implies that either their fit is better, or they interview better.

Success of the transition to employment

Factors for satisfaction once employed have been identified as character strengths (Davidovitch, Littman-Ovadia, & Soen, 2011), mobility between jobs (M. E. Lindberg, 2009), personal satisfaction (Madaus, et al., 2003). Professional development is also identified as important for success. This includes ongoing learning (continuous professional development, life-long learning) in the workplace (Boumer, Greener, & Rospigliosi, 2011; Bridgstock, 2009; Jackling, et al., 2007; Nystrom, et al., 2008), corporate training (Jenner, 2008), and learning how the organisation operates (Rae, 2008). This last one is probably more a case of learning the internal context of the organisation, i.e. the business processes.

Gaps in the literature

As this review shows, the question of what makes for *employability* is a complex one, to which there are many answers depending on the perspective taken. We identify three main strands of activities, all aimed at improving employability.

The first is that of matching graduate-attributes to employer-needs. We refer to this as the a-priori approach, as involves designing the programme before the students begin it. This is by far the largest workstream in terms of attention in the literature, and universities are probably also exerting a large amount of administrative effort (which is not represented in the research literature) at achieving this. Certainly it is a strategic necessity given the national policies in some jurisdictions.

The second set of activities is helping students manage the transition to employment, and thereby enhance employability in a posterior manner. This has less attention in the literature. Most universities provide careers advice services to

their students, and again there is a level of administrative activity even if it is not prominent in the academic literature.

The third is managing the graduate from the time he/she engages with the recruiting firm, and onwards to professional development and a long-term career with that employment sector. This set of activities is the primary responsibility of the employer, and it is therefore unsurprising that this perspective does not feature strongly in the education literature, being rather a matter of human resource management.

Our main focus lies at the junction of the second and third activities. We are interested in how students handle the job-application process. There is a gap in the literature at this point, and the little that exists is primarily of an anecdotal and magazine nature rather than being an intellectual consideration of the issues. It is worth better understanding this stage where universities help their students onwards to the next phase of their lives. Research in this area has the potential to inform students and help them get a position with a good fit, and help university staff in their service to graduates. Education has a life-cycle that does not merely end at graduation but continues into employment, alumnus activities, and potentially extends to the next generation also engaging with tertiary education. The transition to employment is a stressful time for students, and thus a potentially weak point in the life-cycle.

Therefore the research question considered in this paper is: 'How do students handle the job-application process, and can this be improved?' There are two parts to our approach, the first and the topic of the present paper, being the creation of a conceptual framework for this activity. The second is an intended future empirical testing of the model.

3   Engineering context

The particular discipline under examination is engineering. This is an interesting case because many of the employability factors considered in the general literature do not apply. This is because, being a professional degree and subject to accreditation by the profession (IPENZ, 2006), the employer's needs have already been included in the curriculum and are the subject of on-going review and validation. The engineering profession has a set of graduate attributes, and there is an international consensus about the content of these (IEM, 2009). Thus one set of factors, the employer-needs, are no longer a variable in the employability equation. The required graduate attributes also include tacit graduate attributes, so these too are defined. So the first workstream, alignment of the learning-outcomes with the needs-of-the-profession has been achieved and is a maintenance activity than an aspiration.

The engineering degrees also all require work-experience (typically 20 weeks) and this is required to have a professional content and is assessed. So the activity of managed work experience, of which the literature speaks so positively, is also built into the programme.

Finally, the career side is also well-established for engineering. For a start, the concept of an engineering-cadet is well known in industry, so the role expectations are reasonably congruent or at least anticipatable. Second, engineering employers exhibit a commitment to career fairs, and this provides a mechanism for prospective employees and employers to determine mutual fit in a non-threatening

low-stress manner. Thirdly, the concept of professional development is enshrined in the profession (IPENZ, 2007b, 2009), so graduates are aware of the need to take care in this regard, and engineering employers have an obligation to provide structured professional development (PD) opportunities to their new graduates. Some firms use their PD plans as an additional recruitment incentive. Many of the employability-factors are therefore taken care of in the way the engineering profession relates to its academe, but it is still noticeable how difficult the transition is for students.

Challenges for students

One of the challenges for the professional engineering degrees is that they tend to focus on developing abstract thinking skills, and their treatment of material tends to be theoretical. By comparison, problems faced by employers are more concrete. In addition, the canon of theoretical subjects in engineering (fluid mechanics, thermodynamics, etc) is a relatively poor match to the jobs that exist in the profession. This makes it difficult for students to understand what the corresponding roles are in industry. A second challenge for graduates generally is that efficacy of communication is something they have to work on. Poor communication in a resume can undo any amount of other suitability for the position.

We are therefore interested in creating a conceptual framework for the job-application process, specifically for engineering. Surprisingly, there do not appear to be any theoretical models describing the process.

3   Method

We apply a system-modelling approach to create a structured representation of the job-application process. We are particularly interested in representing the graduate's perspective, rather than the employers. Therefore the results are contextualised with the student as the protagonist. The system-modelling method involves describing the *process* of job-application, and systematically decomposing this into sub-activities to tease out the interactions. The resulting model is expressed as a series of flowcharts using the integration definition zero (IDEF0) notation (FIPS, 1993; KBSI, 2000). The method is particularly useful for integrating sparse knowledge and multiple perspectives into a coherent model. It has proved to be successful in other areas including engineering design (Pons & Raine, 2005), lean production (Pons, 2010b), strategy (Pons, 2010a), project management (Pons, 2012), and representing the postgraduate research process (Pons, 2011). Unusually, this method is primarily graphical: it creates a diagram with a logical structure, whereas other methods invariably create a semantic model and then afterwards represent it with a flowchart. The result is more than simply a graphical model: it is a theory, because it represents the proposed causal relationships between the elements. For this reason we refer to it as a 'subjective causality model'.

This model has been used in teaching engineering management to students, and also for guiding those many engineering students (several hundred) who the author has had the privilege of discussing employability with over the years. Some of the insights from this are reported anecdotally in this paper, as they illustrate the type of issues that students experience at the transition phase.

4   Results

The primary outcome is a set of diagrams, representing a conceptual model for the job-application process from a student perspective. Text descriptions are a

secondary output after the diagrams, and provided to assist the interpretation and to interface the model to the works of others. However, a rich content remains in the diagrams, where subtle effects (such as feedback loops) may be observed although not always described in the text. The numbers in the text refer to the numbered activities on the figure.

Notes to assist interpretation of diagrams

With IDEF0 the object types are inputs, controls, outputs, and mechanisms (ICOM) and are distinguished by placement relative to the box, see Figure 1. The model assumes that multiple activities may be simultaneously active, even if that activity is only partial or intermittent. The locus of effort is therefore not a fixed arrow of causality, but a set of multiple threads that can iterate, change direction, and stop/start.
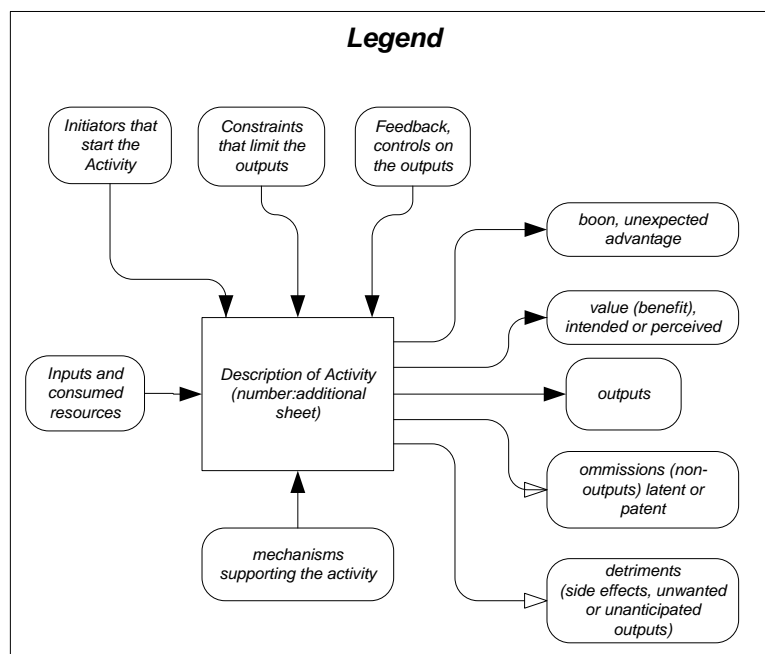

Figure 1: The object types in IDEF0 notation are inputs, controls, outputs, and mechanisms (ICOM), and are distinguished by placement relative to the box, with inputs always entering on the left, controls above, outputs on the right, and mechanisms below. The box itself describes a function (or activity), and the arc (line arrow) describes an object. In most other flowchart notations arrows represent sequence of activities. However, with the present notation it is important to note that arrows should be interpreted as conveying objects to activities (blocks) and not as sequence.

Even without a complex subject matter, a valid criticism of this method is that it produces high information density and complex diagrams that are effortful to interpret. Therefore to aid comprehension the results are presented in a top-down manner, since the concepts are simpler initially.

4.1   Top-level model

Engineering is defined as the solution of complex problems in the technology context (IEM, 2009). We therefore start at the top level by describing engineering in this way. We take the perspective of the graduate as the protagonist in the model, and represent the main building blocks in Figure 2. Our focus in this paper is the graduate achieving a position where he (she) is enjoying the engineering work (activity Ir-4 in the diagram). Below we describe the model for how the graduate transitions to that point, but first it is important to note the other activities in the model.
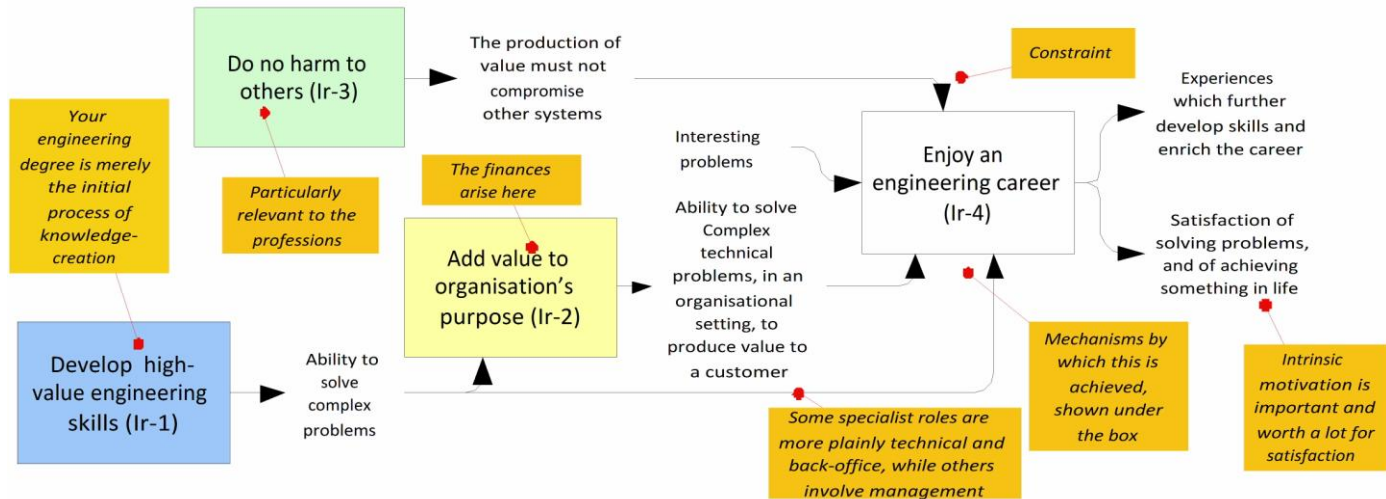

Figure 2: Overall system model for engineering professional practice.

One is the development of engineering skills (Ir-1), these being the taught knowledge, skills, and attitudes of the protagonist. These are all learned at university as part of the studies. Another skill the graduate needs is to know how engineering activities add value to the organisation (Ir-2). The important point being that organisations sustain their existence by adding value to customers. This has direct relevance to the employability debate. The third set of skills are the professional responsibilities, which are summed up in the phrase 'Do no harm to others' (Ir-3). This compartment includes health & safety, ethics, environmental sustainability, and social responsibility. These are particularly important to the engineering profession, and indeed all professions are characterised by having a commitment to the wider good beyond selfish maximisation of personal wealth.

Other models further elaborate on all these, but space not permit their inclusion here. However it is important to note in passing that they include the Washington Accord graduate attributes (IEM, 2009), being repackaged differently. This is important in itself, because it indicates to graduates that their employability is not determined solely or even primarily by their grades in the mathematical and engineering science papers that tend to dominate their workload as undergraduates, but rather by tacit factors that are outside the assessed curriculum.

4.2 Enjoy an engineering career

In this case the graduate engineer who is applying for employment is the protagonist. The antagonist[2] is the recruiting firm, and the potential boss in particular. The immediate choice for the graduate is what to do for the next phase. Typical choices include industry professional, postgraduate studies, scientist, academic, or entrepreneur. Here we follow the locus of a protagonist who seeks industry professional employment, for which the next step is to find such employment, and then work successfully as an engineer. Such employment, while providing a financial income to the graduate, also supplies the satisfaction that comes from solving complex problems. The graduate engineer also needs to grow further in knowledge and skills, to solve more complex problems and access other jobs. Commitment to professional development is ranked as highly important by the profession (IEM, 2009).

4.3 Finding engineering employment

We now further elaborate on the process of finding employment, and suggest the model shown in Figure 3. Main activities are to decide on the sub-field of practice (1), explore vacancies (2), and decide on the willingness to relocate (3). This much is straightforward. In the author's experience of talking individually to hundreds of engineering students about their careers, it is apparent that students invariably then prepare and submit an application (5), and struggle to identify the employer's expectations (4). They are also often apprehensive about the interview and selection process (6) and unable to anticipate what this might involve. There are several areas where this model has the potential to assist.

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[2] No pejorative meaning should be associated with the term *antagonist*. This should rather be considered as the main opposite actor in a play. Indeed, students who may read this paper are encouraged to approach the content as a role-playing exercise, albeit a thought-experiment.
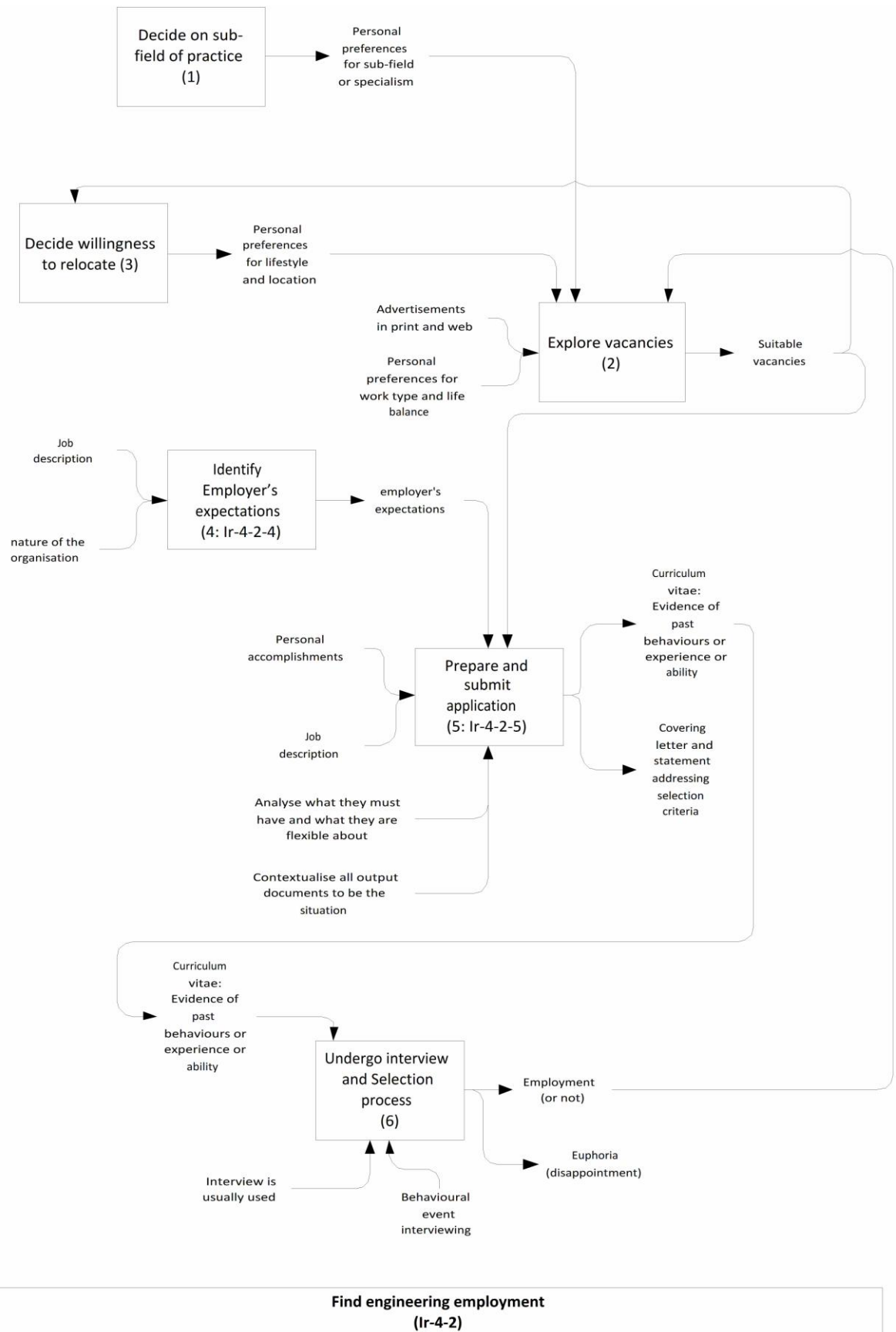
Figure 3: Finding employment

4.4   Identify the employer's expectations

The prospective employer has explicit expectations, which are given in the advertised position descriptor. What graduates struggle to understand is that the employer also has tacit expectations. Although these are tacit, they can still be anticipated, often quite easily, and Figure 4 shows how.

In this context *tacit* means not stated overtly, but still important. The employer will have implicit requirements for how this position adds value towards the organisational purpose. These are based on the nature of the organisation (for profit, non-profit, state-sector), the management style of existing superiors and desired attributes of subordinates. Most engineering organisations in the NZ culture have a participatory management style (low power-distance), as opposed to an authoritarian-compliance type. They also expect professional engineers to be self-directed and self-motivated, i.e. these organisations do not rely on output-control. These comments may be self-evident to a NZ graduate, but it is important to note that expectations can be very different in other countries. In particular, one of the main factors differentiating cultures is power distance (Hofstede, 1985). Therefore graduates from one country who seek work in another are advised to be particularly careful about understanding these cultural differences.
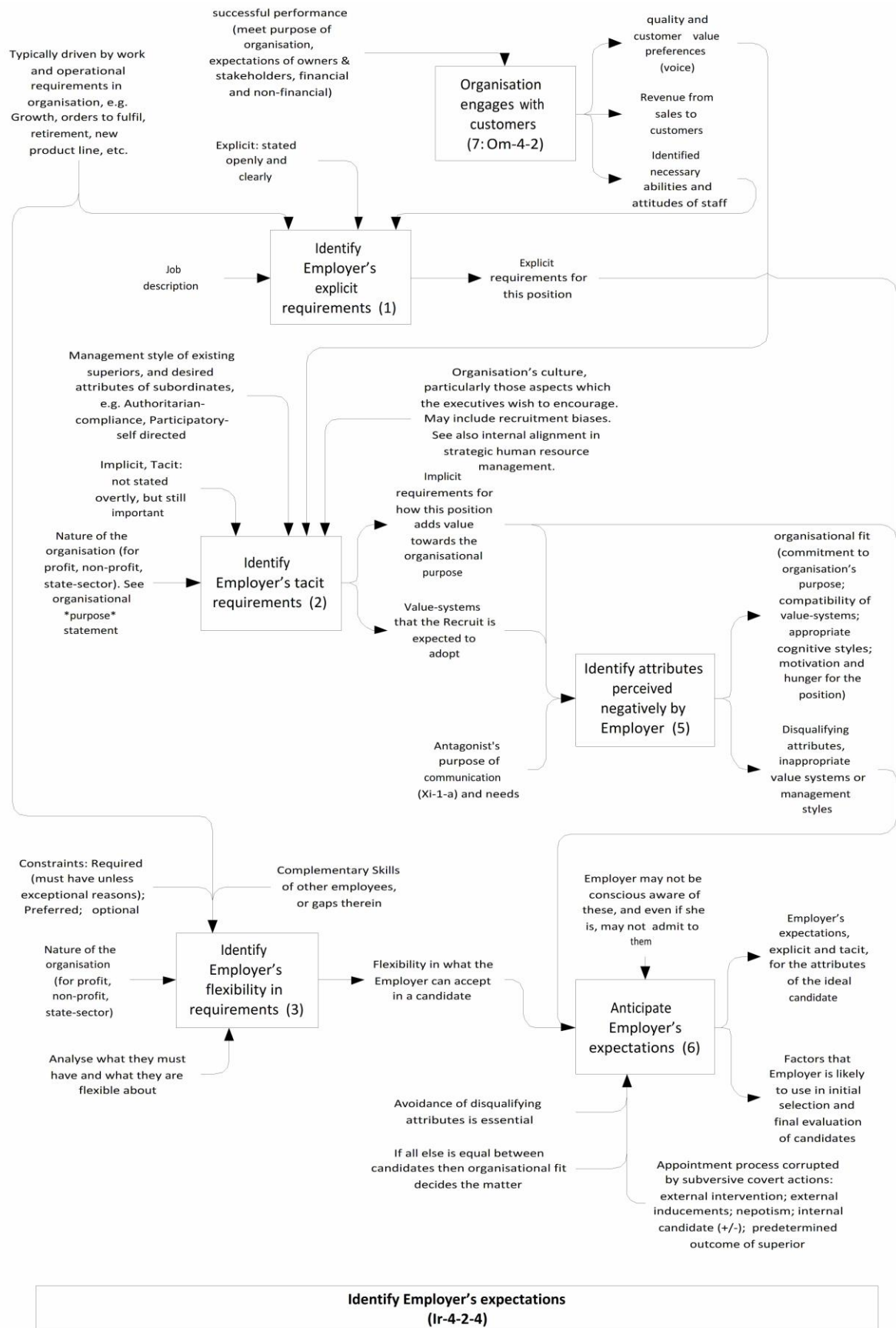
successful performance
(meet purpose of
organisation,
expectations of owners &
stakeholders, financial
and non-financial)

quality and
customer value
preferences
(voice)

Typically driven by work
and operational
requirements in
organisation, e.g.
Growth, orders to fulfil,
retirement, new
product line, etc.

Organisation
engages with
customers
(7: Om-4-2)

Revenue from
sales to
customers

Identified
necessary
abilities and
attitudes of staff

Explicit: stated
openly and
clearly

Job
description

Identify
Employer's
explicit
requirements (1)

Explicit
requirements for
this position

Management style of existing
superiors, and desired
attributes of subordinates,
e.g. Authoritarian-
compliance, Participatory-
self directed

Organisation's culture,
particularly those aspects which
the executives wish to encourage.
May include recruitment biases.
See also internal alignment in
strategic human resource
management.

Implicit, Tacit:
not stated
overtly, but still
important

Implicit
requirements for
how this position
adds value
towards the
organisational
purpose

organisational fit
(commitment to
organisation's
purpose;
compatibility of
value-systems;
appropriate
cognitive styles;
motivation and
hunger for the
position)

Nature of the
organisation (for
profit, non-profit,
state-sector). See
organisational
purpose
statement

Identify
Employer's tacit
requirements (2)

Value-systems
that the Recruit is
expected to
adopt

Identify attributes
perceived
negatively by
Employer (5)

Disqualifying
attributes,
inappropriate
value systems or
management
styles

Antagonist's
purpose of
communication
(Xi-1-a) and needs

Constraints: Required
(must have unless
exceptional reasons);
Preferred; optional

Complementary Skills
of other employees,
or gaps therein

Employer may not be
conscious aware of
these, and even if she
is, may not admit to
them

Employer's
expectations,
explicit and tacit,
for the attributes
of the ideal
candidate

Nature of the
organisation
(for profit,
non-profit,
state-sector)

Identify
Employer's
flexibility in
requirements (3)

Flexibility in what the
Employer can accept
in a candidate

Anticipate
Employer's
expectations (6)

Factors that
Employer is likely
to use in initial
selection and
final evaluation
of candidates

Analyse what they must
have and what they are
flexible about

Avoidance of disqualifying
attributes is essential

If all else is equal between
candidates then organisational fit
decides the matter

Appointment process corrupted
by subversive covert actions:
external intervention; external
inducements; nepotism; internal
candidate (+/-); predetermined
outcome of superior

**Identify Employer's expectations
(Ir-4-2-4)**

Figure 4: Employer's expectations are explicit and tacit.

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The tacit expectations also include the organisation's culture, and employers are particularly interested in how well the candidate might fit therein. Candidates who already show evidence of fit, perhaps by work-experience in a similar industry or showing awareness to the particular way that *quality* is understood in this industry, are likely to be at an advantage all other things being equal. Another way that organisational culture can be important is when executives wish to recruit new people with certain desirable characteristics, for strategic reasons. For example they may want different attitudes to problem-solving, or to change an existing negative culture. Tacit expectations may also include recruitment biases regarding gender or other demographics. Like any bias those work in favour of some groups at the expense of others.

These tacit expectations are usually easy to understand once a candidate has some work experience in a related industry. The employability literature identifies such experience as important, and one reason might be the cultural fit that it creates. Even if a graduate lacks relevant work experience, it is still possible to anticipate many of the tacit requirements, simply by examining two exhibits which are commonly available on the internet or provided with the job description: (1) the organisation's purpose statement (or mission or vision statement), which identifies the reason for which it exists (NIST, 2009), and (2) its marketing material, in which will be found its proposition of value to customers and thus its definition of quality. In this way it is possible to anticipate the factors that the employer is likely to use in the initial selection and final evaluation of candidates.[3]

4.5   Prepare and submit application

The process of applying for a position is briefly documented in this model (Figure 5). Included here is the activity of composing a curriculum vitae (CV, or resume) (1), preparing the covering letter (2), and transmitting the application (3). Most of this is within the ken of, and therefore well-covered by, university careers services. However we will make two observations based on experience with students. The first is that students often struggle to identify their developed skills. Part of this is the previously mentioned issue that their courses do not directly correspond to professional roles, which is confusing.[4] The model provides some suggestions to students in this regard. It also shows how to deal with another niggling problem for students, which is how to represent non-engineering work experience. The suggestion is to reflect on whether those experiences have developed any complementary skills.[5] The second observation concerns the covering letter, which

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[3] As mentors we never need to encourage students to falsely claim attributes that they expect the employer is seeking. That would result in poor fit and an unhappy employment situation. However we can encourage graduates at transition to move their focus away from the relentless pursuit of high grades which invariable characterises the university phase of their career, to understanding how they might best contribute to an organisation that in turn seeks to add value to its customers, and express that coherently in their application. Too many students write in their CV that their objective is to 'have a rewarding personal career', as if the organisation exists solely to support their aspirations.

[4] Many students at the point of graduation do not know exactly what they want to do after graduation, perhaps because they do not know themselves or the industry as well as they would like. They also often express apprehension about limiting their future options if they venture down a particular path.

[5] We do not recommend being too specific about this lest we put words in student's mouths. Students have to come to this awareness themselves, otherwise we do them a disservice. We can only invite them to reflect on their past experiences and extract the complementary skills therein. In our experience this can be difficult for students to do without some mentoring. Part of the problem may be that their construct of engineering is still only that

is often a very great mystery to students. Again, the model provides some simple suggestions for how a student can approach this.
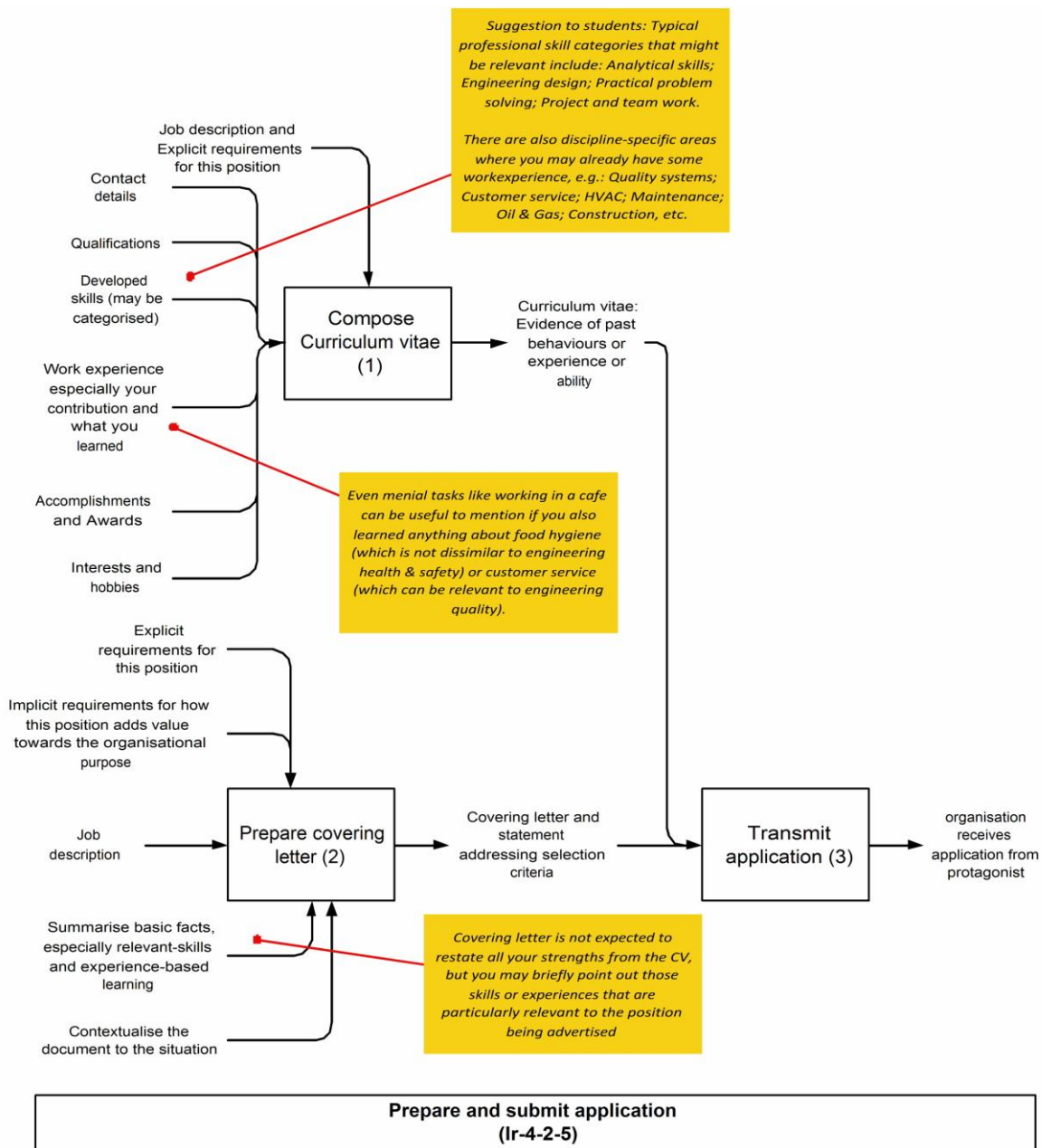

Figure 5: Process of applying for employment.

4.6   Undergo interview and selection process

The final part of this model is the interview and selection process. Graduates are naturally anxious about this, especially as they have little experience in this

of the academic programme, and they struggle to understand just how important things like ethics are to the profession. Therefore they cannot readily, without help, see how a work experience involving operating a cash till at a grocery store has anything to do with ethics, quality, or standard operating procedures in production engineering. In addition, generic university career services cannot reasonably be expected to know enough about the profession of engineering to make the association themselves, so the responsibility to assist students probably does rest with the profession and its academics.

situation. They find it difficult to anticipate the types of questions, which further contributes to the sense of unknown.

In this industry, selection is typically made on the basis of the interview. This typically uses behavioural event interviewing, where candidates are asked to tell about a time when they faced with a certain situation. Sometimes the interviewer will provide a technical case-study or physical artefact and ask what the applicant thinks of the problem. Grades do not feature greatly in the discussion, to the surprise of students for whom this has been a personal focus.

It is helpful to switch perspectives at this point, and take the position of the engineering manager who is doing the recruiting. Many graduate engineers will be in such a position within the next decade of their career (Pons & Raine, 2011), and it is easy and natural to describe this scenario. A separate model exists for engineering management, and an extract is shown in Figure 6. The main activities to note are the interview (8) and its preparation (7). The model shows how managers approach recruitment, which also helps students anticipate how their own interview is likely to progress.
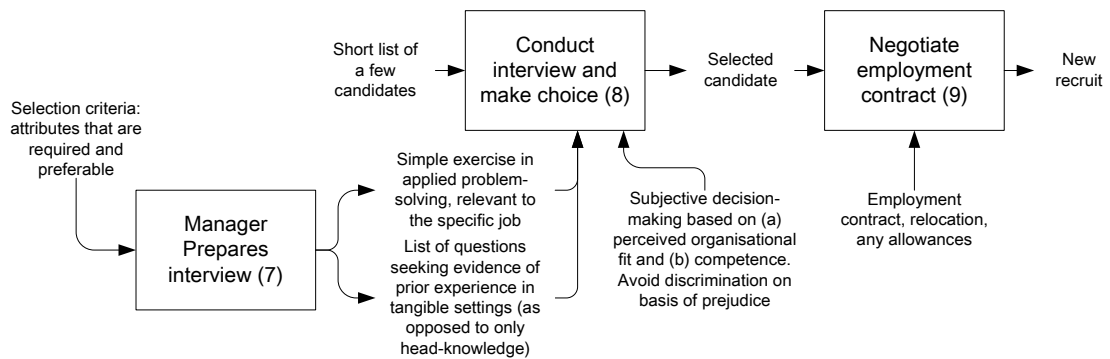

Figure 6: Manager's perspective of the recruitment and interview process.

Taking this managerial perspective has two benefits. It helps graduates better understand the process as a whole, and therefore enhances their employability. Second, it teaches them about basic human resource management which is another important skill that they will need to do themselves in the future. In this way we also achieve, through scenario-based learning, another of the learning objectives for the course. Several other managerial activities are included in the full model (not shown here) and these can also be discussed with students.

5   Discussion

What has been achieved?

The feasibility of constructing a theoretical model for the job-application process has been demonstrated. This is useful for two purposes.

First, it can be used as a guide for a staff member who has the passion to mentor students in their transition to employment. Anecdotal evidence from mentoring a large number of students suggests that it is helpful. Students who are about to be graduates are appreciative of generic career services as provided by most universities, but desirous of additional context-specific assistance from someone in their own profession. The model provides a systematic framework for such a

practitioner to provide mentoring. The students themselves need not be exposed to the full model, but rather it can be used as a guide, by the mentor. Students invariably express appreciation for the insights that come to their minds during such discussions, and the improvements to their CVs. In addition, they are often surprised by the accuracy with which it is possible to predict interview questions.

Second, the model, or parts thereof, serves as a framework for structuring a taught module on engineering management, specifically in the area of human resource management and professional development. The model is tightly integrated with the Washington Accord (IEM, 2009) graduate attributes, especially at its onset (see Figures 2-5), so the relevance to engineering is explicit. Not shown here, but it is easy to expand the model with more detailed explanations suitable for delivering to students. A sample of this is shown in Appendix A.

This model also readily lends itself to a scenario-based approach to teaching engineering management. Scenario-based learning is known to have many benefits: develops professional graduate attributes; develops the professional identity of students through their participation in the scenario introduces the cultural expectations of the workplace (including ethics); practises teamwork (Errington, 2011). Scenarios include a degree of realism, which may be developed by representative professional case studies, fabricated documents (briefs, case-notes, records), role-playing, realistic-interviews (Errington, 2011). Framing the scenario in the language of the professional context is important (Litchfield, et al., 2010).

In this specific case under examination, the scenario is a very real and proximal one: how to get a satisfying job after graduation. By discussing something that is real to the student, their engagement is heightened. It also makes them receptive to other complementary knowledge, e.g. human resource management, which otherwise they may find irrelevant. In our own teaching strategy we refer to this as *proximating the topic to the student.*

In addition, we have constructed an extensive set of scenarios for the whole of our engineering management course. These are all based around a common theme: the fictitious 'Hydra' engineering company and all the personalities of its people and the projects that it undertakes. We use this to contextualise the delivery material, exercises, and even the assessments. An example of the scenario for writing a job description is included in Appendix B. This also includes an exercise in financial present value, i.e. another complementary learning objective is introduced.

Overall, what this work has contributed is a conceptual framework for managing the employment transition for graduates. There is currently no other model in this space. The model is also tightly integrated with professional graduate attributes and is readily deployable into the teaching environment.

Being able to systematise this has the immediate benefit of being comprehendible to engineers thanks to their structured thinking approach, and therefore has the potential to assist graduates with their own engagement with this important transition into the profession.

Implications for practitioners

In this context Practitioners are graduating Engineering students. The low-level practical implications are in the specific guidance that is offered on preparing a covering letter and composing a CV. While in some ways this advice is simply

comparable to similar conjectural material in the popular press, it has the benefit of being constructed around a theoretical framework.

At a deeper level this theory implies that the Employer's tacit expectations are important in evaluating candidates. This may warrant empirical research. The model offers mechanisms whereby the graduate can anticipate these organisational expectations.

Limitations

The obvious limitation of this model is that it is conjectural and has not been proven other than through anecdotal success in mentoring students. Nonetheless the systematic method does provide a means to make the underlying assumptions transparent.

Another limitation is that the model is built around the engineering context. We already know that this is a simpler situation than for other disciplines, because this profession has an established set of graduate attributes that are internationally recognised (IEM, 2009). By comparison other disciplines have more variables and hence are more complex. Consequently the model may need to be generalised to be applicable outside of engineering.

Implications for further research

While the validity of the framework as a whole may take some time to determine, the modular nature of the theory readily permits sub-hypotheses to be extracted and potentially investigated. It is relatively straightforward with this type of modelling approach to take any activity block of interest, and from noting the arrows entering and leaving it, compose a hypothesis of causality. This may then be checked using standard research methods. This is also easy to carry through to a survey.

For example, it would be interesting to investigate the recruitment practices of actual engineering firms to check the strength of the tacit expectations for employability. The hierarchical nature of the theory readily permits investigations like this. The proposed causality is shown in the sub-model of Figure 7, from which survey questions are readily extracted, e.g.:

> 'To what extent are your hiring decisions for new engineering graduates made on the following attributes of the Applicant? (technical competence; qualifications; grades and course marks; particular university attended; experience; organisational commitment; attitude and motivation; compatible value systems of Applicant; appropriate cognitive (thinking) styles; motivation and hunger for the position; passion; communication skill; knowledgeable about industry; awkwardness, clumsiness in written application; embarrassment during interview; English language skills; need for supervision; customer-focus; ..'

In this way we have also presented a structured way to progressively build and test a model of causality for this area, and a framework within which to integrate future empirical results.
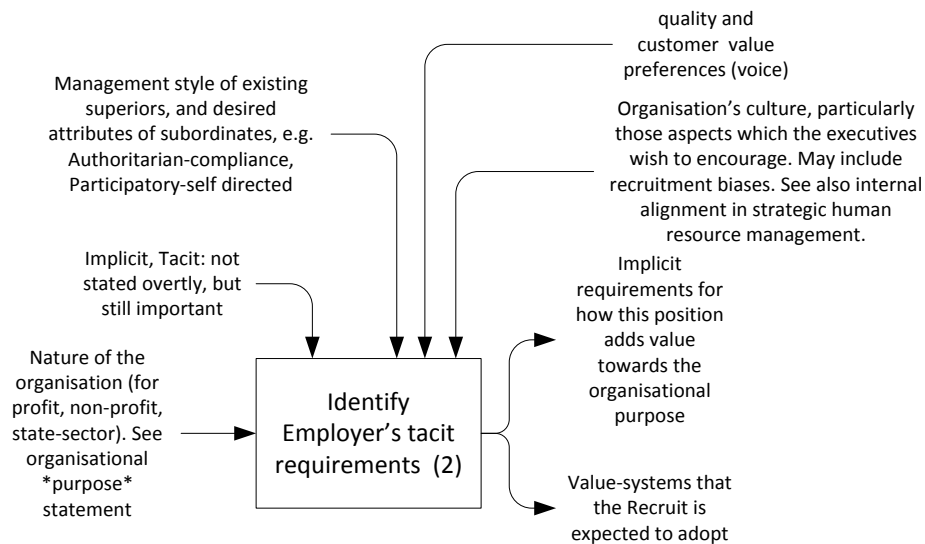
quality and
customer value
preferences (voice)

Management style of existing
superiors, and desired
attributes of subordinates, e.g.
Authoritarian-compliance,
Participatory-self directed

Organisation's culture, particularly
those aspects which the executives
wish to encourage. May include
recruitment biases. See also internal
alignment in strategic human
resource management.

Implicit, Tacit: not
stated overtly, but
still important

Implicit
requirements for
how this position
adds value
towards the
organisational
purpose

Nature of the
organisation (for
profit, non-profit,
state-sector). See
organisational
purpose
statement

Identify
Employer's tacit
requirements (2)

Value-systems that
the Recruit is
expected to adopt

Figure 7: Sub-model for setting research question.

6   Conclusions

We have analysed *employability* for the specific case of engineering education, and developed a conceptual model of the processes, using a system-engineering method. This model embodies a proposed causality whereby identified factors result in successful outcomes (meaningful employment with a good fit). Implications for graduates and their mentors are identified, as are further research questions.

A   Appendix: Example delivery material for guiding students on how to prepare a covering letter for a job application

Each of the employer's requirements (or at least as many as are relevant to the applicant) should be *briefly* mentioned in the covering letter. Your challenge is to create one sentence or paragraph in which you mention all the keywords. Consider doing so in the same order in which the employer listed them, because you want to make it *easier* for them to find the information they are looking for. Brevity is essential, since you want this first impression to be easy to engage with, and memorable. So less is better.

In this particular example the keywords are: BE, engineering design, Pro E, team, project management, admin, quality or AQ/QC, plastics, consumer goods, NPD. Other interpretations of the key attributes are also possible. In addition, there are other *implicit* attributes, which the observant respondents will spot.

If the reader cannot skim read a covering letter and find several of the keywords, then the letter is ineffective. It's like prospecting for oil and gas: bounce a sound wave into the substrate and look for the right echo coming back. No echo, no success. Only if there is the right echo on a quick scan will the prospector invest the effort to drill into the rock and look at the details.

Explicit criteria are the things that are obvious, e.g. the advert calls for a BE degree. Implicit criteria are the non-obvious requirements, e.g. 'extremely organised', that are hidden elsewhere in the text. There are many such things scattered in the text. Generally students struggle to perceive the existence of these, or cannot think of relevant evidence (even partial) from their own experience, or couldn't find the words to express it. Those skills will grow with experience, and my recommendation is simply to be aware and develop the skills when you can. Volunteering to be on an interview panel is a great way to gain that experience.

I do not wish to provide a template for a covering letter, as this would just be used thoughtlessly, and erode the power of the tool. However a basic concept is shown in the figure.

Derek (Design Manager)
Hydra Pty Ltd
12 Everywhere Rd
Universal City

Dear Sir

APPLICATION: Design Engineer (Ref: H-DE-012B)

Herewith my application for this position. Particular skills that I bring are CAD familiarity (SolidEdge, Inventor), project management (e.g. plant upgrades), and production engineering experience with quality systems.

Attached please find a copy of my CV.

I look forward to hearing from you

Sincerely,

Name

Figure A1: A really basic covering letter that brings a few key personal attributes to the attention of the potential employer.

Some specific personal recommendations regarding covering letter. Please note these are only my perspective as author, so do not accept them as universal truths but rather as ideas to consider.

(1)   **Focus on your strengths**: Make a first impression within the first 5 sec of reading. That's your window. Emphasise your professional engineering degree, or your skills.

(2)   **Organisational fit.** There are two approaches. Generally I'd say take Option A, unless you are prepared to role-play an Option B approach.
> (A) Avoid *'I would fit in well at Hydra'*. Everyone says that.
> (B) Or if you do say it, be passionate about it and consistently so - slightly over do it. But be aware that doing so will be a turn-off for some employers, so it's a bit of a high stakes approach.

(3)   **Avoid Superlatives**. Avoid statements that come across as proud, arrogant, or know-it-all: *'excellent team skills'*, *'competent communicator'*, and other superlatives. Especially avoid these as a new graduate, since the Employer is conditioned to think that new graduates think they know everything. So why reinforce that opinion? (But see #2b). Avoid asserting positive judgements abut yourself, e.g. 'good', 'strong at x'. These are too easily interpreted as knowing better than the employer. See (2, 3).

(5)   **Avoid Bubble World thinking.** They (the employing organisation) are not there as a service to humankind. They are not primarily a mechanism to give you recognition, reward, promotion, satisfaction, or experience. Statements like '*This would be a great opportunity for me*', or '*this job would develop my career'* may be true, but you don't need to say so. These types of statements show a failure at Xi-1. Instead, show how you could add value to *them*. Not the other way round. Your purpose and theirs are not the same, and that's OK, as you can still make it work for both. They will give you all those things, providing that you first give them what they want.

The covering letter should address the main selection criteria. These are seldom apparent (except in government type jobs), so you use the job description as the nearest proxy. After writing the covering letter, re-read the job description. Perhaps ask someone else to look over it.

B   Appendix: Hydra scenario

Job application

Hydra Inc. makes office chairs. Business is booming, and they have several new projects starting, so they are hiring Engineers. Well, that's what seems to be the case, judging by the advertisement on the job site (see below).

'Well, what do you think?', asks Mark impatiently. 'I reckon it would be a great job for you.'
'In fact', he continues, 'if not for the fact that I've got a great job lined up, I'd be tempted to apply for it myself. But I think this one has your name written all over it!'
'Sure does look interesting', you reply hesitantly, 'It's just that …'.
'It's just that what?' replies Mark.
'Well, I'm not sure ….',
'So, what are you trying to say? That you don't want to leave the student life or something?!'
'No! It's just that I'm not sure that I meet all the things they seem to be looking for.'
'Oh', responded Mark with relief, 'that's the least of your problems. Make it their problem. Just write the best application you can, and see if they will bite.'
'You never know', he continued, 'they obviously need to take someone, so they might relax on some of their criteria when it comes down to it. Besides, if you wrote a good CV I reckon you could show something towards most of those criteria.'
'What do you mean?' you reply. 'I've go next to no experience on half those areas!'
'Maybe not a lot, but better than nothing', shot back Mark encouragingly. 'You have got that final year project you've been working on – that has to be worth something for project management and team and all the other stuff they want.'
'Hmm, you have a point there', you respond cautiously. 'Maybe I could have a shot at it.'
'That's it!', replies Mark warmly, 'And if you don't feel too awkward about it, I'd be happy to proof-read whatever you write'.
'Thanks, but it's a bit personal so . . . . . ', you trail off into a pause as another train of thought develops: 'no, what an idiot! Yes, of course I'd like you to see it, thanks for the offer!'
'If you are going to send a CV out into the wide world', Mark chuckles, 'it's not like you can keep it entirely private!'
You both enjoy a good laugh.
'Thanks Mark. Got to go to class now. I'll modify my CV for the job and show you tomorrow'.
'Cheers. Break a leg!'

Junior Mechanical Engineer

Hydra is a dynamic and growing business dedicated to delivering high-value products to customers. We design and manufacture products that are aesthetically attractive, highly functional, and mechanically reliable. Like our award winning 'Octopus' office chair.

Strong growth in market demand for our quality products means that we are looking to employ Mechanical Engineers. We have vacancies in product design and production engineering. This is an excellent opportunity to put your skills to use in bringing high-value products to market. We are looking for an Enthusiastic, hands on, and extremely organized, project driver with a strong desire to own fast paced development programs.

Responsibilities include:
- To create product and component designs
- To prepare technical feasibility studies
- To work in conjunction with engineers and production teams to bring tasks/projects to completion within stipulated time and cost limits.
- To produce full manufacturing drawing/documentation sets to meet the company's internal standards
- To liaise with and provide technical assistance to other departments, customers, suppliers, consultants and authorities as required.

Applicants should have the following attributes:
- Sound Bachelor of Engineering or equivalent degree.
- Proven design skills, and preferably knowledge of Pro/Engineer
- Prior experience working in a project team, and also the ability to work independently as an individual.
- Project management experience, and a structured approach to achieving challenging objectives.
- Effective and efficient administration skills.
- Knowledge of QA/QC requirements in an engineering environment.
- Plastics injection moulding experience and experience in part design for mould ability preferred.
- Experience with electronics/consumer goods preferred
- Experience working with overseas product development and manufacturing.

Hydra offer an attractive salary package and the opportunity to be a part of a successful and satisfying work environment. We offer the opportunity to grow your skills and knowledge.

A great opportunity! Are you an Engineer who is a fearless problem solver and with a passion for technology and a relentless drive for success and quality? Apply now in confidence by clicking on APPLY below! For a detailed job description email Hydra Closing date is 20 August.

Apply!

…
…

Career options

'So', asked Mark quizzingly, 'how did that job interview go at Hydra?'
'Well it seemed to go OK, thanks', you reply. 'It would be great if it came off – I liked what I saw of the technical work, and the people seemed genuine too.'
'Were you a bit nervous?'

'And how! I was as nervous as anything, and I'm sure that came across. But they did their best to put me at ease, which was nice of them.'

'So what's next?' asked Mark.

'Well, it's really made me think. I've got to give some thought to whether I go and do some postgraduate studies or accept any job-offer that might come from Hydra.'

'Not an easy choice', answered Mark with a smile, 'but for me I've already decided to start earning an income. I see myself as a practicing Engineer, maybe even a director of a company eventually.'

'Yes, I can see you successful at that', you reply with a laugh. 'Remember me when you have earned your million and have a holiday house in Greece!'

'Yum, don't you just love those Kalamata olives – I can picture it already: blue sky, white walls, sparkling blue sea, Greek cuisine. Ah, that's the life for me!', exclaims Mark with a dreamy look.

'So how do I make my decision then', you ask.

'Well, if the path of personal preference is not clear before you,' responds Mark with a wry smile, 'then maybe try that net present value method.'

'Good idea!', you reply, 'at very least it will help me understand the options better just by working through the issues.'

<As an exercise, compare the longitudinal present value of postgraduate study versus immediate engineering employment. You can find all the remuneration data you need on the IPENZ website, and student membership is free. One of the issues we have in NZ is that the salary premium for postgraduate study is generally negative –though this applies on average to postgraduate study generally and may not apply specifically to your area of engineering. Worthwhile checking out anyway, so that you are informed. >

…

…

Job description

Well the Hydra job came off, and you decided to accept it. It's a decision you don't regret. You moved in a couple of days ago and the people are friendly and the work looks like it's going to be interesting.

'You settling in OK?', asks Derek the boss, poking his head round the door.

'Yes, fine thank you', you respond with a genuine smile.

'That's great. Got a moment to talk about next actions?'

'Sure', you reply, 'now's good.'

'Thanks', says Derek as he takes a chair next to you, and pulls out a sheet of paper. 'What I'd like you to do', he continues, 'is write your own detailed job description.'

'Hmm, OK!', you reply, 'that sure turns it the other way round!'

'Yes! But there is method in the madness, because doing so will help you better understand your own work.'

'OK, I can do that', you reply positively.

'Great', responds Derek, 'If you can knock up a draft then the two of us can work through it, reconcile our expectations, and finalise it'.

…

…

'That job description was a bit of a risky idea, wasn't it', you ask Derek a week later at morning coffee.

'Sure would be, for the risk averse!', laughs Derek, 'and most people don't do it that way.'

'But really', he continued, 'the risk was not very big because we could always have defaulted to a vague generic JD if necessary. However this way both you and I have a better idea of the job and where you can particularly add value.'

You nod and take a sip of coffee. It was a good experience and helped you reconcile your expectations and better understand how the firm worked and what it valued. You quietly wonder if it would have gone quite so well with an authoritarian boss – somehow you think not!

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