

ON THE DEFINITION OF CAPABILITY IN THE WORKPLACE, A NEW PERSPECTIVE – PART 1

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Abstract

This paper attempts to establish a logical definition for the measurement of capability in individuals within their working environment, referred to as Applied Capability in terms of current practices in the field of management science. A literature review across a range of relevant disciplines (including management, human resources, industrial systems, and education) has been conducted; this has resulted in a definition for Applied Capability that is a function of the way in which individuals utilise their innate capabilities in the work place.

This work has resulted in a general analytical model that acts as a capability predictor and as an indicator to the future performance of an individual in the context of their work environment. Part 2 of this paper will test the validity of the proposed model using capability indicators from the education sector.

Managerial Relevance Statement

In the current highly competitive marketplace many organisations both public and private are experiencing a shift in their recruitment pattern away from permanent to short-term contract. The need to sustain a competitive edge, to embrace flexibility and the stark realities of economic survival are forcing many companies to embrace alternative employment strategies and base their recruitment policies on a shorter-term project basis rather than the more traditional long-term and permanent employability. The ability to quickly identify the most capable individuals, individuals who could be rapidly deployed into specified job roles is a key factor in ensuring the success of this policy.

1. Motivation and Research Objectives

Faced with the challenges of globalisation, competition and financial constraints, many organisations are evolving from a functional to a project-based structure. Future project-based

organisations will maintain high levels of capability by recruiting project-focussed individuals who are highly specialised, flexible and mobile. Nearly 60% of the UK employment market is provided by SMEs where fixed term contracts are the norm [1]. This model of working is prevalent in project-based organisations, which traditionally recruit individuals or assemble teams to address the needs of a particular task, project or programme of work. Increasingly, the members of these teams are employed on short-term contract basis, they are fit-for-purpose i.e. “*highly capable*” and rely heavily on technology to enable and support virtual team-based working practices, sometimes referred to as the ‘*Hollywood*’ effect.

In such environments the challenge is to identify those employees who possess innate qualities and skills (collectively referred to as their *resources*) and additionally measure their ability to utilise those resources in meeting and delivering corporate objectives effectively and efficiently. The ability to meet this challenge is a paramount factor in the operation of the organisation. Here we propose the concept of “*Applied Capability*”; a method to predict applied capability based on the findings in this paper, an analytical method that measures the relative impact of an individual’s resource and the extent to which that resource is used (i.e. its *utilisation*) in completing a task or a series of tasks.

Given the innate ability to measure an employee’s applied capability, then an organisation is in a better position to forward plan and control the process of acquiring, renewing, updating, and enhancing its capability. A side effect of this process is the identification, enabling and supporting of individual employees with the goal of improving their personal and professional strengths and abilities. In the inevitable and natural evolution towards project based organisations, it is imperative that an organisation is able to support the continual education and training of their individual employees with a view to attaining, expanding and enhancing their necessary skill set and interpersonal relationships, all undertaken in the context of monitored progression.

The objectives of this paper are:

1. To establish a common definition for *Applied Capability* in industrial systems. A lateral literature

review has been undertaken to establish a common definition for capability across economics, management science, business administration, human resource management, and industrial systems. The findings of this review have identified the commonalities and differences with respect to capability across the chosen disciplines and have allowed a definition for *Applied Capability* to be determined in the context of this study.

2. To establish the definition for capability parameters that facilitates the expression of applied capability as an abstract mathematical format. Here we refer to such parameters as *Capability Factors* and they are used to represent a number of enabling resources. Since at present no phenomenological formulation is available for the physical measurement of such parameters, the validity of an empirical measurement mechanism will be investigated. The method used to establish the capability factors and their associated resources will subsequently be used to ascertain the *Impact* and the *Utilisation* of those resources in fulfilling a given task.
3. The *Capability Factors* and their associated innate/acquired resources required to perform a job are established by domain experts (e.g. in this case professors, supervisors and trainers). The relative impact of each resource is also determined by the expert. The utilisation of each resource is then measured by observing the individual and the assessments made by their supervisors whilst performing the task.
4. To establish a framework for matching and mapping *Resources* (an individual's traits and qualities) to a set of job/task descriptors (i.e. a job fitting exercise).

The expected outcome of this exercise is the ability to express *Applied Capability* as the product of the *impact* and *utilisation* of the *resources* required to complete a task or set of tasks.

2. A Review of Existing Literature on Definition of “Capability”

In the past 3 decades the concept of “Capability”, its definition, evaluation and comparison have been discussed in the economics, social sciences, engineering and management literature. According to Barney major business decisions are based on the assessment of an organisation's capability [4]. According to Sen, from an economics stand point, capabilities are used to represent

people's quality of life and “*what people are able to do or are able to be*” [58]. The psychoanalysts Jaques and Cason believe that an individual's capabilities can be assessed based on the complexity of the work they perform and levels of attainment achieved [33]. From a Human Resource Management (HRM) standpoint, employee capabilities are evaluated based on job descriptors and levels of fitness [17][19]. Across the various disciplines, while capability is defined using differing terminology; there is however significant commonality in the principles and perspectives used. Analysis of the literature will more closely identify a generic definition for capability based on the commonalities across the various disciplines. Such analysis will help in establishing the modelling principles, define the assumptions and suggest the way forward in terms of implementation.

2.1 Capability in Industrial Systems

From the literature one can conclude that there is an underlying consensus on the definition of “Capability” [2][14][20][30][37][47][48][62][68]. From the perspective of Industrial Systems, then capability is potential that manifests itself through a set of enabling resources. A resource is an entity that is owned and controlled by an individual or an organization. Put simply, capability is the ability to deploy a resource to achieve an end result [29][16]. Capabilities in industry are linked with the practical deployment of resources. This *applied* perspective of Capability resonates with the methodology pursued in this research paper and as such the authors suggest the use of the term “*applied capability*” for their proposed model.

In order for companies to remain competitive and successful, the company has to create the environment in which individuals can develop and grow. They need to provide the necessary motivation for their employees to seek improvement and to provide the necessary support in the acquisition of that capability (e.g. training, access to new technologies, further education etc.). In this way the employers can influence the development and evolution of the individual employee's applied capabilities which collectively represent the capability of the organisation [68]. Such a view countenances investigation into the relationship that exists between tasks and the utilisation of resources as one of the parameters affecting *Applied Capability*.

Systems literature makes a distinction between capability and the performance of individuals. Performance is the level of attainment against objectives, whilst capability cannot be realised unless an objective has been attained [2]. The implication is that performance is a factor in determining an individual's capability. An assumption of this research is that historical evidence of performance (in the form of experience or past attainments) when undertaking similar tasks is a factor in the determination of *Applied Capability*.

2.2 The “Capability Approach” in Economics

The Capability Approach in economics describes human capabilities as “*what people are able to do or are able to be*” in contrast to “*functioning*”, which is their actual ability [59]. Economists distinguish between capabilities and functioning; capabilities are predictors of potential, whilst functioning is about how individuals apply their resources in practice. Capabilities and functioning converge when individuals make choices. The choices differentiate individuals in terms of what they choose to be or what they choose to do [5]. Personal, social and environmental circumstances influence people's choices [51].

Gasper categorised capabilities into either O-capabilities (opportunities and options) or as S-capabilities (skills and potentials) [26]. It would appear that economists have focused their arguments on the potential rather than the applied capabilities of an individual.

The economist's viewpoint of capabilities helps us to interpret *Applied Capability* as a function of an individual's potential, their choices and their functioning. In other words, what individuals can do; what they choose to do and what they actually do. This interpretation allows us to formulate a set of logical rules for formulating *Applied Capability*. Figure 1 shows the distinction and the relationship between *potential* and *applied* capabilities.

Figure 1: The logical relationship between Potential and Applied capabilities
Research Methodology

Robeyns suggests a list of human capabilities and a method to measure individuals against those parameters [51][52]. Sen believed that instead of providing a list of capabilities and assessing individuals against it, we need to assess their wellbeing and compare it to their functioning [60]. Nussbaum implemented this method [46], which was subsequently modified by Stewart [61] and Vogt [65]. What can be inferred from the Economists approach to defining capability is their emphasis on the distinction between potentials and actions. Each individual could be considered to have potential capabilities arising from their innate abilities, skills, education, experiences and the opportunities afforded them in life. However individuals differ in the way they apply those capabilities in a specific context or given environment. In order to transform potential capability into applied capability one needs to know the nature of the task and the environment in which the individual performs that task. Any evaluation is solely reliant on self-assessment procedures that at times may not be completely reliable on their own.

2.3 “Capability Theory” in Business Administration and Human Resource Management

The majority of the body of knowledge that relates to capability to date has been generated by Business Administrators and Human Resource Management practitioners. An alternative perspective on capability, the so-called “Capability Theory” has emerged [33][34]. Capability theorists have linked an individual’s innate traits and qualities with the level of complexity associated with specific tasks. This approach asserts that the more capable an individual is, then the more complex are the responsibilities and the tasks they are able to undertake. For example a Managing Director may very well be required to undertake multiple tasks in parallel, whilst a single repetitive labour intensive task may be assigned to a low or moderately skilled operator. The method proposed by Jaques [34] describes capability as a combination of *Potentials (P)* and *Applied Capability (A)*.

$$P = f(\omega) \text{ and } A = f(P, v, \phi, \tau) \quad (1)$$

The ability to *processing complex information* (ω) is a function of an individual’s potential capability. Whereas applied capability is a function of an individual’s personal *values* and *interests*

with respect to the task (ν), their knowledge/skill attainment for the task (ϕ), and their dysfunctional or temperamental traits (τ). The τ in this model has psychoanalytical qualities and describes a negative effect on the individual's applied capability.

Capability theorists emphasise that the ability to process complex information is not sensitive to factors associated with the working environment (internal or external). But the application of one's potential capability is influenced by personal traits and values as well as knowledge and skills.

In the context of quantitative measurements, the experimental design used in this research puts this theory to test and concludes that not all the criteria suggested by the "Capability Theory" are adequate predictors of an individual's Applied Capability. It is important to note that our limited empirical study reveals that an individual's abilities, preferences, and past performances are reasonable predictors of Applied Capability.

Campbell et al. do not separate abilities from performance; in their view abilities and performance have a cause-effect relationship [12]. In predicting performance, individuals are assessed based on a set of criteria that examines their abilities, skills and preferences over a number of tests, interviews and past experience [32]. In this approach an individual's track record regarding past performance is as important as an individual's abilities, skills and preferences. Organisations typically use such information about their employees in performance evaluation [32][40]. For new employees, this information is normally determined from such sources as their curriculum vitae, educational reports, interviews, reference letters, and informal enquiries from previous employers. For current employees, subjective and objective models (such as weighted matrices) or managerial discretionary in the form of subjective feedback (based on regular employee appraisals) are normally used to compile information on employee performance. In this context previous task and contextual performance measures which are potentially the most comprehensive performance measurement tools are not being used to predict an individual's future success, but are used as internal assessment tools.

Personality values and interests can be used to predict an individuals' behavioural pattern [57]. Behavioural patterns can sometime manifest themselves in an individual's choice of how much and for how long they would choose to exert effort on a task [12]. The implication is that motivational factors have the potential to play a significant role in encouraging an individual to maximise the application of their innate and acquired resources. Different situations may affect the way an individual use their knowledge, skills and habits [43]. The working environment therefore plays an important role in how an individual's capabilities are best utilized. This means that an individual's abilities, skills, motivational factors and previous performance records, their personal circumstances and the working environment should all be assessed within the context of the task.

2.4 The Search for a Basic Definition for Applied Capability

The purpose of this section is to establish a basic definition for Applied Capability. Table 1 summarises relevant literature, the columns in Table 1 respectively contain information relating to the discipline, the basis for evaluation, the criteria for evaluation, the elements that define capability, and the parameters that assessments were made against.

Table 1: A summary of Applied Capability in different disciplines

The conclusion that can be drawn from the data presented in Table 1 and Table A1 (Appendix) is that what is common across all the subject areas is the need to clearly specify an individual's potentials, to investigate their suitability for a task and to predict how they will utilise their innate/acquired resources to achieve the desired outcome. The current approaches used in assessing capability do not provide a wholly accurate prediction. Moreover, it appears that at present there is a lack of clarity in distinguishing between capability, abilities, performance, and outcome. We believe there needs to be a clear and unequivocal distinction made between these parameters. Using analytical methods we intend to offer a clear definition of capability and demonstrate that capability is different from abilities, performance and outcome.

What distinguishes the proposed method of capability assessment is that it provides a comparative platform on which to base the prediction of who would be the most capable candidate to fulfil a given task rather than simply predicting success or failure. The Applied Capability measurement approach promises to be a fairer and more comprehensive selection procedure. Applied Capability is more inclusive prediction method that focuses on how an individual utilises their innate and acquired resources rather than just on assessing their abilities, strategies, motivations or performance. This form of assessment can be used to select an individual or a team of employees to perform a given task in any organisation. We believed this is a novel approach to the selection problem, an approach that improves the quality of decisions made when employing candidates. We have tested the approach in an educational context producing an applied capability profile for every student in a cohort of 240 over a 2 year period.

The next stage in this modelling methodology is to map capability enabling resources to job descriptors. In the following section we analyse literature on Job-Fitting approaches and select the most appropriate for the Applied Capability modelling domain.

3. A Review of Existing Literature on Job Descriptors

In this section we appraise current techniques and tools used for job evaluation, assignment of individuals to jobs and fitness tests. The purpose of this analysis is twofold, firstly to extract the necessary parameters required for building the Applied Capability model, secondly to ensure that the proposed model meets with current practices and standards for job analysis in management and organisational sciences.

3.1 The Definition of Job and Tasks

A Job can be described as a logical assembly of multiple tasks. A task is defined as “a quantity of things with a certain quality which should be done in a targeted time within the limits of available resources” [34]. Visser et al [63] suggest breaking down tasks into: (a) Task-Oriented (the nature of the work and its requirements), (b) Behaviour-Oriented (the worker’s attitude), and (c) Attribute-

Oriented (the qualitative characteristics). The two most prominent methods adopted by industry for job evaluation are the Traditional Job Analysis (TJA) and Competency Modelling (CM) [63].

The relevance of this task breakdown in the context of the current research is in their method for defining jobs and tasks. The TJA process uses 'experts' as the knowledge source for job definition, a source that may for example include the current job incumbent or supervisor (e.g. production manager/engineer in a manufacturing department or academic supervisor for student assignment). In the TJA approach the expert decides the type and levels of skills, knowledge, and personal qualities required to complete the job. The Competence Modelling (CM) for job evaluation follows a different route. In this approach workers are evaluated based on the competencies required for the job with the objective of maximising the probability of successfully completing the task [7]. Competency models define a set of required competencies with respect to the specific job, the organisational strategy and its prevailing culture. These models are well entrenched in managing human resources within large organisations [49].

Other researchers have expressed doubt about whether there is a significant difference between TJA and CM [53]. Equally Schippmann et al believe that CM is more congruent with business goals of the organisation, whereas TJA is more accurate in developing a detail job specification [55]. The authors conclude that the most suitable definition of job for the purpose of Applied Capability evaluation is the one suggested by Sanchez and Levine [54]. The suggested job definition and analysis method [54] combines both TJA and CM to achieve a more comprehensive definition of a given job. Figure 2 summarises the method used to achieve a Comprehensive Job Definition (CJD).

Figure 2: Job definition and analysis

The CJD method simplifies and generalises the job definition process by allowing the analyst to breakdown jobs into task units and then mapping these units onto the resource (an individual's

innate and acquired qualities), in doing so resource allocation becomes a substitute for subjective task definition.

The substitution of task definition with resource allocation allows us to decouple the capability evaluation from task-specific to yield a more generalised resource-specific process.

The final piece in the jigsaw is consideration of the environmental factors that may either positively or negatively affect an individual's Applied Capability. For this purpose the authors review the literature relating to the relationship between an individual and their work environment.

3.2 The Relationship between Individuals and their Work Environment

One of the principal arguments of this research is to argue that the relationship between an individual and their working environment has a positive effect on developing the potential for demonstrable capabilities. A good working environment encourages an individual to engage and develop their full potential and by doing so harness their actual capacities and capabilities. Thus a good 'fit' between employee and employer is an important factor in capability assessment.

In recent years various measures, methods, classifications and analytical methods have been suggested to assess the suitability of a candidate for a given job or task. The process normally starts with a screening or filtering phase whereby a shortlist of potential candidates is drawn up from the pool of applicants, this is subsequently followed by determination phase to find suitable employees from the shortlist (Figure A1 appendix) [49].

In their extensive literature review Robertson and Smith [50] report on sixty years of work undertaken by psychologists in their search for a single criterion that can be used to gauge the reliability of selection methods and the quality of the predictions made, they studied 17 different methods for employee selection. Data collected on a candidate's progression during training and their actual performance carrying out the job were key criteria in testing the reliability of the candidate evaluation method. The data with greatest relevance was found to be: cognitive ability, interviews, personality tests, bio-data and examinations conducted at assessment centres.

Schmidt and Hunter [56] have reported on the use of multi criteria candidate evaluation process that included real personnel data, production criteria and supervisory ratings.

In an international survey, Browen et al. [8] investigated the variations in candidate evaluation procedures in different countries. They asked managers from ten different nations about the actual criteria used or sought opinion about the ones that they felt they should be using for candidate evaluation. A number of striking similarities between certain countries was attributed to those countries norms and cultures. In some countries (Canada and Australia) there was a potential to recruit people whose personal value systems were compatible with that of the company. In Japan a relatively low importance was attributed to skills and cognitive abilities, here the emphasis was on employee trainability. Nevertheless, Japanese recruiters had expressed a desire to include cognitive abilities test in the future. They cited the highly skilled labour market as a major drive force for including cognitive ability test. In Korea some companies use entrance exams for employment; employee recommendation is also common practice. The cost effectiveness of examination assessment centres has been questioned [50].

Figure 3 lists some of the strengths and weaknesses of the current selection methods and is suggestive of how selection procedures can be improved.

Figure 3: The current selection procedures and the possible improvements

A 'sensible' selection process should result in a good 'fit' between the candidate and the job. The Person-Environment-Fit (PEF) approach encapsulates what candidates bring to a job (i.e. *supply*) with what they expect from a job in return (i.e. *needs*) [23]. PEF employs a combination of person-job, person-group and person-organisation fitting in selecting candidates [25][10]. It is based upon the congruence of the requirements and norms in the 'work' environment with that of the skills, beliefs, values aspirations and personality traits of individual applicants [39]. Warr [66] suggests that the relationship between a candidate and a job or organisation could potentially create

opportunities for greater utilisation of employee skills. Fitting a candidate to the environment can be either complementary or supplementary [44]. A complementary fit occurs when the person brings new or additional attributes to the environment, whereas a supplementary fit occurs when a person is chosen because they best meet the needs of that environment. Due to the subjective nature of the information, it may at times be difficult to obtain a completely accurate and objective PEF [28].

However, any person-environment misfits can have negative psychological effect on the candidate and result in potential behavioural disorder [21][27][28]. Misfit can manifest itself as stress in the working environment [27][28]. On occasions stress can be caused by the work environment not fulfilling the candidates expected needs or indeed when their abilities are insufficient to meet the requirements off the job. Deficiencies in what an organisational supplies in terms of a person's needs could contribute to the ineffectiveness of that person in their job role [22]. Warr [66] has also commented that an over utilisation of the resources that require high level skill may very well harm a person's wellbeing and may result in high levels of stress in the working place. Edwards [23] advised that is better to ask about a candidate's skill and the job requirements separately, rather than about the congruence of the two. Caldwell and O'Reilly [11] believes that by collecting an expert and specialised set of characteristics required for the job and its requirements is better than assessing the individuals based on generic measures (such as intelligence tests). This allows the organisation to include its specific and normative expectations in the selection of employees.

The proposed Comprehensive Job Definition (CJD) for measuring Applied Capability is designed in such a way that the needs and expectations of the organisation and their selection strategies are met. The suggested CJD attempts to achieve a balanced approach to the job-person fitting practice. The principle is not about finding 'super-humans' to perform tasks, but to find the most suitable candidate for a job or vice versa. By finding the most suitable candidate for job, both the individual and organisation gain mutual benefit. As an example of the proposed method for measuring the levels of fitness between a working environment and an individual, let us assume that there is a job with a given set of needs; Figure 4 shows the relationship between the job requirement and the

resource supplied by a candidate in meeting those needs. The y axis shows the level of fit, as we move from the left to the right along the x axis; the change in the y value represents the candidate's ability to meet the needs of the working environment. At point E along the x axis the divergence between the resource supplied and the needs of the job is optimum in that it is minimised. Any further shift along the x axis to the right demonstrates that the individual is supplying higher resource than that requirement to meet the needs of the job and again represents degradation in the person-job fit. This is one of the fundamental concepts in this research and its measurement will be discussed in greater detail in subsequent sections. The logic expressed here is further discussed in Edwards et al [22].

Figure 4: Person-Job Fitness Diagram, y axis represents the work environment needs and the x axis shows the resource supplied by the candidate

Having defined a job using the CJD method, the next step in Applied Capability evaluation is to conduct a Candidate Suitability Test (CST). The purpose of CST is to match individuals to appropriate jobs, in other words to find jobs for individuals with a certain set of capability resources. This matching process results in a candidate-job suitability index which is a predictor of whether the level of capability resource supplied by the candidate is sufficient to successfully meet the requirements of a given job.

4. Foundation for Capability Modelling

The Applied Capability model at its most basic is focused on obtaining three types of data measures referred to as Capability Factors. Data capture is in the form of questionnaires which are designed to survey individuals about their cognitive abilities and skills; here we refer to this data as *Enablers*. Individuals were also surveyed about their personality traits (i.e. drivers, motivations and values); here we refer to this data as *Preferences*. The third grouping of questions was designed to survey individuals about the attainment of relevant past experiences; here we refer to this data as *Attainments*. For example, in academia previous experience in successfully publishing research outputs demonstrates a degree of attainment that could be used as an indicator of a researcher's

capability. The suggested measure of attainment attempts to address the shortcomings of existing methods for recording previous experience discussed in the literature [50][64].

The Enablers, Preferences and Attainment are interpreted as an individual's innate or acquired *Resources* that can be used to successfully perform a given job or task. These resources have an associated *Impact* and a *Utilisation* value (as discussed in section 1). They are expressed as indices whose combination result is an estimate of an individual's applied capability to perform for a given job or set of tasks.

The authors suggest that as part of following the explanations about the formulations, the reader also make reference to table A2 (appendix) for a summary of the key model descriptors and definitions.

Figure 5 shows the underlying logic behind the model and the individual building blocks of the applied capability model.

Figure 5: Applied Capability Relational Model

The *Impact* (I) and *Utilisation* (U) of the resources belonging to *Individual* (M) for *Job* (K) is a function of the *Enablers* (E), *Preferences* (P) and past *Attainments* (A).

$$(I, U)_{MK} = f(E, P, A) \quad (2)$$

The Applied Capability modelling algorithm requires 11 steps performed as part of 4 separate activities. Figure A2 (appendix) illustrates a complete example.

Activity 1 - Job Profiling:

Step 1: Breakdown jobs into tasks. A job may consist of 1...n tasks $J = \{T_{1..t}\}$.

Step 2: Select the resources required for each Capability Factors denoted by $i = 3$ (i.e. *Enablers*, *Preferences*, and *Attainments* ($i=3$)). And j is the resource required:

$$i = \begin{cases} 1, & \text{Enabler for } j = 1, \dots, e \\ 2, & \text{Preferences for } j = 1, \dots, p \\ 3, & \text{Attainment for } j = 1, \dots, a \end{cases} \quad (3)$$

Denote each Capability Factor i , Resource j allocated to Task t as C_{ijt} .

Step 3: Assign a value $X_{ijt} \in (0 \rightarrow 1)$ representing a relative amount of resource j required for task t . A value of “0” means nothing is required and the maximum value of “1” means that the full amount of a specific resource is required for the task. For example in the game of Volleyball, the level of “*agility*”, a resource in the Enabler category required for a specialist receiver of opposition service or spike could be $X_{ijt} = 0.7$ whilst the “*digging technique*”, another Enabler, when defending a service/spike should be $X_{ijt} = 1.0$ or close to that figure.

Step 4: Do a number of simultaneous tasks in a job require the same resource? If “No” go to next step, else assume that the maximum level of the resource required being the sum of all levels required for those tasks. Start with the first task requirement for capability factor C_{ijt} , for $i = 1, j = 1, t = 1$ check if there is any other task that requires the capability factor.

A new list of required set of resources C'_{ij} and the corresponding levels be X'_{ij} , then for all $T_{1...t}$:

$$C'_{ij}, X'_{ij} = \begin{cases} \max X'_{ijt} & \text{or all similar} & C_{ij} \\ X'_{ijt} & \text{for all dissimilar} & C_{ij} \end{cases} \quad (4)$$

For example the required agility levels for a receiving specialist in Volleyball might be 0.8, but at the same time the same player may be required to take part in attack (i.e. spike in front of the net), in the levels of *agility* required for spiking (attack) could be 0.2. Therefore, the overall agility required for this player is 0.8, since this is maximum agility required for the two rendered tasks, or in other words the job of a “defence specialist” in Volleyball.

Step 5: Allocate weight for each resource, if required.

$$\text{For } i=1, \sum_{j=1}^e W_{ij} = 1$$

$$\text{For } i=2, \sum_{j=1}^p W_{ij} = 1 \quad (5)$$

$$\text{For } i=3, \sum_{j=1}^a W_{ij} = 1$$

Activity 2 – Determine the levels of Individual’s Availability for a job – the Matching process:

Step 6: For every individual $M = 1, \dots, m$ determine the level of *availability* (A_{mij}) for \hat{C}_{ij} . A_{mij} is the availability of individual m for factor i and resource j .

Step 7: Normalise A_{mij} for each individual for X'_{ij} of resource requirement for the set of resources \hat{C}_{ij} , and call them A'_{mij} and A''_{mij} , where:

$$A'_{mij} = \frac{\min(A_{mij}, X'_{ij})}{X'_{ij}} \quad \text{and} \quad A''_{mij} = \frac{\min(A_{mij}, X'_{ij})}{A_{mij}} \quad \text{for } \forall i, j, k \quad (6)$$

Step 8: Calculate all A'_{mi} and A''_{mi} for \forall all M_s .

$$\begin{aligned} \text{For } i=1 \quad A'_{m1} &= \sum_{j=1}^e W_{1j} A'_{m1j} \quad \text{and} \quad A''_{m1} = \sum_{j=1}^e W_{1j} A''_{m1j} \\ \text{For } i=2 \quad A'_{m2} &= \sum_{j=1}^e W_{2j} A'_{m2j} \quad \text{and} \quad A''_{m2} = \sum_{j=1}^e W_{2j} A''_{m2j} \\ \text{For } i=3 \quad A'_{m3} &= \sum_{j=1}^e W_{3j} A'_{m3j} \quad \text{and} \quad A''_{m3} = \sum_{j=1}^e W_{3j} A''_{m3j} \end{aligned} \quad (7)$$

Activity 3 – Determine the resource Impact and Utilisation indices

The level of impact of an individual on the completion of a task I_m can be queried through a self-assessment or an assessment made by their supervisor. Where I_m is a number between 0 and 1.

Step 9: Define a statistical model to infer the most suitable predictor of impact I_m with respect to A'_{mi} , for $i \in \{1,2,3\}$ and list of j resources.

$$I_m = f(A'_{mi}) \quad (8)$$

The statistical inference model will estimate the closest possible function (f) for estimation of the Impact index.

Step 10: In order to predict the *utilisation of resources* (U_m) for an individual we suggest using regression of the Impact indices. For $i \in \{1,2,3\}$:

$$U_m = f(A''_{mi}) \quad (9)$$

Steps 1 to 9 of the proposed algorithm are designed to estimate the Impact and Utilisation of an individual's resources in completing a job. The job-individual matching process with respect to the availability of resources was achieved by proposing a minimum function in step 7. The final part of the algorithm uses the inputs to predict the applied capability. Step 10 infers the levels of utilisation of resources based on the impact they have on completing jobs, thus purporting to the application of one's capability.

By implementing the 10 steps we derive a comparative measure of an individual's "Applied Capability" against their peers. A further example of the method is given in Figure A2 appendix of this paper and further demonstrates the feasibility of the proposed assessment method. In part 2 of this article the authors attempt to validate the algorithm by considering results of an empirical study undertaken in the educational sector.

5. Conclusions, Discussions and Future Work

In this paper an attempt has been made to establish a basic definition for the capability of an individual in the work place. A literature review was conducted covering a wide range of subject areas that includes Industrial Systems, Economics, Engineering, Management Sciences, and Human Resources. The appraisal of existing findings allowed the authors to propose the concept of "Applied Capability", which relates to the innate and acquired resources and qualities of an individual and to the way in which they utilise them in completing given tasks. This perspective on capability assessment relates the application of resources to the achievement of task objectives. The approach allows forward prediction of an individual's performance based on their capabilities.

An analytical model for describing applied capability is proposed and an example is provided to illustrate its rationale and outcome. For the purpose of model validation and verification, Part 2 of this paper will test the model using a real-world example from *Academia*.

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Table 1: A summary of applied capability literature in various subject areas

Sector	Subject Area	The Evaluation Criteria	Capability Factors	Assessment Parameters
Industrial Systems	Industrial Capabilities	Resources, Strategies and attainment of objectives	<ul style="list-style-type: none"> • Capabilities are context dependents. • Capabilities can be defined in different levels of organisation. • Capabilities are evolving. 	<i>Resources</i>
				<i>Strategies</i>
				<i>Attainment of objectives</i>
Capability Approach	Wellbeing	Life, bodily health, bodily integrity	<ul style="list-style-type: none"> • Capabilities are potentials. • Capabilities are changeable. • Applying capabilities results in functioning 	<i>Measures of wellbeing</i>
				<i>Choices</i>
				<i>Functioning</i>
Capability Theory	Work and problem solving Capability	Complexity of Information Processes, Values, Skilled Knowledge and Temperamental behaviour	<ul style="list-style-type: none"> • Potential and Applied Capabilities are different. • Applied capabilities are task based. • Potential capabilities evolve over time. 	<i>Complexity of Information Processes</i>
				<i>Values</i>
				<i>Skilled Knowledge</i>
				<i>Temperamental behaviour</i>
HRM	Future and previous Performance	Abilities and skills, personality and motivations Task/Contextual performance	<ul style="list-style-type: none"> • Workforce Capability is an indicator of organisational maturity. • Environment and the context are important. • Performance prediction is different from per 	<i>Abilities / Skills</i>
				<i>Values</i>
				<i>Personality</i>
				<i>Performance</i>

Figure 1: The logical relationship between potential and applied capability

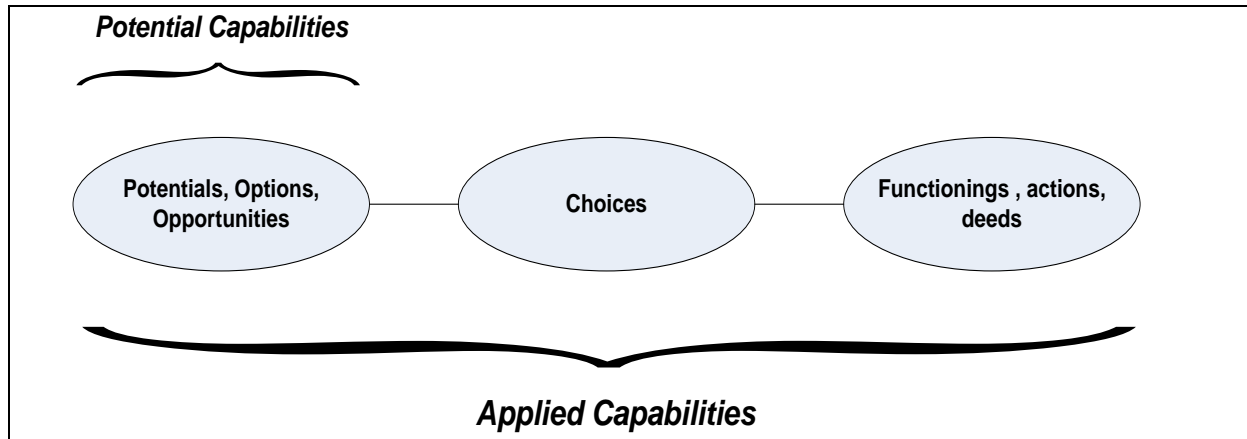


Figure 2: The stages of combined approach in Job analysis.

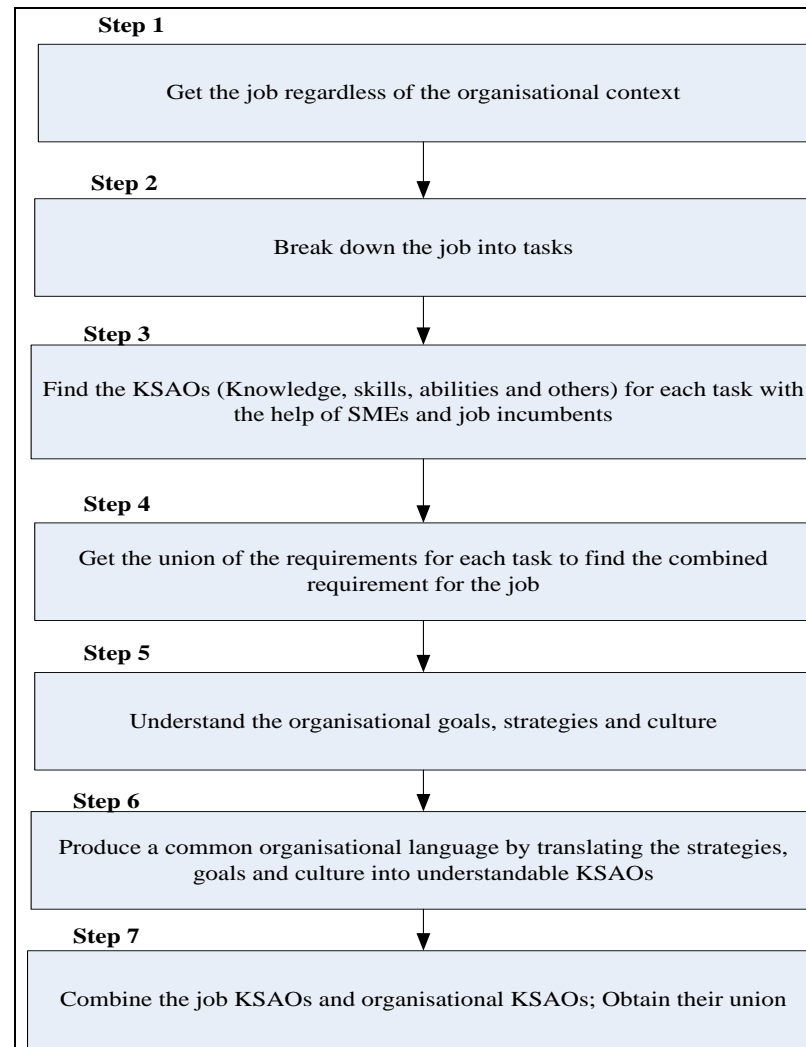


Figure 3: The current selection procedures and the possible improvements

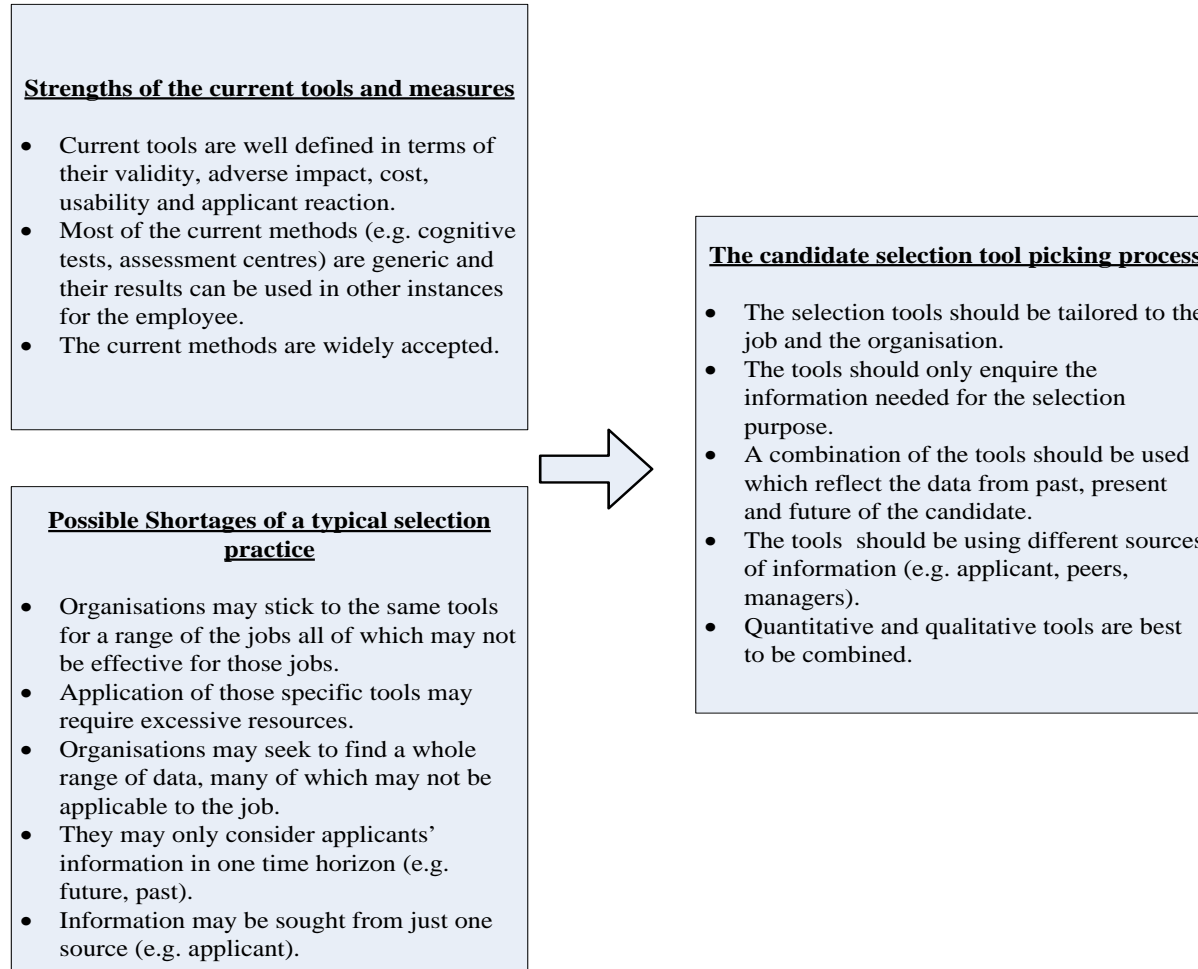


Figure 4: Person-Job Fitness Diagram, y axis representing level of fit and x axis showing the person supplies and the work environment needs.

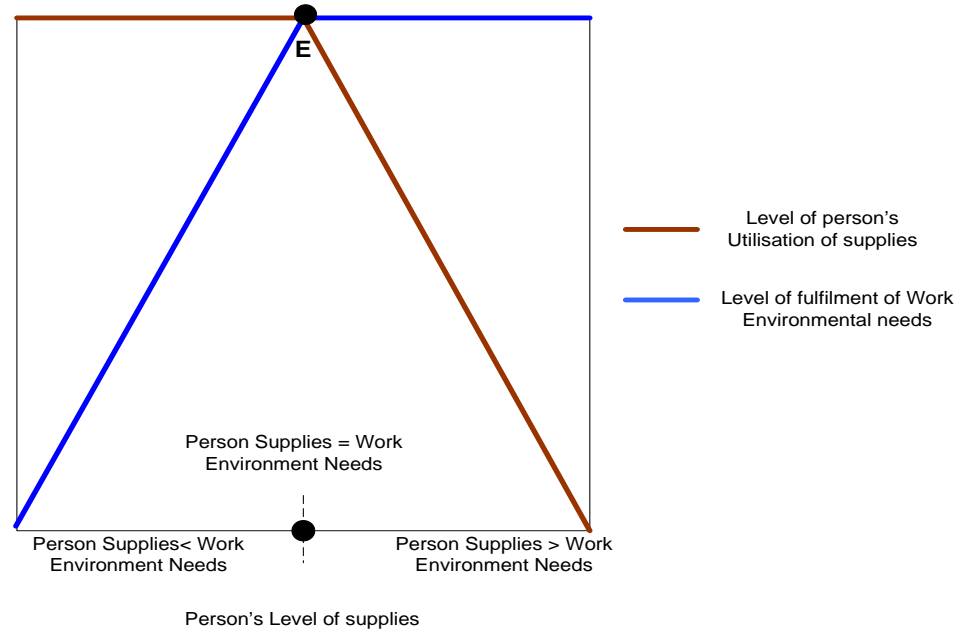
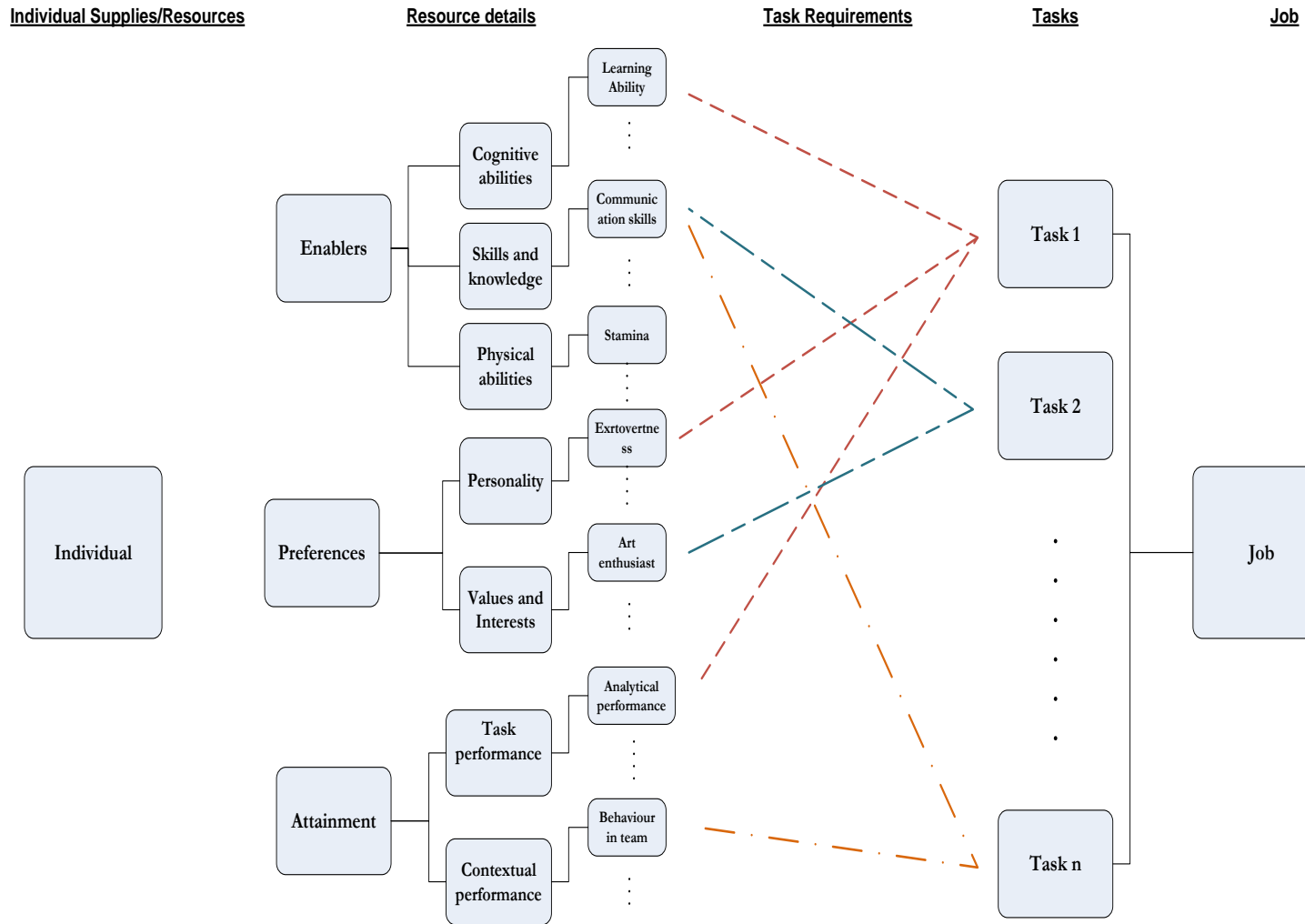


Figure 5: Applied capability relational model



Appendix

Table A1: The identified criteria for Applied Capability Assessment based on the literature in different subject areas

		Applied Capability Assessment		
		1 st Criteria	2 nd Criteria	3 rd Criteria
Subject Areas	Industrial Systems	Resources(Capron and Hulland’s,1999) Generally reliable capacity (Dosi et al., 2000, pg2) Core Capabilities (Helfat and Lieberman, 2002) Zero Level capabilities (Winter,2003) Competence(Zehir et al. 2006)	Methods and strategies (Kogut and Kulatilaka , 2001)(Zehir et al. 2006) Complementary Capabilities (Helfat and Lieberman, 2002) Dynamic Capabilities (Winter,2003) Organisations' culture and structure(Kim and Lee, 2005) (Kimberly, 1979)	Move from Current to critical positions (Kogut and Kulatilaka, 2001) Attainment of objectives (Amit and Schoemaker, 1993)
	“Capability Approach”	S and O capabilities (Gasper,2002) Basic Capabilities (Lloyd-Sherlock, 2002)	Personal, Social and Environmental Conversion factors (Robeyns,2005)	Functioning (Sen, 1987)
	“Capability Theory”	Complexity of Information Processes (CIP) (Jaques and Cason,1994) Skilled Knowledge (Jaques and Cason,1994)	Value (Jaques and Cason,1994) Dysfunctional or Temperamental Behaviours (Jaques and Cason,1994)	Performance on a task (Jaques and Cason,1994)
	Human Resource Management	Performance predictor domain ; Cognitive and physical abilities (Caroll,1993)	Personality constructs (McCrae and Costa ,1996) Preferences (McCrae and Costa,1996) Motivation (Campbell et al., 1993)	Performance (Campbell et al. 1990) Great Eight Competencies (Kurz and Bartram, 2002)

Figure A1: Screening and Evaluative stages of Employee selection

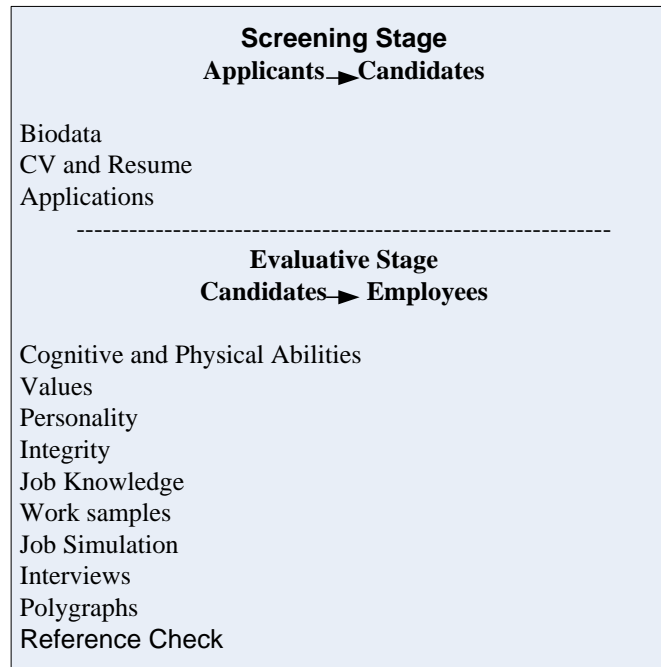


Table A2: Definitions for the algorithm of “Applied Capability Assessment”

Agent (A):	A person who owns a set of resources that they use to undertake a set of tasks (job). Agents interact with other agents.
Resources (R):	Innate and acquired qualities of an agent that collectively contribute to completing a specified job. Resources have an impact and can be fully or partially utilised in the job.
Job (J):	Is a set of tasks that are designed to achieve certain objectives. A job is a combination of its constituent tasks each of which is necessary to accomplish the objective.
Task (T):	A predefined transition of a system from one state to another state at a given time. A task is interpreted into a set of required resources and their levels of requirement leading to agent selection process (agent-task matching). The requirements of the environment are also translated and reflected into the task requirements.
Applied Capability (C):	Predicted by measuring the impact and utilisation of the resources that an agent owns and uses to complete a job.
Resource Impact (I):	The degree to which an agent'(s) resources contribute to the fulfilment of the job/organisation requirements. This is called impact in this research.
Resource Utilisation (U):	The extent to which the agent(s) use their resources in a job/organisation. This is called Utilisation in this research.
Enablers (E)	A number of substantive cognitive and physical skills and abilities that agents deploy during the job life cycle. They can pre-exist and/or be developed in time.
Preferences (P):	A number of personal qualities that allow agents to cope with different situations (e.g. personality, motivation ...).
Attainment (A):	Historical performance of agents in similar jobs and work environments

Figure A2: An example of using the algorithm in a simple job and candidate evaluation scenario.

Step 1		Step 2		Step 3		Step 4				Step 5		Step 6		Step 7	
Job	Task 1	C ₁₁₁ Writing skills	X ₁₁₁ 0.7	C ₁₁ Writing skills	X ₁₁ 0.7	W ₁₁ 0.3	A ₁₁₁ 0.7	A' ₁₁₁ 1.00	A'' ₁₁₁ 1.00						
		C ₁₂₁ Language skills	X ₁₂₁ 0.6	C ₁₂ Language skills	X ₁₂ 0.8	W ₁₂ 0.6	A ₁₁₂ 0.5	A' ₁₁₂ 0.63	A'' ₁₁₂ 1.00						
				C ₁₃ Analytical ability	X ₁₃ 0.7	W ₁₃ 0.1	A ₁₁₃ 0.9	A' ₁₁₃ 1.00	A'' ₁₁₃ 0.78						
		C ₂₁₁ Extrovertness	X ₂₁₁ 0.5												
		C ₂₂₁ Likes working in teams	X ₂₂₁ 0.8	C ₂₁ Extrovertness	X ₂₁ 0.5	W ₂₁ 0.2	A ₁₂₁ 0.8	A' ₁₂₁ 1.00	A'' ₁₂₁ 0.63						
				C ₂₂ Likes working in teams	X ₂₂ 0.8	W ₂₂ 0.2	A ₁₂₂ 0.7	A' ₁₂₂ 0.88	A'' ₁₂₂ 1.00						
		C ₃₁₁ Analysing and Interpreting	X ₃₁₁ 0.7	C ₂₃ Intuition	X ₂₃ 0.5	W ₂₃ 0.4	A ₁₂₃ 0.5	A' ₁₂₃ 1.00	A'' ₁₂₃ 1.00						
	C ₃₂₁ Adapting and Coping	X ₃₂₁ 0.5	C ₂₄ Likes working with software x	X ₂₄ 0.8	W ₂₄ 0.2	A ₁₂₄ 0.4	A' ₁₂₄ 0.50	A'' ₁₂₄ 1.00							
	Task 2	C ₁₁₂ Writing skills	X ₁₁₂ 0.5	C ₃₁ Analysing and Interpreting	X ₃₁ 0.7	W ₃₁ 0.3	A ₁₃₁ 0.8	A' ₁₃₁ 1.00	A'' ₁₃₁ 0.88						
		C ₁₂₂ Analytical ability	X ₁₂₂ 0.7	C ₃₂ Adapting and Coping	X ₃₂ 0.5	W ₃₂ 0.4	A ₁₃₂ 0.4	A' ₁₃₂ 0.80	A'' ₁₃₂ 1.00						
		C ₁₃₂ Language skills	X ₁₃₂ 0.8	C ₃₃ Interacting	X ₃₃ 0.7	W ₃₃ 0.3	A ₁₃₃ 0.5	A' ₁₃₃ 0.71	A'' ₁₃₃ 1.00						
		C ₂₁₂ Intuition	X ₂₁₂ 0.5												
		C ₂₂₂ Likes working with software x	X ₂₂₂ 0.8												
C ₃₁₂ Interacting		X ₃₁₂ 0.7													

Step 8				Step 9		Step 10	
A' ₁₁	0.78	A'' ₁₁	0.98	Impact	Utilisation	Use of statistical methods to approximate the model	
				0.75	0.9		
A' ₁₂	0.88	A'' ₁₂	0.93				
A' ₁₃	0.83	A'' ₁₃	0.96			Impact	Utilisation
						0.72	0.87

Indices using one of the resulted models

Impact	Utilisation
0.72	0.87