Project Control & Management

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Lecture 3

We will be discussing

1. Human resources capability modelling and measurement
2. Capability in teams

Result of 8 years, to date of research by SERG. It is continuing

Sources

- M. Shekarriz, et al (2015), paper on capability (print out of the paper distributed in class)
- E. Hosseini et al (2015), paper on team capability (print out of the paper distributed in class)

Definition of Capability

Capability is the ability of an individual to ***utilise*** a series of innate and acquired qualities and skills that lead to or impact on the fulfilment of a task.

Project Based Jobs

- Nearly 60% of the current UK employment opportunities are based on fixed term project-based contracts
- Project-based contracts traditionally recruit individuals or assemble teams for a particular task, project or programme of work.
- The members of these teams are employed on a short-term basis and are 'fit-for-purpose'.
- Members are characterised by being technology savvy and are able to work independently or contribute to larger physical or virtual teams.
- Research Projects, joint ventures, quick response teams for environmental/health disaster, aerospace, and healthcare organisations are good examples of this type of organisation.

Tasks for people and people for Tasks

- Person-job-fit literature
- Resource oriented project management literature
- Human Resource management literature
- Economics
- Work Complexity and capability literature

Different Disciplines Views - 1

- According to Barney (1999), major business decisions are based on the assessment of an organisation's capability.
- Sen (1985) takes the view that 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*".
- The psychoanalysts Jaque and Cason (1994) believe that an individual's capabilities can be assessed based on the complexity of the work they perform and levels of attainment achieved.
- From the Human Resource Management (HRM) standpoint, employee capabilities are evaluated on the basis of job descriptors and levels of fitness (Caplan, 1975; Carol, 1993).

Different Disciplines Views - 2

- The Industrial Engineers interpret capability as a **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 organisation.

- The engineering interpretation defines capability as the ability to deploy a resource for achieving an end result.

- Applied capability is to deploy the potential energy into work (completion of a task).

Our Method

- Task oriented challenges require individuals who possess innate qualities and skills (collectively referred to as their *resources*) and
- The individuals have the ability to ***utilise*** those resources effectively and efficiently.
- Innate resources play a role and have an ***impact*** on the fulfilment of assigned tasks;
- The appropriate ***utilisation*** of those resources ensures the completion of those tasks.
- The *Capability* of an individual in this context is the measure of the relative ***impact* and *utilisation* of resources** in completing a task or a series of tasks.

Indicators of Capability for Individual's

First step is to define the *Indicators of Capability Indicators. They* are:

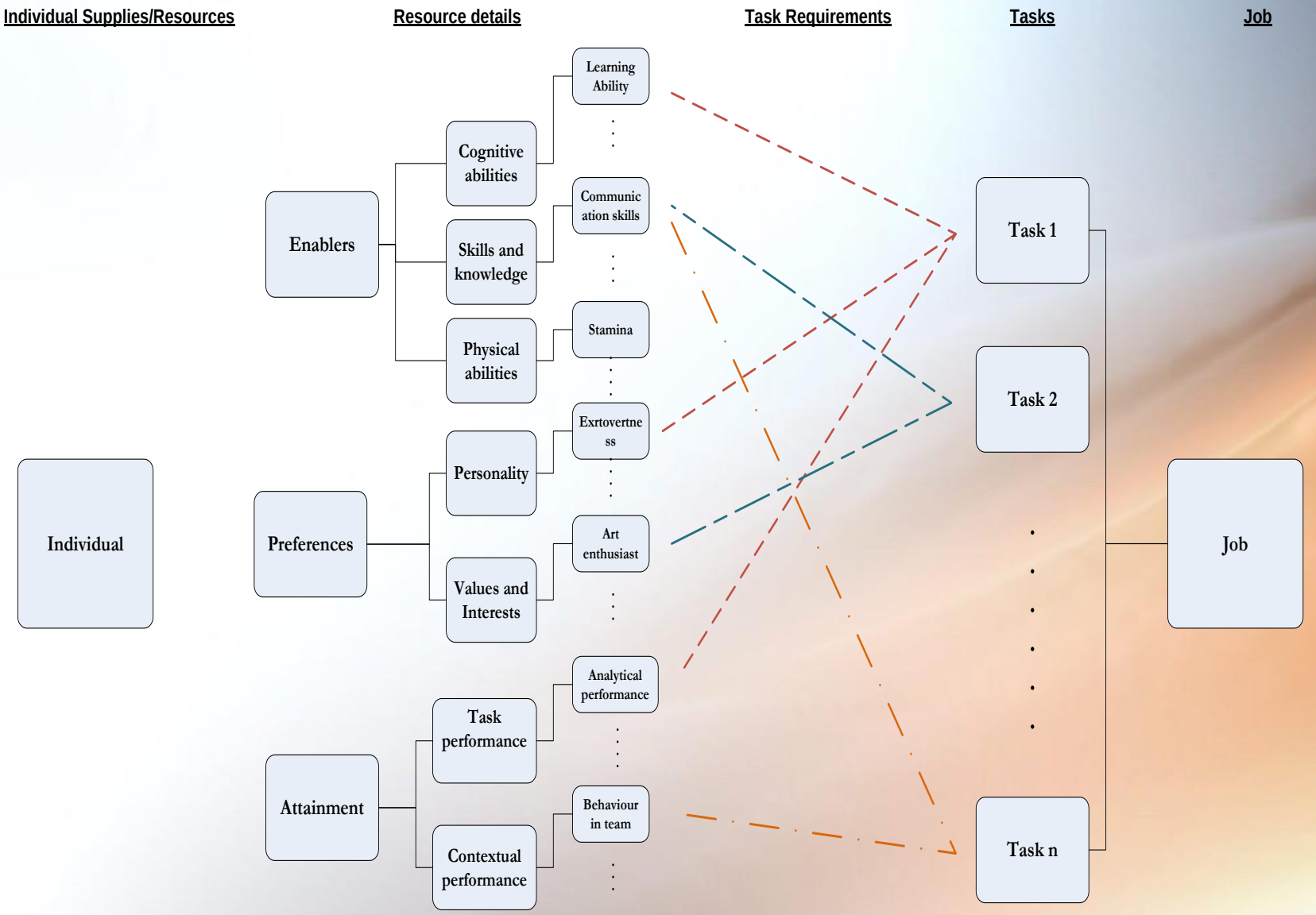
1. **The *Enablers (E):*** are the cognitive abilities and skills of the individuals (i.e. software, hardware, mathematical, technical,…).
2. **The *Preferences (P):*** are the personality traits (i.e. drivers, motivations, social/cultural ethics and values).
3. ***The past Attainments (A)*:** encompasses the past experience in similar roles (i.e. number of successful projects, innovations, working in teams, ...)

The EPA

The *Enablers, Preferences and Attainment (EPA)* are:

- Interpreted as a measure of an individual's innate or acquired *Resources that are* available for deployment in successfully performing a given task
- They act as the independent variables of the model.
- The information and levels of the independent variables are extracted from self and peer assessment (e.g. CV, formal and informal references from peers and supervisors).

The capability Relation Model



Capability of an Individual is expressed

The *Impact (I)* and *Utilisation (U)* of the resources belonging to an *Individual (M)* for *Job (K)* is a function of the

EPA.

$$(I, U)_{MK} = f(E, P, A) \qquad (1)$$

Figure 1: An example of using the algorithm in a simple job and candidate evaluation scenario.

		Task-Resource Matching				Weight		Individual Availability					
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									

Normalisation			Impact/Utilisation	Statistical Inference
A'_{11}	0.78	A''_{11} 0.98	Impact 0.75 / Utilisation 0.9	Use of statistical methods to approximate the model
A'_{12}	0.88	A''_{12} 0.93		
A'_{13}	0.83	A''_{13} 0.96		

Indices using one of the resulted models

Impact	Utilisation
0.72	0.87

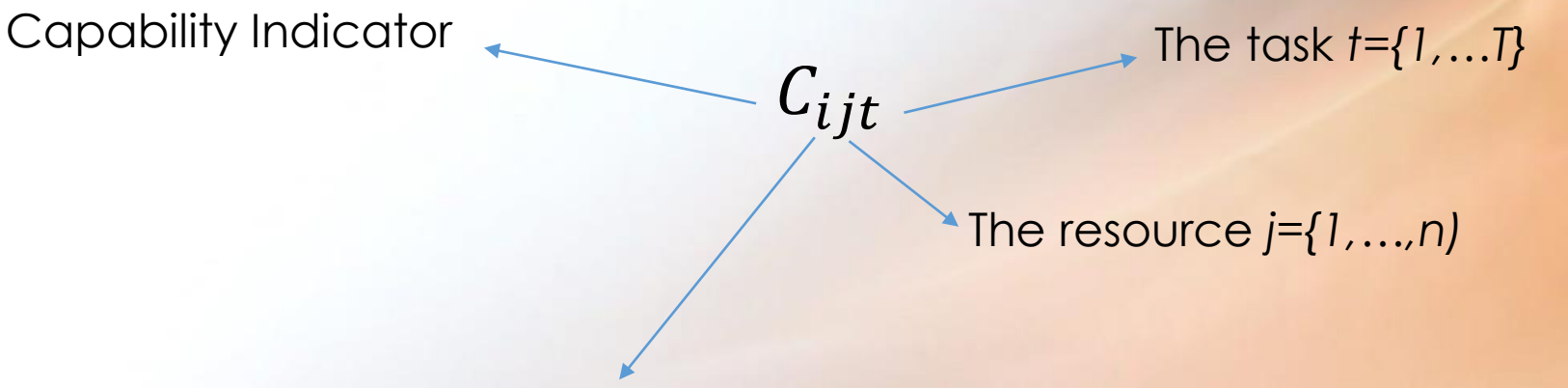
3 Activities consisting 10 Steps

1. Resource Allocation
2. Determine the levels of an Individual's Availability for a job – the Matching process
3. Determine the resource Impact and Utilisation indices

Activity 1 Resource Allocation

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

2. Match resources to the tasks:



Activity 1 Resource Allocation cont.

3. Determine the amount of resource required for the task:

$$X_{ijt} = (0,1)$$

Full capacity of resource *j is* required for task *t*

No resource *j* is required for task *t*

Continue with allocating resources to task until the capacity of resources reach full or all tasks are allocated with resources.

Activity 1 Resource Allocation contd.

4. Performing different tasks simultaneously using the same resource? If there is no other tasks that requires the specified resource, go to the next step; otherwise add the relative amount of resource required for the new task until the maximum level is reached.

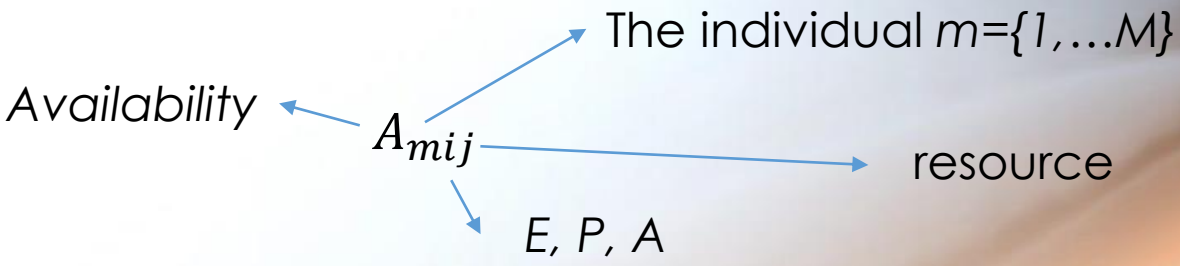
5. Do the resources have equal impact on fulfilling the task? If YES go to next step.

If resources have different weights allocate a weight for each:

$$\text{For } i=1,\ \sum_{j=1}^{e} W_{ij} = 1$$
$$\text{For } i=2,\ \sum_{j=1}^{p} W_{ij} = 1 \qquad (1)$$
$$\text{For } i=3,\ \sum_{j=1}^{a} W_{ij} = 1$$

Activity 2 – Availability of Individual to fulfil the task

6. An individual $M = 1, \ldots m$ may be not-available (busy), fully available (idle), or partially available (remaining capacity).



7. Normalise A_{mij} for each $\acute{X}_{ij}$ resource requirement in the set of remaining resources $\acute{C}_{ij}$, and name them A'_{mij} and A''_{mij}, where:

$$A'_{mij} = \frac{\min(A_{mij}, X'_{ij})}{X'_{ij}} \quad \text{and} \quad A''_{mij} = \frac{\min(A_{mij}, X'_{ij})}{A_{mij}} \quad \text{for } \forall\, i, j, k \quad (2)$$

$\acute{C}_{ij}$ = New list of required resources for the remaining tasks, $\acute{X}_{ij}$ = levels required

A'_{mij}= remaining capacity (availability) for the remaining tasks, and so …

Activity 2 – Availability of Individual to fulfil the task cont.

8. Calculate all A'_{mi} and A''_{mi} for ∀ all Ms.

For *i*=1 $A'_{m1} = \sum_{j=1}^{e} W_{1j} A'_{m1j}$ and $A''_{m1} = \sum_{j=1}^{e} W_{1j} A''_{m1j}$

For *i*=2 $A'_{m2} = \sum_{j=1}^{e} W_{2j} A'_{m2j}$ and $A''_{m2} = \sum_{j=1}^{e} W_{2j} A''_{m2j}$ (3)

For *i*=3 $A'_{m3} = \sum_{j=1}^{e} W_{3j} A'_{m3j}$ and $A''_{m3} = \sum_{j=1}^{e} W_{3j} A''_{m3j}$

Activity 3 – Resource Impact and Utilisation indices

The impact level of an individual on completion of task I_m can be measured by self-assessment or an assessment made by their supervisor. Where $0 \leq I_m \leq 1$.

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.

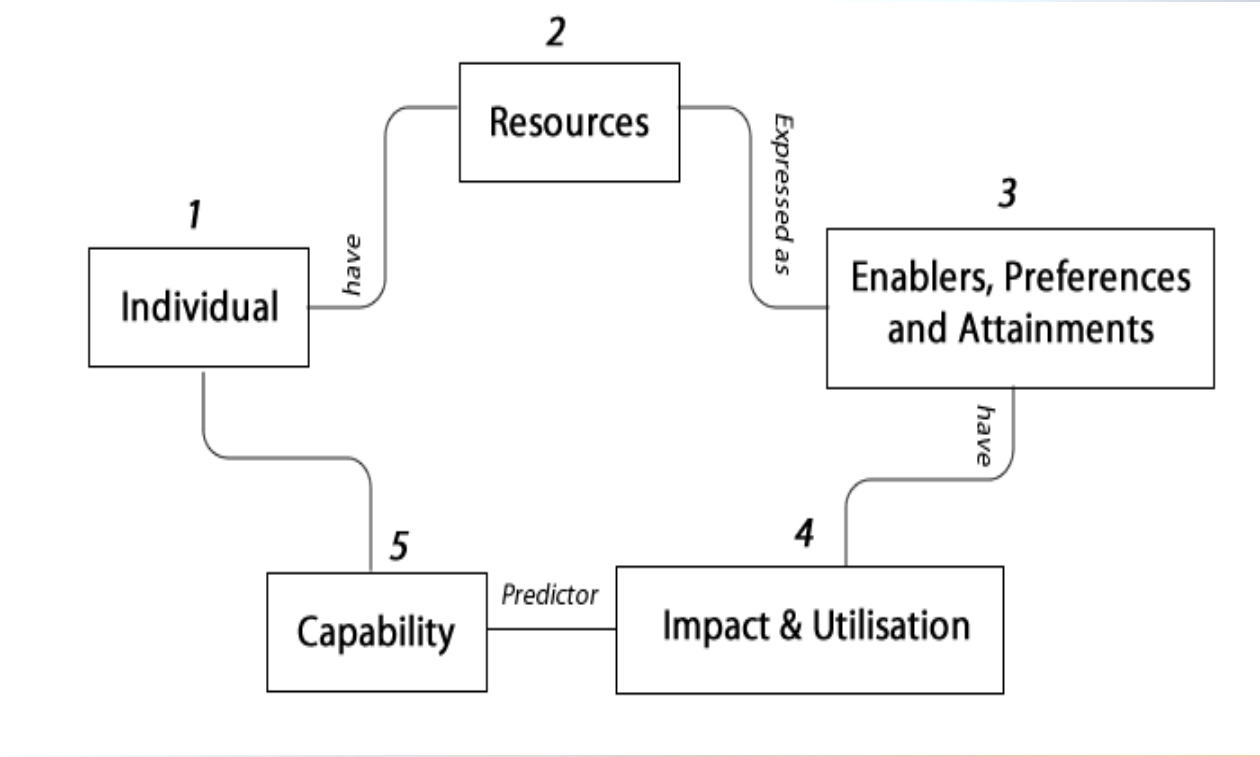
$$I_m = f(A'_{mi}) \quad (4)$$

The statistical inference model estimates the closest possible function *(f)* for estimating the Impact index.

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

$$U_m = f(A''_{mi}) \quad (5)$$

Summary of findings and key definitions for the proposed Capability Model



Impact & Utilisation (EPA)

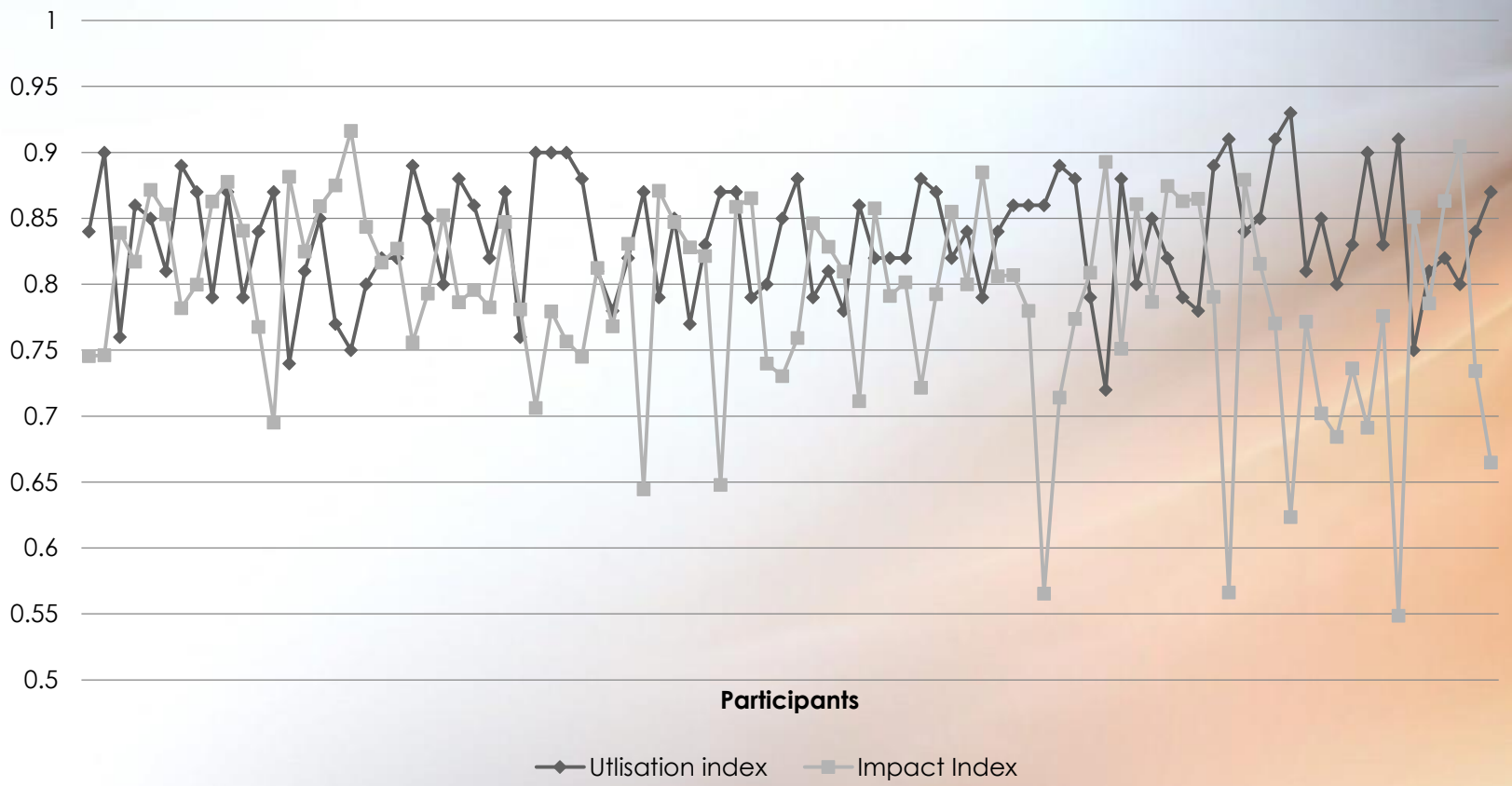
A linear model:

$$I = -0.326 + 0.234I_E + 0.436I_P + 0.585I_A \quad (6)$$

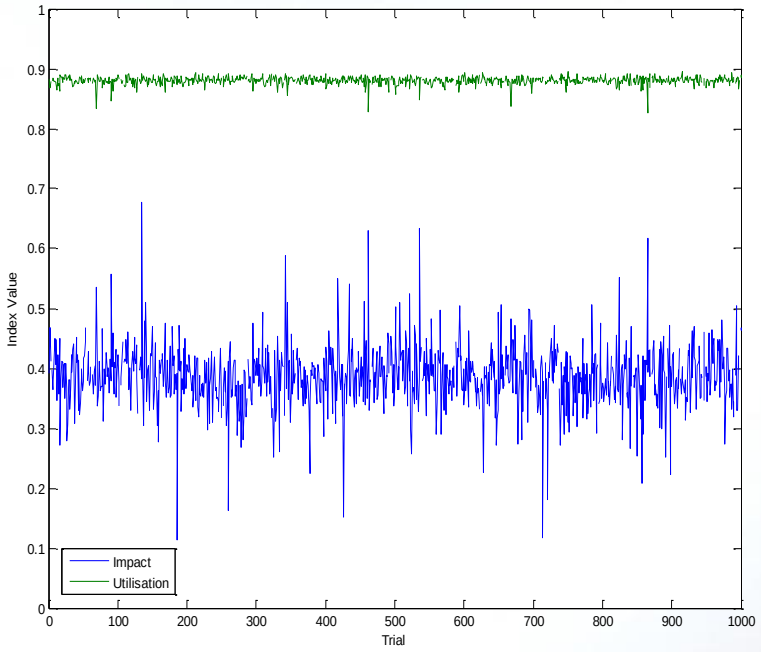
Using the Impact factors the Utilisation of resource "*I*" for individual *m* can be estimated as:

$$A''_{mi} = -0.326 + 0.234A''_E + 0.436A''_P + 0.585A''_A \quad (7)$$

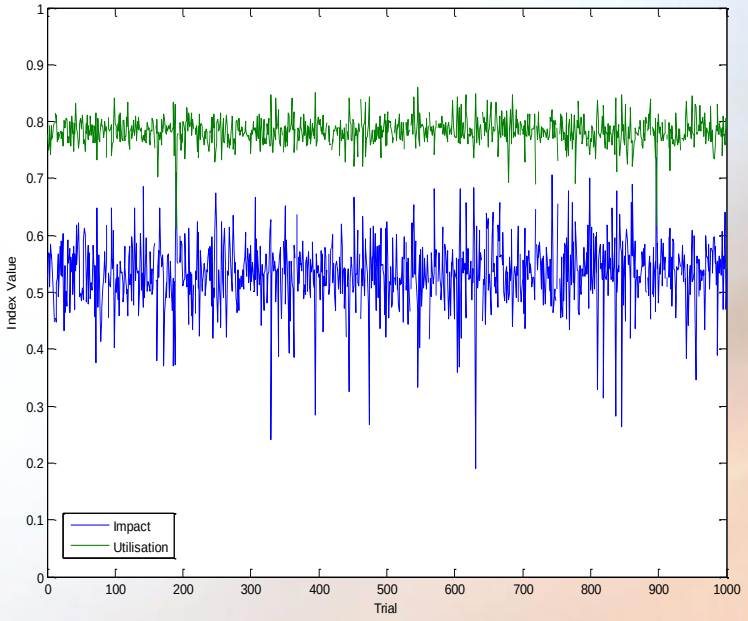
The predicted Impact and Utilisation values for all participants



The Impact and Utilisation levels resulted from the three experimental conditions



a



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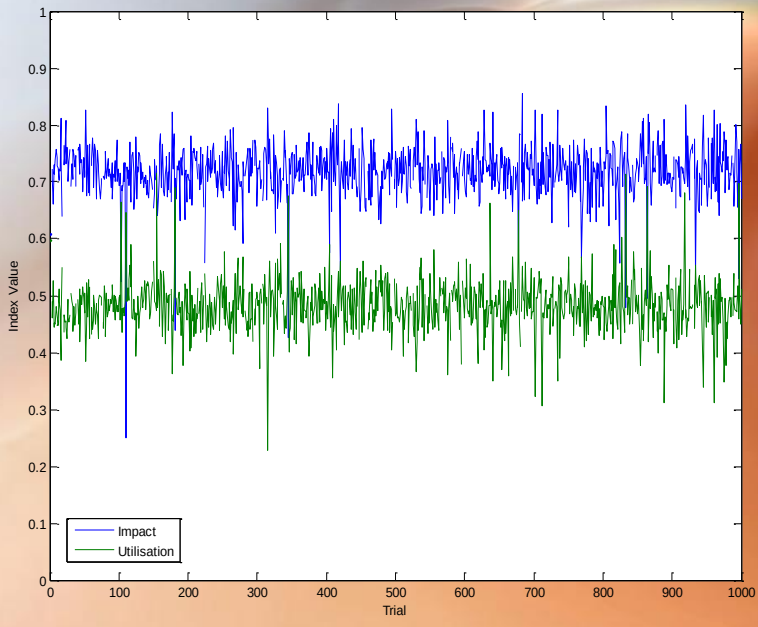

c

Team Collective Capability(just briefly)

1. Synergetic
2. Altruistic
3. Individualistic
4. Parasitic

Team Capability

The key findings by (Hosseini et al, 2015)is that collective capability is a functions of:

1. Demographic homophily of members of the team,
2. The diversity of skills that each member brings to the team,
3. The past experience or attainments of the members, and
4. The strength of relationship amongst the members of the team.

Linear Formula

- The Linear Predictor model of the collective capability suggested by this study:

$$CC = 0.207 + 0.204*H + 0.233*S + 0.109*A + 0.123*D1 \quad (8)$$

A statistical testing reveals that 84% of the variation in the dependent variable (Collective Capability) can be accounted for by the formula.

Further Reading

References mentioned in:

- M. Shekarriz, et al (2015), paper on capability (print out of the paper distributed in class)
- E. Hosseini et al (2015), PhD Thesis.