Forecasting for Social Good:

Relative performance of methods for forecasting the success of Large Capital Projects

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Abstract

Forecasting for Social good, most notably the socio-economic impact of major high-impact projects - like Olympic games or space exploration -is a very difficult but also extremely important task; not only for the resources allocated in such project but predominantly for the great expectations around them. This study evaluates the performances of Unaided Judgment (UJ), Structured Analogies (SA) and semi-Structured Analogies (s-SA) as well as Interaction Groups (IG) in forecasting the impact of such projects. The empirical evidence reveals that the use of s-SA Analogy leads to accuracy improvement compared to UJ. This improvement in accuracy is greater when introducing pooling of analogies through interaction in IG. A smaller scale experiment run to compare Delphi with IGs with inconclusive results.

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1. Introduction

Forecasting for social good entails by and large to be able to forecast the success, failure, and impact of one-off Special Events – most notably the initiation and implementation of Large Capital Project (LCPs). However forecasting the socio-economic impact of LCPs like Olympic games or space exploration is a very difficult but also extremely important task; not only for the resources allocated in such project but predominantly for the great expectations around them.

This study evaluates the performances of Unaided Judgment (UJ), Structured Analogies (SA) and semi-Structured Analogies (s-SA) as well as Interaction Groups (IG) in forecasting the impact of such projects.

The reason and motivation for the experimentation and evaluation of the relative performance of the aforementioned judgmental methods comes from two recent studies in the broader field of structured judgmental methods: Savio and Nikolopoulos (2013) evaluation of s-SA and Sa versus UJ for individual forecasters – in a very difficult forecasting problem; and Nikolopoulos et al (2015) where extend the scope of such endeavors via including groups judgmental forecasts with IGs and Delphi approaches.

By Bent Flyvbjerg, Garbuio, and Lovallo (2014) argue vividly of how difficultit is to forecast the success of LCPs. The claim that:

> *"Large capital investments that are completed on schedule and within their budgets are probably the exception rather than the rule—and even when completed many fail to meet expected revenues. Executives often blame project underperformance on foreseeable complexities and uncertainties having to do with the scope of and demand for the project, the technology or project location, or even stakeholder opposition. No doubt, all of these factors at one time or another contribute to cost overruns, benefit shortfalls, and delays."*

Turner and Zolin (2012) even claim that we cannot even properly define what success is – or what it will be when the LCPs target are materialized to some extent. They argue that we need to reliable scales in order to predict multiple perspectives by multiple stakeholders over multiple time frames – so definitely a very difficult long term problem. This could be done via a set of leading performance indicators that will enable managers of LCPs to forecast during project execution how various stakeholders will perceive success months or even years into the operation. LCPs have many stakeholders who have different objectives for the project, its output, and the business objectives they will deliver. The output of an LCP may have a lifetime that lasts for years, or even decades, and ultimate impacts that go beyond its immediate operation. How different stakeholders perceive success can change with time

Although the empirical evidence in this study was derived from an LCP context, the results may be generalized and applied to a variety of other project situations in which the proposed forecasting methods might be used to successfully forecast critical success factors of projects. In essence, the literature that favors the use of simple methods to forecast with information (Nikolopoulos, Goodwin, Patelis, & Assimakopoulos, 2007) was corroborated.

The rest of the paper is structured as follows. Section 2 surveys the relevant literature on. Section 3 explains the methodological approach employed in selecting the LCPs, methods, and evaluation metrics, as well as in choosing the experts and deciding their level of expertise. Section 4 presents the results, while the last section offers concluding remarks and roadmaps for future research.

2. Background Literature

The application of the simplicity principle to theories is sometimes defended as an application of Occam's Razor, that is, “accept the simplest theory that works” (Simon, 1979). Zellner (2007), a leading economist, believed that complicated problems could be solved by the application of a few powerful, simplifying concepts, which he called "sophisticated simplicity". These powerful and simplifying concepts have been implemented in a myriad of industries and services. Simplicity also plays an integral role in shaping decision-making heuristics. Gigerenzer (1996) argues that biases that stem from heuristics can be eliminated by utilizing particular methods in a suitable context. In our case this aforementioned methodological approach translates into using structured judgmental forecasting methods in a very complex and long term forecasting problem

2.1 Project, Project Management and Project Managers

There is a continuous discussion among researchers (Maylor, 2017), what kind of elements constitute a project, and, if project management is an academic discipline or is an area that practitioners mainly have to deal with it. Thus, on the project management literature front, *project is a given, plannable and unique task, limited in time, complex in its implementation and subject to evaluation,* Packendorff, 1995). For Harvard Business Review Staff (2016) a project is the entire process that needs to be followed, in order to solve a problem that has been identified and needs to be addressed. Nevertheless, Geraldi and Soderlund (2017) state that project management is a series of elements -processes, tools, techniques and concepts- in order to manage a project.

According to Pinto and Kharbanda (1995), Taveres (2002) and Krahn (2006) project management is a fast growing discipline with considerable impact to other fields as well. Munns and Bjeirmi's (1996) perception is as the achievement of a specific objective constitute the project when the series of activities and tasks to complete it, is the project management. Moreover, Bakar, A.H.A. et al. (2011), defined the projects as a series of activities that should be followed in order to reach a specific objective, which a company has set earlier. Alias (2014) add to this that the majority of the projects demand project management to some extend. Muller and Jugdev (2012) acknowledge the contribution of the three "giants" Pinto, Slevin and Prescott to the field of project management and their work as a dominant component to continuous development of the area.

Lister (2014) state that everyone is a project manager in a different extent even without realising this; people do have to deal with a number of projects in their everyday life – from having to finish a task, organizing a gathering and many more set duties. Furthermore, according to Carden and Ega (2008), the literature in the discipline is limited to the traditional areas of project management. Project management's roots could be found in the engineering field (Geraldi and Soderlund, 2017) that has changed in recent years; Maylor (2003:6) state: *"Recently the nature of project management has changed"*. Kwak and Anbari (2009) cite that project management has been expended in several areas and has been increasing the interest of diverse organisations and companies non-traditional project management areas have been arise in the discipline (Kezner, 2001; Carden and Egan, 2008).

2.2 The Development of Project Management PM

From Maylor's point of view, the development of project management can be broadly divided in three stages as follows:

Stage 1: Pre-1950s

The development of the project management (PM) as we see it today didn't exist earlier than the 1950s. Nevertheless, projects were undertaken before 1950s, but PM as a discipline wasn't generally accepted and there weren't defined methods (Maylor, 2017).

Stage 2: 1950s

During the 1950s, formal tools and techniques were developed to help manage large, complex projects that were uncertain or risky (Maylor, 2017).

Stage 3: 1990s

In the third stage – after 1990s – a new approach of project management emphasises on the strategic role of projects; particularly on the processes that the results of the project should meet the customer's satisfaction. The role of the project managers is evident in this stage as he is the key component between the objectives and the delivery of the project. *Project managers become project integrators* (Maylor, 2017).

Nevertheless, Carden and Egan (2008) analyse the articles that outline historical perspectives of project management and they identify four key periods:

The emergence period:

The emergence period is referred in the early of 1900s during which project management was established as an orderly work-related framework and was provided as a tactical and strategic approach to chart and implement projects Carden and Egan (2008). Furthermore, Packendorff (1995) stress that project management started as an organised, work-related approach in the early 1900s and the reason behind this was mainly the need to have a tool to plan and manage a project; Henry L. Gantt developed the Gantt chart in 1910.

The refinement period:

During the refinement period - the 1950s, project management became more theoretically and mathematically oriented, adding refined algorithms and project-planning techniques. For Packendorff (1995), during the same period – 1950s, it was the time when the project management entered a new era,.

The human resource period:

During, human resource period - in the 1960s, project management emphasise on the effectiveness of the individuals, the teams and the organisation on the process. According to Packendorff (1995), focus was given to the resources and managerial concerns in the context of organizational projects.

The performance period:

Lastly, Carden and Egan (2008) state that the performance period indicates the project management as known today. *Recently there is an increase focus on the dynamic contexts that are often technology driven and involve sophisticated support tools.* Even so, the project management discipline continues to grow and as Carden and Egan (2008) state that *this performance-oriented era remains a major focus as some of the focus shifted from humans as inputs and processors of projects to project outcomes.*

2.3 The Project Management Knowledge Base

In the Project Management area there are two main institutions that constitute the unique idea of Bodies of Knowledge; the APM and the PMI body. Both bodies' presence and input in the discipline is notable as they are allied with project management professional qualifications.

The Project Environment

Studies of communication in and around projects have generally concluded that project effectiveness is strongly correlated to the quantity of communication in the project organization and the quality of the communication with the project environment (Packendorff, 1995). However, Krahn (2006) support that there are several factors – such as the type of project being managed, the specific project's characteristics, the business environment, the characteristics of the team and many more – that influence and impact on the project environment.

Project manager

Project managers play a crucial role in all kinds of projects and influence projects' success (Jaloscka et al., 2014). Kerzner (2001), support that project manager's role is to mainly coordinate and to combine activities across multiple operations. Particular project manager's techniques for a successful project have been seen mainly in areas of planning and control time, cost and quality. (Pandya, 2014; Munns and Bjeirmi, 1996).

Since the very first periods of project management development Gaddis (1959) state that in the project leadership literature, it is acknowledged that the project manager's skills follows between corporate management and project specialists. The demanding business environment needs people to lead a project not just to manage it (Dubois, 2015) and as Eweje et al (2012) argue, successful project management involves powerful leadership. This latter demand brings a huge challenge for the organisations; they have to operate in a very complex and uncertain environment (Mason, 2007) and as Lloyd-Walker and Walker (2011) stress, it is vital for project leadership to adapt to the needs of the 21st century

Researchers (Badewi, 2016; Mir and Pinnington, 2014; Munns and Bjeirmi, 1996) agree that project success and project management success are two separate features and as such should be considered. Nevertheless, Kaiser et al. (2015) state that however, is allied to the final outcome of the project and very often, unsuccessful management reach a successful project and vice versa (Munns and Bjeirmi, 1996). Moreover, (Alias et al, 2014), argue that the project manager and the success of the project are closely linked with project manager as the most critical part to the project success.

2.4 Public Value: the ultimate criterion for the success of LCPs

The main goal of modern paradigms of public administration, such as Public Value Management, is to enhance public values through forces that do not rely solely on traditional reformative norms (Stoker, 2006). Thus, Public Value Management emphasizes the feasibility and value creation of individual actions. The core idea of adding value to the public domain by ensuring that policy objectives are met while improving the efficiency of the public policy process is consistent with the fundamental notion of this research (Pitts, 2007; Talbot, 2009). Public Value Management would effectively require any government to base its decisions on a priori forecasts of policy effectiveness, which is defined as the extent of change in the current situation in the direction of the policy target. Ex-ante evaluations of policy effectiveness typically involve a mixture of Impact Assessment and Cost Benefit Analysis.

IA may be performed by using a variety of different models (European Commission, 2009). The selection of a particular model is dependent on the availability of data in each particular case (De Gooijer & Hyndman, 2006; Savio & Nikolopoulos, 2009); IA is considered a rather costly and resource-extensive tool (Savio & Nikolopoulos, 2010, 2013).

Although CBA is a useful tool, it is limited because it only evaluates policies in terms of economic efficiency (Maas, 1966; Simpson & Walker, 1987). Both IA and CBA are tools that can be used after a specific policy implementation has been decided upon (Savio & Nikolopoulos, 2013). As a result, they are not used in the preliminary screening of alternative policy implementations, which leads to the space for simple and fast forecasting approaches that estimate the effectiveness of policies that may be implemented. Consequently, those forecasts might be used to select which alternative to implement, and then IA or CBA would be employed.

2.5 Forecasting

The standard benchmark of the Judgmental Forecasting approach is Unaided Judgment (Green & Armstrong, 2007a) in which individuals are not given guidance as to proper forecasting procedures. The unstructured employment of panels of experts (Savio & Nikolopoulos, 2010) has several limitations (Lee, Goodwin, Fildes, Nikolopoulos, & Lawrence, 2007), such as the inability of forecasters to recall analogous cases and the recollection of unusual or inappropriate past cases. Thus, the adoption of structured approaches is seen as a better way to overcome these limitations and fully capitalize on expert judgment (Green & Armstrong, 2007b).

The Delphi method (Rowe & Wright, 2001) is a multiple-round survey in which experts participate anonymously and provide their forecasts and feedback. At the end of each round, participants receive a report, including descriptive statistics of the forecasts provided. The Delphi method is completed after a predefined number of rounds or whenever a desired consensus level is reached. Generally, four key features tend to define a 'Delphi' a group procedure – anonymity, iteration, controlled feedback, and the statistical aggregation and presentation of group responses. Conversely, the Interaction Groups method suggests active interaction with a group of experts until a consensus forecast is reached through debate and discussion. A key driver in this method's success is the pooling of information. However, potential problems arise from group biases introduced by the face–to-face contact of the experts, such as the 'central tendency' and the 'dominant personalities' effects (Van de Ven & Delbecq, 1971).

Evidence of the forecasting potential of Interaction Groups is not consistent (Armstrong, 2006; Boje & Murnighan, 1982; Graefe & Armstrong, 2011). Moreover, group-based approaches incur extra costs resulting from multiple rounds in the Delphi setup or the need for meetings in the formulation of Interaction Groups. This fact renders these methods relatively more costly than other methods that group-based approaches are competing against.

3. Methodology

The LCP examined in this research is about space Exploration – the project tis sufficiently disguised so the experts cannot – and should not – identify it. The detail of the project description and the two experimental setups for UJ and s-SA are provided in detail in appendices 1 and 2. Table 1 presents the actual results of the LCP.

Table 1 here.

3.1 Experts

The authors would also like to thank for their feedback the attendants of sessions where earlier versions of this work have been presented. The authors would also like to thank the MBA (PGP) class of 2018 (Term 7 – Mohali campus) in the Indian School of Business www.isb.edu that attended the FCAS 187 elective course in "Forecasting Analytics" from 15-01-2018 to 14/02-2018 and participated in the respective experiments; all students had at least three years of industrial experience and full training in quantitative forecasting methods. In total, - from a class of 69 experienced and excellently educated students - 55 experts responded positively to the call and participated in the research. These experts were sourced from a wide variety of sectors, including academia, industry, financial services and consultancy firms, all however having south-east Asian origin, almost all of them raised in India.

No monetary but an in-kind incentive was provided to the participant for taking part in the experiment: that was a bonus grade of 0.5 in case students fell below 2.5 (with a maximum of 4.0) in their grade for the Forecasting analytics course- so more like a ‘safety net’ rather than bonus per se.

3.2 Methods

Four methods have been evaluated in this study; the first – Unaided Judgment – is the benchmark. The methods that were deployed included the following:

Group A - (53 experts from a pool of 69 students), Unaided Judgment (UJ): This method is a simple and quite popular Judgmental Forecasting approach. Experts are given no guidance except for a general description of the intended policies. The task lasted for 5 minutes

Group B - (45 experts from the same pool of 69 students), semi-Structured Analogies (s-SA): The Structured Analogies approach was proposed by Green and Armstrong (2007b) and is based on forecasting by analogy by exploiting the similarities of past events or experiences. These past events/situations have the same or similar characteristics as the problem to be forecasted and can be used as templates. These types of mental templates are the analogies. The experts are first asked to recall as many analogies as possible. Subsequently, they produce a quantitative similarity rating between each analogy and the problem to be forecasted and state the outcome of that analogy. The administrator uses the experts’ data to produce a final forecast. In this study, a slightly simpler version of the method, called semi-Structured Analogies (s-SA, Savio & Nikolopoulos, 2013) was implemented. In this approach, similarity ratings and outcomes are not used by the administrator to generate forecasts because the final forecasts are produced by the experts. The task lasted for 15 minutes

Group C - (6-7 experts per group - from the same pool of 69 students), 8 (eight) Interaction Group (IG): These groups met in a restaurant/cafeteria for an hour with their laptops and internet connection available. The entire process was supervised by an relatively inexperienced facilitator – the team captain. The meeting lasted three hours and was recorded. The first hour was spent with introductions and a light dinner. In the next two hours, the group forecasting exercise occurred, in which the experts were first given the questionnaires, then encouraged to recall analogies and their corresponding outcomes, and then to rate those analogies in terms of similarity. Finally, the experts were asked to select the most appropriate analogies to produce point forecasts as well as 90% prediction intervals. This process was first performed individually and was then followed by the group interaction in which experts repeated the process aloud and exchanged their information until a consensus group forecast was reached.

Group D - (6-7 experts experts - from the same pool of 69 students), one (1) Delphi group (D): This approach is a popular group Judgmental Forecasting method that includes multiple rounds of questionnaires administered to a group of experts. Although several variations of the method exist (Rowe & Wright, 1999, 2001), only two rounds were run in the current implementation – with a few hours in between them - to limit the process to one day (and to avoid having experts drop out). In the first round, the experts forecasted with SAt. Once the forecasts were collected, feedback was provided to the group in the form of an average forecast for the group, in addition to the maximum and minimum forecasts and the justifications for those extreme forecasts (in a short memo). In the second round, the participants could revise their forecasts in light of the initial feedback. The average of the second round of forecasts was used as the group forecast.

Participants' Expertise

The participants' expertise was rated based on the self-adminisered questionnaire provided with the SA method – see appendix 2. Table 2 demonstrates how the experts were allocated to each group.

Table 2 here.

Measuring Performance

Forecasting accuracy was measured through a [% success] metric of how often the correct answer was achieved from every group. In the future relative metrics will be used as well such as Mae, RAE and RMASE

4. Results

For the three questions presented in 3.1 (with the realized outcomes listed in Table 1), all errors for the experts' forecasts were calculated. For each of the methods and questions, the % success, the MAE, and the RAE. The results for each method will be presented separately; at the end of the section, a cross-comparison will be conducted and the results will be discussed in the subsequent section.

4.1 Unaided Judgment

The results for UJ (Group A) are presented in Table 3. For Q1 the success rate was: **22.64%.**

Table 3 here.

4.2 Semi-Structured Analogies

The results for s-SA are presented in Table 4. For Q1 the success rate was: **27.27%** so better by almost 5% in absolute terms and as an performance improvement in the range of 20%

Table 4 here.

Many experts recalled one to two analogies per policy, whereas others provided no analogies at all. Table 5 presents the average number of analogies recalled and the respective mean similarity rating.

Table 5 here.

4.3 Interaction Group (IG)

The results for IG are presented in Table 6. For Q1 the success rate was: **57.14%** so better by almost 30% in absolute terms and as a performance improvement in the range of 100%

Table 6 here.

4.4 The Delphi Method(D)

There is only one team provided results – promising but statistically insignificant and as such these are not presented here until we have a bigger sample to draw some more convincing insights.

4.5 Methods Comparison

The group forecasting techniques provided the most accurate forecasts especially IG.

Table 7 here.

5. Conclusions and Further Research

Forecasting LCPsSpecial Events is challenging. This study utilizes Space Exploration, one of the most challenging, multinational ad long-range LCP, in which available historical information is limited and the forecasting horizon is long. The results presented here might be generalized and applied to many other LCPs – however more research should be thrown towards that direction.

The empirical evidence reveals that the use of s-SA Analogy leads to accuracy improvement compared to UJ. This improvement in accuracy is greater when introducing pooling of analogies through interaction in IG. A smaller scale experiment run to compare Delphi with IGs with inconclusive results. The results also corroborate the stream of forecasting research in the presence of information cues.

Decision makers are expected to benefit by adopting these simple Judgmental Forecasting methods. Nevertheless, further experiments should be conducted to improve estimates of effect size and knowledge of how conditions and variations in the methods affect their relative accuracy in different contexts.

The preliminary empirical findings suggest that overall actual forecasting improvement might exceed 100%. These results are consistent with the previous body of literature; however, the exact effect size varies depending on the context of each study.

With the aforementioned results, it can be claimed that this study corroborates the existing body of evidence that supports the forecasting principles as maintained by J.S. Armstrong (2001a) at www.forprin.com and his respective book. In further detail, empirical evidence is provided in favor of the following source: www.forprin.com, “Armstrong_2001_Checklist –form.doc” or “Standardshort.pdf”), Armstrong, J. S. (2001b).

Principle 3.5: *Obtain information from similar (analogous) series or cases.*
Principle 6.3: *Use structured forecasting methods rather than unstructured.*
Principle 7.1: *Keep methods simple.*
Principle 8.3: *Ask experts to justify their forecasts.*
Principle 8.5: *Obtain forecasts from heterogeneous experts.*
Principle 12.2: *Use many approaches (or forecasters), preferably at least five.*
Principle 13.25: *Use multiple measures of accuracy.*
Principle 13.26: *Use out-of-sample (ex ante) error measures.*
Principle 14.1: *Estimate prediction intervals (PI).*

The results presented herein are based on small-sized samples of experts, a fact that might be an impediment for generalizing the findings. However, a sensitivity analysis and a fair amount of argumentation could be provided in order to give more confidence that the findings can be generalized. Furthermore, if the context of this case study was take into account, and how public LCPs are managed and more importantly a-priory forecasted in real life conditions, these results might provide valid insights into the performance of each forecasting method. Repetition in other case studies might help to prove the validity of the findings and provide a generalized output for the superiority of some these methods, especially the simpler ones, such as Structured Analogies.

As far as the future of such studies is concerned, the proposed approaches could also be tested in different contexts for smaller and bigger LCPs – however space exploration is one (if not the-) biggest ones -in order to gather further evidence that would allow for the full generalization of the results.

Moreover, an evaluation of other judgmental approaches, such as the Nominal Group Technique (Van de Ven & Delbecq, 1971), might be explored (Graefe & Armstrong, 2011). In addition, sampling more experts would offer the opportunity to test more treatments, such as IGs with UJ versus IGs with s-SA or to test SA, direct comparisons of IGs and Delphi and versus UJ/s-SA as well as versus SA as it was originally designed by Green and Armstrong (2007b).

Finally, the option to offer strong incentives to the participants/experts has not yet been tested – not to mention that who is an expert is a big question anyway - , and this feature has provided strong insights into similar studies in the past. Certainly more avenues could be pursued in this research domain, and it is hoped that this study will provide interest for future investigations.

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Table 1. Realized outcomes for the two Special Events.

LCP **Case**	**Question**	**Outcome**
LCP - Q1	Success rate of project.	80%
LCP - Q2	Boolean result 1.	Yes
LCP - Q3	Boolean result 2.	Yes

Table 3. Unaided Judgment (Group A).

Question	Expertise	MAE	RAE	Intervals Accuracy Rate	Standard Deviation
LCP - Q1	Low				
	High				
	ALL				
LCP - Q2	Low				
	High				
	ALL				
LCP - Q3	Low				
	High				
	ALL	21.9%	0.94	25.0%	0.23

Table 4. Semi-Structured Analogies (Group B).

Question	Expertise	MAE	RAE	Intervals Accuracy Rate	Standard Deviation
LCP - Q1	Low				
	High				
	ALL				
LCP - Q2	Low				
	High				
	ALL				
LCP - Q3	Low				
	High				
	ALL				

Table 5. Analogies produced in s-SA per level of expertise.

		s-SA	
	Level of Expertise	**Number of Analogies**	**Mean Similarity Rate of Analogies**
LCP 1	Low		
	High		

Table 7. IG group forecast vs. the average error of the individuals participating in this subgroup.

	IG				Individuals participating in IG			
Question	**AE**	**RAE**	**Intervals**	**Accuracy Rate**	**MAE**	**RAE**	**Intervals**	**Accuracy Rate**
LCP - Q1								
LCP - Q2								
LCP – Q3								

Table 8. Analogies recalled in IG.

	IG	
	Number of Analogies	**Mean Similarity Rate of Analogies**
LCP 1		

Table 9. Methods comparison (APE%).

	UJ (%)	**s-SA (%)**	**IG (%)**
LCP - Q1			
LCP - Q2			
LCP - Q3			
Mean MAPE			
Relative improvement (to UJ)	Benchmark		

** These numbers indicate the most accurate forecasts for the relevant questions*

Appendix 1. Large Project 1: Unaided Judgment (Group A).

Large Project 1 : Space Exploration

Description

A number of space probes left Earth for Planets in the past few years. One of the missions is estimated to cost £250m to £300m and it would become a European built probe on a spacecraft touching down on another planet. The aim is always simple - to find evidence of life, past or present, on another planet. The mission carries scientific instruments that will study the geology of planets and search for water under the surface. Research institutes throughout Europe have provided the instruments. A consortium of more than 20 companies from more than a dozen European countries and the USA built the spacecraft. The spacecraft will fly around the target planet for an entire planet year. Scientists are confident that if water is present on the Planet, the spacecraft with the probe will find it.

European scientists want the mission to:

a) map the composition of the surface at 100-m resolution
b) map the composition of the atmosphere and determine its global circulation
c) determine the structure of the sub-surface to a depth of a few kilometres
d) determine the effect of the atmosphere on the surface, and,
e) determine the interaction of the atmosphere with the solar wind

On landing, cameras on the probe's robotic arm will take close-up images of soil and rocks to look for interesting specimens. The samples will be analysed for chemical signs of life using a package of instruments on the probe.

The Launch

The spacecraft carrying the probe would be launched from earth and placed on the right trajectory for the interplanetary voyage. If all goes well, the journey would take a few months.

Judgmental Forecasting

We are interested in the following **Forecasts**:

1). To what extend do you think objectives a-e will be achieved?

a. 0% - 20% [ ]

b. 21% - 40% [ ]

c. 41% - 60% [ ]

d. 61% - 80% [ ]

e. 81% - 100% [ ]

2). Do you think water will be found?

Yes [ ]   No [ ]

3). Do you thing close-up images will be captured?

Yes [ ]   No [ ]

Appendix 2. Large Project 1**: S**tructured Analogies Judgment (Group B).

Large Project 1 : Space Exploration

Description

A number of space probes left Earth for Planets in the past few years. One of the missions is estimated to cost £250m to £300m and it would become a European built probe on a spacecraft touching down on another planet. The aim is always simple - to find evidence of life, past or present, on another planet. The mission carries scientific instruments that will study the geology of planets and search for water under the surface. Research institutes throughout Europe have provided the instruments. A consortium of more than 20 companies from more than a dozen European countries and the USA built the spacecraft. The spacecraft will fly around the target planet for an entire planet year. Scientists are confident that if water is present on the Planet, the spacecraft with the probe will find it.

European scientists want the mission to:

f) map the composition of the surface at 100-m resolution

g) map the composition of the atmosphere and determine its global circulation

h) determine the structure of the sub-surface to a depth of a few kilometres

i) determine the effect of the atmosphere on the surface, and,

j) determine the interaction of the atmosphere with the solar wind

On landing, cameras on the probe's robotic arm will take close-up images of soil and rocks to look for interesting specimens. The samples will be analysed for chemical signs of life using a package of instruments on the probe.

The Launch

The spacecraft carrying the probe would be launched from earth and placed on the right trajectory for the interplanetary voyage. If all goes well, the journey would take a few months.

Judgmental Forecasting

We are interested in the following **Forecasts**:

1). To what extend do you think objectives a-e will be achieved?

2). Do you think water will be found in?

3). Do you thing close-up images will be captured?

You are going to follow the process for **<u>Structures Analogies</u>** for producing your forecasts as in the **<u>following pages</u>**

Judgmental Forecasting with <u>Structured Analogies</u>

In the tables provided below, please describe any analogous project to the one described. Please include details on:

- the similarities and differences between your analogous project and the target projects.
- their source (e.g. your own experience, media reports, history, literature, etc.)
- a similarity rating between your analogous project and the target projects (0 = no similarity… 5 = similar… 10 = high similarity)
- the outcome of your analogous project (which of the outcomes a-e found at the bottom, is most similar, in terms of effectiveness, to the outcome of your analogy?).

<u>Example analogy</u>

Description	Landing to the Moon – Apollo mission
Similarities and differences	Similarities: same objective Differences: different budget available

Source __ <u>Media</u> __ Similarity rating __8__ OUTCOME:

Q1.To what extend think objectives have been achieved?

a. 0% - 20% [ ] b. 21% - 40% [ ] c. 41% - 60% [V]

d. 61% - 80% [ ] e. 81% - 100% [ ]

Q2. Was water found ?

Yes [ ] No [V]

Q3.Have close-up images been captured?

Yes [V] No [ ]

1. Your Analogies

Analogy 1

Description	
Similarities and differences	

Source _______________ Similarity rating _______ OUTCOME:

Q1.To what extend think objectives have been achieved?

a. 0% - 20% [ ] b. 21% - 40% [ ] c. 41% - 60% [ ]

d. 61% - 80% [ ] e. 81% - 100% [ ]

Q2. Was water found ?

Yes [ ] No [ ]

Q3.Have close-up images been captured?

Yes [] No [ ]

Analogy 2

Description	
Similarities and differences	

Source _______________ Similarity rating _______ OUTCOME:

Q1.To what extend think objectives have been achieved?

a. 0% - 20% [ ] b. 21% - 40% [ ] c. 41% - 60% [ ]

d. 61% - 80% [ ] e. 81% - 100% [ ]

Q2. Was water found ?

Yes [ ] No [ ]

Q3.Have close-up images been captured?

Yes [] No [ ]

Analogy 3

Description	
Similarities and differences	

Source ______________ Similarity rating ______ OUTCOME:

Q1.To what extend think objectives have been achieved?

a. 0% - 20% [ ] b. 21% - 40% [ ] c. 41% - 60% [ ]

d. 61% - 80% [ ] e. 81% - 100% [ ]

Q2. Was water found ?

Yes [ ] No [ ]

Q3.Have close-up images been captured?

Yes [] No [ ]

Analogy 4

Description	
Similarities and differences	

Source ______________ Similarity rating ______ OUTCOME:

Q1.To what extend think objectives have been achieved?

a. 0% - 20% [ ] b. 21% - 40% [ ] c. 41% - 60% [ ]

d. 61% - 80% [ ] e. 81% - 100% [ ]

Q2. Was water found ?

Yes [ ] No [ ]

Q3.Have close-up images been captured?

Yes [] No [ ]

if you need MORE analogies reprint this page

2. <u>Your OWN Forecast</u>

Q1.To what extend do you think objectives a-e will be achieved?

a. 0% - 20% [ ] b. 21% - 40% [ ] c. 41% - 60% [ ]

d. 61% - 80% [ ] e. 81% - 100% [ ]

Q2. Do you think water will be found in?

Yes [ ]   No [ ]

Q3.Do you thing close-up images will be captured?

Yes []   No [ ]

How **confident** you are about your Forecast in

Q1[   ]%,

Q2 [   ]% and,

Q3[   ]%?

3. Questionnaire

(1) Roughly, how long did you spend on this task?

{include the time spent reading the description and instructions} [__] mins.

(2) How likely is it that taking more time would change your forecast?

{0 = almost no chance (1/100) … 10 = practically certain (99/100)} [__] 0-10.

(3) If you knew that this case was from the UK, how likely would you be to change your forecast?

{0 = almost no chance (1/100) … 10 = practically certain (99/100)} [__] 0-10.

(4) How many people did you discuss this forecasting problem with? [__] people.

(5) Roughly, how many years experience do you have working in a project management (PM) issues setting?

[__] years.

(6) Roughly, please rate (out of 10)

- your experience with project management (PM). [___] 0-10

- your experience with projects similar to this one. [___] 0-10

- your suitability for predicting the success of major projects. [___] 0-10

(7) If you were contracted to produce such a forecast what process/process would you adopt?

[___ ____] In what sort of time-scale?

[___]

Authors

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