Megaproject

Managing Stakeholders in Megaprojects
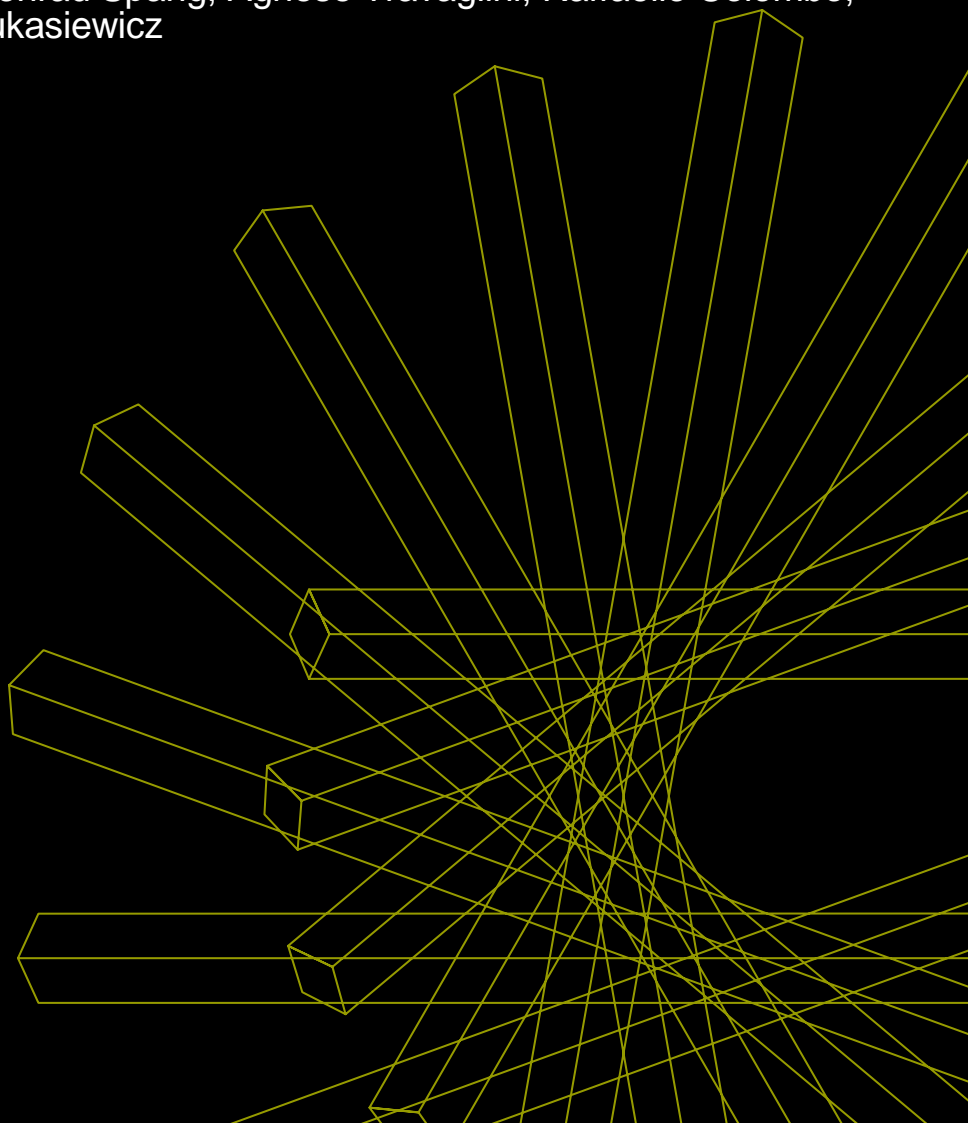
The MS Working Group Report

Edited by: Paul Littau

Authors:
Paul Littau,Ivana Burcar Dunović,Louis-Francois Pau, Mauro Mancini, Ana Irimia Di-eguez, Carmen Medina-Lopez, Konrad Spang, Agnese Travaglini, Raffaello Colombo, Maja-Marija Nahod, Agnieszka Lukasiewicz

cost
EUROPEAN COOPERATION
IN SCIENCE AND TECHNOLOGY

COST – European Cooperation in Science and Technology is an intergovernmental framework aimed at facilitating the collaboration and networking of scientists and researchers at European level. It was established in 1971 by 19 member countries and currently includes 35 member countries across Europe, and Israel as a cooperating state.

COST funds pan-European, bottom-up networks of scientists and researchers across all science and technology fields. These networks, called 'COST Actions', promote international coordination of nationally-funded research.

By fostering the networking of researchers at an international level, COST enables break-through scientific developments leading to new concepts and products, thereby contributing to strengthening Europe's research and innovation capacities.

COST's mission focuses in particular on:

+ Building capacity by connecting high quality scientific communities throughout Europe and worldwide;
+ Providing networking opportunities for early career investigators;
+ Increasing the impact of research on policy makers, regulatory bodies and national decision makers as well as the private sector.

Through its inclusiveness, COST supports the integration of research communities, leverages national research investments and addresses issues of global relevance.

- Every year thousands of European scientists benefit from being involved in COST Actions, allowing the pooling of national research funding to achieve common goals.

As a precursor of advanced multidisciplinary research, COST anticipates and complements the activities of EU Framework Programmes, constituting a "bridge" towards the scientific communities of emerging countries. In particular, COST Actions are also open to participation by non-European scientists coming from neighbour countries (for example Albania, Algeria, Armenia, Azerbaijan, Belarus, Egypt, Georgia, Jordan, Lebanon, Libya, Moldova, Montenegro, Morocco, the Palestinian Authority, Russia, Syria, Tunisia and Ukraine) and from a number of international partner countries. COST's budget for networking activities has traditionally been provided by successive EU RTD Framework Programmes. COST is currently executed by the European Science Foundation (ESF) through the COST Office on a mandate by the European Commission, and the framework is governed by a Committee of Senior Officials (CSO) representing all its 35 member countries.

More information about COST is available at www.cost.eu

Content

Managing Stakeholders

Aim & Background of the Working Group

Stakeholder management (SM) in megaprojects was established as one of four working groups within the Megaproject COST-Action. The critical importance of stakeholder management in megaprojects was identified in the first phase of the COST-Action's research by case studies. It was obvious that stakeholder have huge impact on the performance of megaprojects.

Thus, this working group started with the focus on this specific aspect of megaproject management. Thereby, the focus was aligned with the overall aim of the COST-Action:

> *"…to understand **how** megaprojects can be designed and delivered more **effectively** to ensure their effective commissioning within Europe. Effective design and delivery means not only insuring that the megaproject is delivered **on-time** and **to budget** but that it **satisfies the societal and commercial needs** that motivated its creation and that it continues to do so **throughout its entire life-cycle**"*

Thus, two guiding questions were developed for this working group:

1. What are the problems that occur with stakeholders in megaprojects?
2. How to manage those problems and stakeholders?

To answer these questions different methods have been applied – all based on a case study approach which was the data foundation of this COST-Action. The methods applied and the results reached will be presented in this report in the following pages.

There were various ways possible to the group to choose of how to work together: group meetings, "small" meetings, short term scientific missions (STSMs), conferences, student projects, etc.!

Research Methods

The Interdepence between the different methods

To address the research question properly, different methods have been applied to cover different aspects of the problem. A general approach was developed and contained two methodological ways in order to understand how stakeholders impact megaproject performance. The first methodology way focused to uncover how project context und culture influence stakeholders' behavior whereas the second addressed stakeholder interactions and thus used network analysis. Furthermore, a framework was needed to measure stakeholder impact on megaproject performance.

The **Figure 1** explains the connection between the clustering of stakeholders according cultural context, stakeholder network analysis and megaproject impact. This is in line with the more detailed framework presented in **Figure 2**.
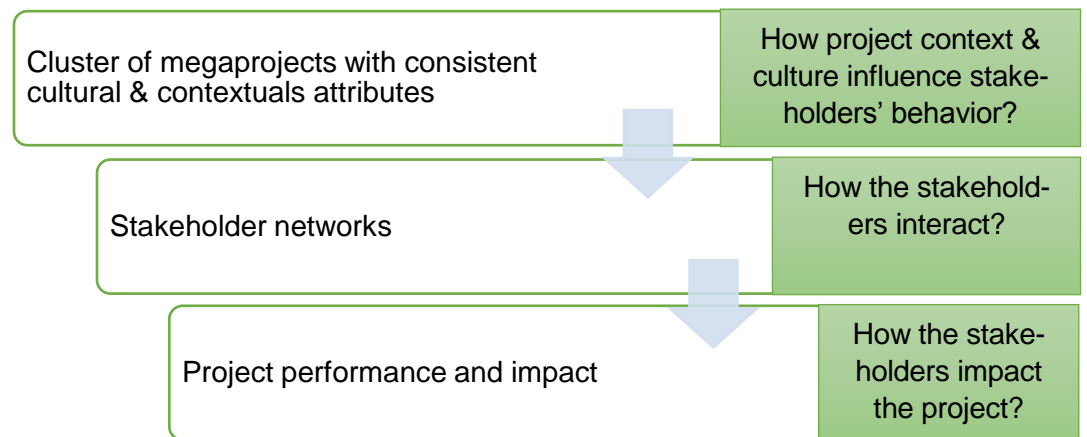
Figure 1: The methodological approach used in this research.

Clustering of stakeholders according cultural context

Methodology (Pau, L-F, Njaa, O., Langeland, A., 2014)

Departing from traditional project management, this work focuses on cultural and localized differences and influences on a specific project activity, and furthermore on the specific influences on large important critical projects (also called "megaprojects"). It analyzes relevant methodologies, theories and results from other disciplines such as micro-behaviors influenced by local cultures, socio-cultural theories, cultural synergy processes and hybrid institutions, physioeconomics as well as different practices in contracting. It is shown that the very definitions of the concept of "megaproject" are diverse in the world, and details are given. A scaled gap analysis

tool is proposed, rooted in the above theories and results, aiming at identifying cultural differences between megaprojects from a set of qualitative measures. To further allow for causal analysis, a set of cultural impact measures is proposed, and the same sample of international megaprojects is assessed correspondingly.

Taking thereafter the viewpoint of characterizing a given regional culture, it is shown that Scandinavian project management practices evidence a specific combination of cultural influence measures relying on hybrid governance and communications, unique work culture and tools, as well as an approach to adaptation.

The conclusions shows that, despite the fact that, to apprehend cultural factors in general is a very complex endeavor; the limited set of cultural influence measures identified in this research allows to characterize cultural impact on megaprojects. Megaprojects can be clustered or contrasted by cultural influences, by management styles, thus serving concrete needs in megaproject management.

Data Analysis (Pau, L-F, 2014a)

The general tool mentioned above, with its specific megaproject cultural attributes, has allowed to analyze a sample of 18 documented international megaprojects on 5 continents. It is very important to point out that for 15 of these projects, their respective project management heads were the one's grading the cultural gap attribute values as well as the qualitative project outcome values. This data acquisition was carried out in a separate project from the COST Action Megaprojects.

Three Megaprojects (out of 18) had data collected inside the WG. The taxonomy of the cultural attributes and causal impacts allows to group the megaprojects by clusters of similar culturally driven management styles, irrespective of implementation countries.

Cluster analysis refers to a diversity of algorithms which allow to group together samples characterized by N vector attributes, and possibly to determine a reduced space of dimension $M<N$ preserving most of their mutual properties. In supervised cluster analysis, a separate sample set from the same population with known group assignments is used. When such prior categorizations are not known, only unsupervised cluster analysis can be used, relying on metric, statistical and/or semantic similarity measures between samples.

As the megaprojects have not yet any prior categorization, only unsupervised cluster analysis can be used. The similarity measures are however totally independent from the population distribution. But, the choice of similarity measure may affect the clustering outcomes, and small-sample effects apply. By choosing as attribute vector only the cultural gap attributes, or the cultural gap attributes AND impact attributes, one can group megaprojects by contextual aspects only, or by contextual aspects and project impact.

The algorithms which have been tested on the cultural attributes include: simple k-means clustering, extreme value analysis from centroid distances, decision tree inference by PART, MakeDensityBasedClusterer, LVQ, Hierarchical clusterer, and principal components analysis.

The characterization of cultural factors affecting the 16 megaprojects provides a sharp divide into two groups linked to governance styles inside the projects in response to external factors. The groupings are not country or sector dependent. More refined interpretations can be derived from projection of megaprojects onto principal axis; five combined attributes only can explain over 50 % of the differences in cultural aspects and outcome. Only one cultural attribute (style of execution and control of a megaproject) shows some cross-correlation with three other cultural attributes.

- **Cluster I** : 4 megaprojects
  (Torrevaldaglia, Hardanger, Rogfast, Ryfast)

- **Cluster II:** 14 megaprojects
  (Victoria, Daocheng, Nuremberg, ARJ21, Metroselskabet, Ringsted, Anholt, Oeresund, Celtel, Yme, Taipeh, Sevilla, Apple, Hudson)

In Table 1 an overview of the 15 other megaprojects is given which were analyzed by another group than the stakeholder working group but has been build upon in this research.

	Megaproject	Country	Sector
1.	Victoria	Australia	Civil engineering
2.	Daocheng Yading Airport	China	Transport
3.	ARJ21 C919 COMAC Aircraft	China	Aerospace
4.	Metroselskabet Copenhagen	Denmark	Transport
5.	Copenhagen Ringsted rail connection	Denmark	Transport
6.	Anholt Offshore Wind farm	Denmark	Energy
7.	Oresunds bridge	Denmark/Sweden	Civil Engineering
8.	Celtel / Zain Group	East Africa	Telecommunication
9.	Yme	Norway	Offshore oil
10.	Hardanger Bridge	Norway	Civil engineering
11.	ROGFAST tunnel	Norway	Civil engineering
12.	RYFAST tunnel	Norway	Civil engineering
13	Taipeh 101	Taiwan	Construction
14.	Apple Headquarters	USA	Construction
15.	Hudson Yards	USA	Construction

Table 1: Overview of megaprojects analyzed (Pau, L-F, Njaa, O., Langeland, A., 2014)

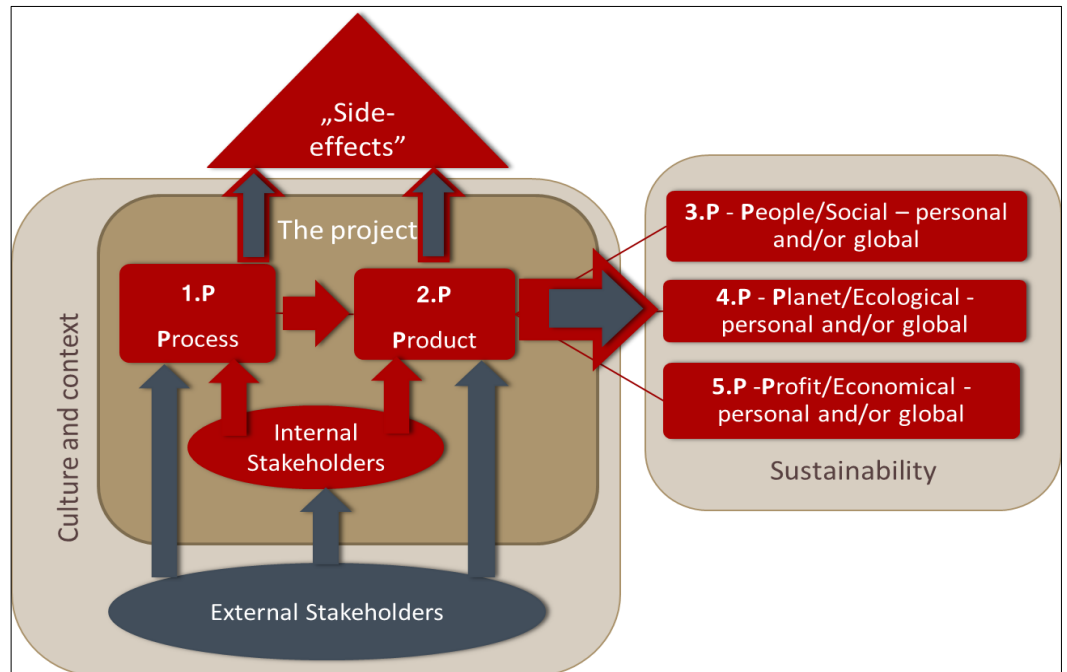### Stakeholder Impact and performance measurement framework

Starting from a research framework which will be explained in the following, a questionnaire was developed to conduct the case studies. Four European megaprojects were selected and interviews were conducted by direct contact to project managers of the respective megaprojects. Based on the widely accepted multi case study approach (Yin, R., 2003), the comparison of such data is highly relevant and reliable. Though, the data is based only on four cases, it represents 52 stakeholders and thus is a good number to draw some conclusions. Furthermore, four cases are recognized as the minimum in multi case study research (Eisenhardt, 1995). Thus, this approach allows identifying attributes of 52 stakeholders in four different megaproject settings.

The framework for this research was inspired by two facts and influenced from literature on construction projects: Achieving sustainability-related targets in (construction) projects is increasingly becoming a key performance driver (Bal et al., 2013). Gibson's thesis is that sustainability concerns should be embedded in stakeholder theory rather than being treated as a marginal issue (Gibson, 2012). Sustainability assessment process, if appropriately designed could be the ideal process through which the benefits of stakeholder engagement within a project can be maximized and the sustainability agenda be pursued (Mathur et al., 2008).

Based on previous analysis, the most appropriate sustainability model for megaproject analysis is the 5P model. It enables to capture interest and impact together. Stakeholders by definition have interest in project. It is our proposition that their interest in megaproject must be measured using sustainability measures. Their impact, on the other hand, have broader spectrum, and for that we need 5P model.

5P model is suitable to separate internal and external impact on stakeholders. Internal impact is considered to be process and product, and external are social, ecological and economical aspect of megaproject. To understand how stakeholders are influencing the megaproject we need to know how their actions were with respect to project and how their influence affected the project. The first part is analysed through the first and second P (process and product), their interest is measured by "the triple bottom P's" and impact are measured with two sets of measures: the "iron triangle" (budget, time, scope) named as "side effects" and the "the triple bottom P's". When stakeholder interests were analysed, the hypothesis was made that each of them can have personal and/or global interest in project.

Figure 2: Stakeholder impact on Megaproject performance and sustainability.

Based on this understanding, the framework (Figure 2) and the following questionnaire was developed for data gathering. For this research data was collected by direct interviews with project managers. They were asked to:

1. Identify stakeholders, their role and type, internal or external,
2. Rate different type of stakeholder POWER as the ability to change the process: political, legal, social and business, and GRADE OF INTEREST as willingness to engage and ATTITUDE towards the project
3. Assess the type and rate the level of interactions/relationships between the stakeholders
4. For each identified stakeholder state (in words) and rate their INTEREST in the project with respect to 3P sustainability
5. For each identified stakeholder rate their IMPACT on project
6. For each identified stakeholder explain in words how they IMPACTED the project
7. Stakeholder involvement: When was stakeholder management strategy developed? When was consensus with stakeholder reached? When were external stakeholder's representatives involved in regular meetings? Is public consultations part of legal framework? Is public consultations part of good practice?

Four European megaprojects used for case study analysis

The data gathered for this research was gained from four European megaprojects that will be described shortly. The data was primary data gained by interviews led by working group members or information that is based on well researched secondary data and from personal involvement with the megaproject.

Nuremberg – Ingolstadt High Speed Railway, Germany

The High Speed Railway from Nuremberg to Ingolstadt is a new stretch of track in southern Germany (Bavaria). The track has a total length of 171 kilometers and was finished in the year 2006 with a total cost amount of 3'573 Mio. €. The planned costs for the project were 1'200 Mio. € in the year 1985, which means a cost increase of about 80%. The project was planned by the DB Projekt Bau which is subsidiary company of the Deutsche Bahn AG. The DB Projekt Bau divided the project in five sections and each section had its own general contractor. With the start of the plan approval procedure several stakeholders were involved in the project. Therefore the project management had an employee for public relations. This employee was responsible to inform the public and the press about the project. However, there were some discrepancies in the course of the process with stakeholders. For example the Nature and Biodiversity Conservation Union of Germany. They launched legal action against the project to stop the realization of the track but the complaint was rejected and the project was realized.

Zagreb on the Sava River, Croatia

Project "Zagreb on the Sava River" is a multifunctional program of regulation, protection and utilization of river Sava from Slovenian border to the town of Sisak. The experts have been dealing with the regulation of Sava river for some decades now. It all started with a big flood in Zagreb in 1964. Several concepts have been made throughout the years. They were all multifunctional, including power plants, trying to resolve flood protection problems. Probably one of the reasons why neither one of the concepts were even begun with construction is the fact that there wasn't a management model which would gather, coordinate and manage all Program stakeholders. In 2012 the new company was established as a subsidiary of HEP Group (Croatian Energy Utility Company) to manage the project. Project manager, made a model that puts together stakeholders at one side, and expert council as verification body on the other side connecting them through the operational team. Zagreb on the Sava River is a long-term sustainable solution to the problems related to the Sava River and the hinterland area of the Slovenian border to Sisak, and the project benefits are the environmental, social and economic. Potentials and benefits of the project will be realized in water management, transportation, energy and space and will enable long-term sustainable development of the area. From the WBIF Program the Project management company received a grant funds in the form of Feasibility, Environmental and Social Impact Study. It will evaluate three different solutions/concepts and will select the most acceptable one. Current budget estimation is 1,4 billion euro and project time completion of 15 years.

Torrevaldaliga Nord Power Plant, Italy

Torrevaldaliga Nord is a coal power plant running since August 2010 by Enel S.p.a., the Italian energy utility company. The project regarded the conversion from oil to coal of the former power plant located in Civitavecchia, 6 km far from Rome in the center of Italy to increase production yield and efficiency (now up to 45%, one of the highest in the world) to reduce the final energy price for users, to diversify the Italian energy mix, actually depending upon oil and gas sourced by risky areas and to reduce environmental impacts. The project included the dismantling of the previous plant and the building of the new one based on the new Clean Coal technology, including ultra-supercritical boilers, steam turbines, filters, control systems and two docks on the coast in front of the plant for coal supply and by-products dismantling. Enel started the authorization process in April 2002 and the EIA process started. Final authorization was finally provided on December 2003 but only for 3 of the 4 initial plant sections required, reducing the plant capacity to 1,980 MW (compared to the initial 2,640 MW). Production activities were initially planned to start in 2004 and end in 2008 with an initial budget of € 1,5 billions, but due to problems with local governments, which halted the docks construction activities requiring a new specific EIA, and other oppositions by local communities and environmentalists opposed to the conversion, the operation phase just started on August 2010 with a total cost of € 2 billions.

SEVILLE METRO LINE, SPAIN

Seville metro line is one of the world's most advanced subway railway network, equipped with platform screen doors and a ticketing system based solely on smart-cards. The project scope included the construction of 22 stations, 18 km of railway connecting Ciudad Expo and Olivar de Quintos and 17 trains, provided by CAF, able to reach a speed of 70 km/h and equipped with automatic train operation. The construction initially started in 1974 but after few tunnels construction it was halted due to fears about historical buildings damages and questionable population raise forecasts. The project was reopened in 1999 and the construction formally started in 2003 with the foundation of the Metro de Sevilla Sociedad Concesionaria de la Junta de Andalucía S.A., with an initial budget of about € 0.36 billions and an planned completion in 2006. Incurring in construction problems as ground water and coarse gravel the project was partially inaugurated on April 2009 reporting an overall cost of about € 0.658 billions (81 per cent overbudget. The Puerta Jerez station was completed only in September for repairing due to a ground collapse, while the final trait between Condequinto and Oliver de Quintos was opened on November 2009. Lines 2, 3 and 4 are still under construction since 2010 and are planned to finish in 2017.

These four cases were analysed and 52 stakeholders were identified within. These stakeholders were classified according to Winch's stakeholder classification framework (Winch, 2002).

Stakeholder Classification (Winch's Framwork, 2000)			Number of Stakeholders
Internal	Demand Side	Client	9
		Financiers	13
		Client's Employees	
		Client's Customer	2
		Client's Tenants	3
		Client's Suppliers	3
	Supply Side	Architects	
		Engineers	
		Principal contractors	2
		Trade contractors	8
		Materials	
		Supplier	7
External	Private	Local residents	3
		Local landowners	
		Environmentalists	2
		Conservationists	
		Archeologists	
		Other external stakeholder categories (private)	
		Professional Associations (e.g. NGOs)	1
		Interested Parties	2
		Media	2
	Public	Regulatory agiencies	6
		Local government	9
		National government	4
		Public Agencies	2

Table 2: Stakeholders classified according to Winch's Framework (Winch, 2002)

Stakeholder Impact and performance measurement analysis

In a STSM an analysis was conducted aiming at providing a preliminary understanding of how stakeholders impact megaprojects. The framework on stakeholder impact and megaproject performance was applied and provided insight from four cases within 52 stakeholders were analyzed.

Impact types were distinguished and stakeholders classified according to their impact type. Thus, a valuable framework is developed not only according power, interest and attitude, as in classical literature (e.g. Mitchel et al., 1997), but according to impact types and impact level. This is a valuable and important contribution to the theory and practice on stakeholder management.

After all the considerations that needed to be taken into account, a new framework for classifying stakeholder categories on the basis of their real impacts on the

projects is proposed, to highlight the key players having impacts and deserving proper attentions.

The new framework consists of a three dimensional matrix, or a cube, in which each dimension is one of the three impact dimensions. Based on this cube, eight stakeholder classes may be identified as follows (**Table 1**):

		Impact on PM-Success	Impact on Project Execution	Impact on 3P
1. Total Impact	above avarage	x	x	x
	below avarage			
2. PM / PE Impact	above avarage	x	x	
	below avarage			x
3. PM / 3P Impact	above avarage	x		x
	below avarage		x	
4. PE / 3P Impact	above avarage		x	x
	below avarage	x		
5. PM Impact	above avarage	x		
	below avarage		x	x
6. PE Impact	above avarage		x	
	below avarage	x		x
7. 3P Impact	above avarage			x
	below avarage	x	x	
8. Little Impact	above avarage			
	below avarage	x	x	x

Table 3: Framework to classify stakeholders according to their type of impact.

This new framework can be used as an additional way to cluster stakeholders when conducting stakeholder analysis.

In a follow-up STSM the number of stakeholders was significantly increased as then 20 megaproject cases could be analyzed. Thus, the objective was to analyze and re-elaborate the information gathered in the 20 case studies of the Megaproject Portfolio. It was analyzed the attitude, the influence, the impact on project and the impact on external stakeholders, influence on project performance, stakeholder satisfaction and change of interest.

As a result, the national government, the European government, the local government and environmentalists play an important role when one aims to manage stakeholders in megaproject successfully.

Stakeholder network analysis (SNA) and dynamics

A further development of the network analysis approach was the dimension of dynamics. This discussion led to considerations of related methodologies.

Together with business activities on megaprojects, there are complex (un)formal relationships between stakeholders, that have direct impact on megaproject success. It is obvious that stakeholder analysis is related to social network analysis. One of the main reason why this field is not researched so much is this complexity and multidisciplinary, while on the same time "every project is consists of people". A common criticism of social network research is neglecting the network dynamics (Watts, 2003; Borgatti, 2005). Many researchers prove that centrality measures of social networks can say a lot about its participants (Barranquero et al.2014, 20 Carrington et al., 2010; de Nooy et al., 2005; Oliveira, Gama, 2012).

Dynamic network analysis (DNA) as improved SNA takes into account interactions of social features conditioning structure and behavior of networks; DNA is tied to temporal analysis but temporal analysis is not necessarily tied to DNA, as changes in networks sometimes result from external factors which are independent of social features found in networks. In SNA, people in the networks are not treated as active adaptive agents capable of taking action, learning and altering their networks. This problem solve Multi-agent network models.
Key advances that extend SNA to the realm of dynamic analysis are: meta-matrix, treating ties as probabilistic and combining social networks with cognitive science and multi-agent systems and all of them result in a dynamic network analysis.

Concerning the probabilities, various factors affect the probability, including the observer's certainty in the tie and the likelihood that the tie is manifest at that time. Bayesian updating techniques (Dombroski and Carley, 2002), cognitive inferencing techniques, and models of social and cognitive change processes (Carley, 2002; Carley, Lee, Krackhardt, 2010) can be used to estimate the probability and how it changes over time.

There are several possible approaches to stakeholder analysis that include the mentioned dynamics and integrate classical and modern approaches: system dynamics, Bayesian networks, fuzzy cognitive mapping and agent-based modeling. All mentioned tools are for better understanding of social network analysis and its usage in stakeholder's analysis.

Stakeholder-based modelling & system dynamics

Stakeholder-based modelling is not new approach for researchers, but its application on megaprojects is not well-known and thus tested and discussed in this research. Forrester (1961, 1985, and 1994) emphasized the need to access the mental database of managers in order to be able to construct system dynamics models of strategic problems in business. It is very close to stakeholder management on megaprojects, since they are more strategically important than other projects.

There are several approaches to stakeholders modelling and analyzing. Each of them has its own advantages and disadvantages.

The crucial is to understand that every one of the approaches have system dynamic in itself. Whether stakeholders are missing or adding to a megaproject, the whole system as a structure is going to misbalance and has to rebalance by time. The question is *what does this balance mean?* The answer could be in calibrating the system of stakeholders in megaprojects.

The following table (Table) shows basic classifications of stakeholders modelling and researchers who have developed and/or applied them:

Stakeholder modelling approach	Researchers
Group Model Building (GMB)	Andersen, Richardson,1997; Richardson, Anderson,1995; Andersen et al., 2006; Exter, Specht, 2003; Vennix, 1996
Mediated Modelling (MM)	Belt, 2004
Companion Modelling (CM)	Souchere et al., 2010; Campo et al, 2010; Anselme et al., 2010; Rouan et al., 2010; Simon and Etienne, 2010, Vieira et al., 2010
Participatory Simulation (PS)	Meadows, 1986; Resnick and Wilensky, 1998; Wilenski and Stroup, 1999
Shared Vision Planning (SVP)	USACE, 2005; Palmer, 1999; Palmer, Werick, 2004; Deli-Priscoli, 1995; IWR, 1994; IJC, 1999;
Social science experiment (SSE)	Ostrom at al., 1994; Cardenas et al., 2000
Participatory Action Research (PAR)	Wadsworth, 1998; Kemmis, McTaggart, 1998
Participatory Decision Analysis (PDA)	Bacu et al., 2003; Mendoza, Prabhu, 2006; Giordano et al., 2007; Lynam et al., 2007

Table 4: Existing research of stakeholder modelling

These considerations inspire think about other research approaches and methods that would allow more sound understanding of stakeholder behavior and impact. One first step is done in this working group and presented in the following.

Social Network Analysis & System Dynamics in Stakeholder Analysis: a proposed model

There is no doubt that stakeholders are in the centre of three level sets: collective, individual and environmental level. There is mutual impact of each stakeholder on the individual level, as there is their impact on collective level (see Figure 3).
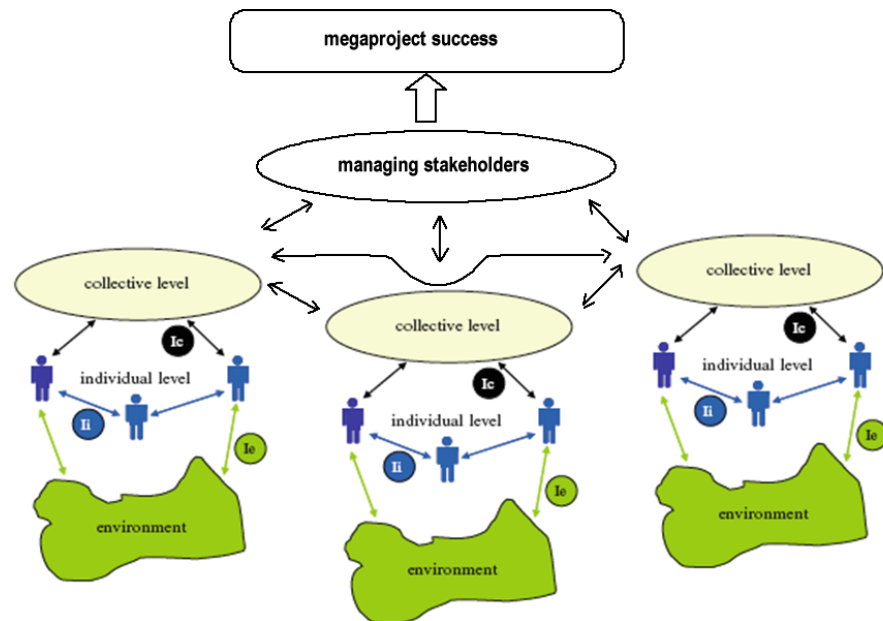
Figure 3: Stakeholders & their impact on megaproject success

Concerning the impact on megaproject success and managing the stakeholders, it is obvious that impact has two main dimensions: power and interest. Stakeholders have different interest in (mega) projects, but the impact on (mega) projects depends on the power by which this interest is engage in project success. Furthermore, if we succeed to measure those characteristics, we could better understand the weight of stakeholders in achieving and managing the megaproject success.

A new model of stakeholders' behavior is, would have three main purposes:
- to increase the knowledge and understandings of a system and its dynamics under various conditions, as in collaborative learning (Lynam et al, 2010) and
- to identify and clarify the impacts of solutions to a given problem, usually related to supporting decision making, policy, regulations of management.
- To find the relationship between interests & impact, through power and interaction as position in the social network analyses of stakeholder system.

The proposed model for stakeholder analysis is described in Figure 3. Stakeholders in megaprojects are not as simple as in other projects. The main differences are related to their quantity and complexity.

Stakeholders are defined by their impact on a project. If it is so, than it is necessary to find the way to measure this impact as well as to find the causes of certain impacts. The most suitable system to achieve this is to look at the stakeholders as entities with their power, interests and dynamics of their relationships. Combination of it such as "map" or "color" determines the particular impact on project. In this way, stakeholders are grouped into groups of different entities that show impact on megaproject.

There are two possible references for considering the impact of stakeholders to project success:
- by impact on the project success, which consisting of project management success and the impact on product as a result of the project
- by impact on sustainability, which consist of impact on Profit, Planet, People.

Stakeholders have their power and interest. Those two characteristics together with relationships between them form "a map" that is specific and gives particular impact on project.

The model presented in **Error! Reference source not found.** must be calibrated as it is in the reality, where interests strive to become impact, which depends on power and network position. Calibration involves finding the model constants (values) that make the model generate behavior cuvres that best fit the real world data. Using optimization, system dynamics will automatically vary the constants of our choice and look for the best fit between the simulation and real world data.
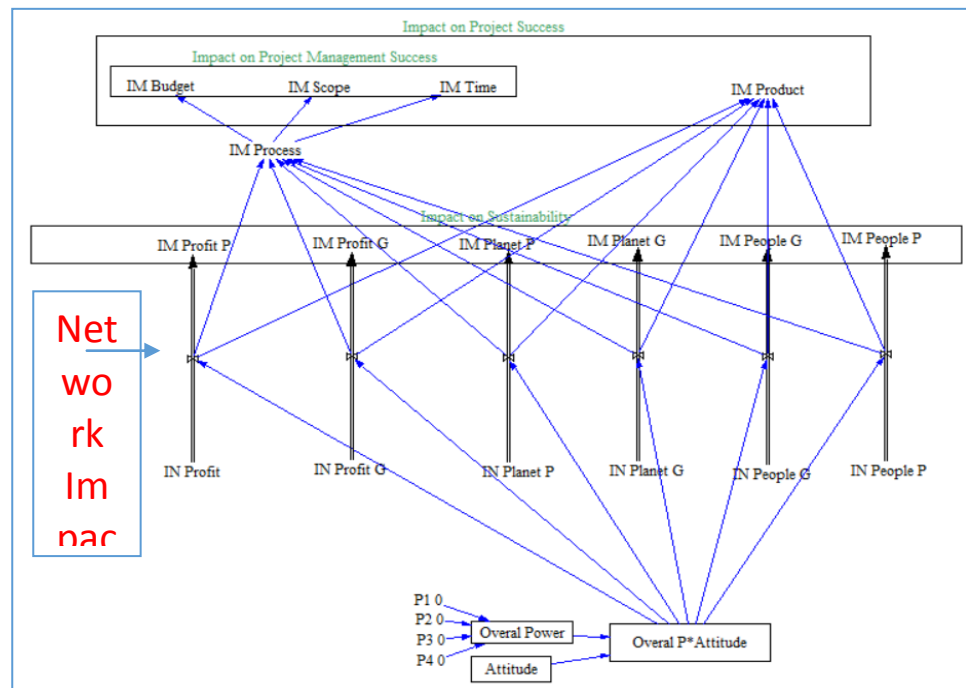
IN = Interest; G = Global; P = Particular; IM = Impact; P1,..P4 = Power

Figure 4: Proposed model

Results

Results from analysis

After classifying all the stakeholders identified in the interviews according to the Winch's framework, it was possible to evaluate, on a quantitative basis, the average classes attributes (power, interest and attitude) and classify them as shown in figure 2, in which the positioning has been calculated according to power and interest and the bubbles diameters represent their attitude (circles represent negative attitudes). According to this three-dimensional matrix we could identify the stakeholders having the highest potential to influence the projects.
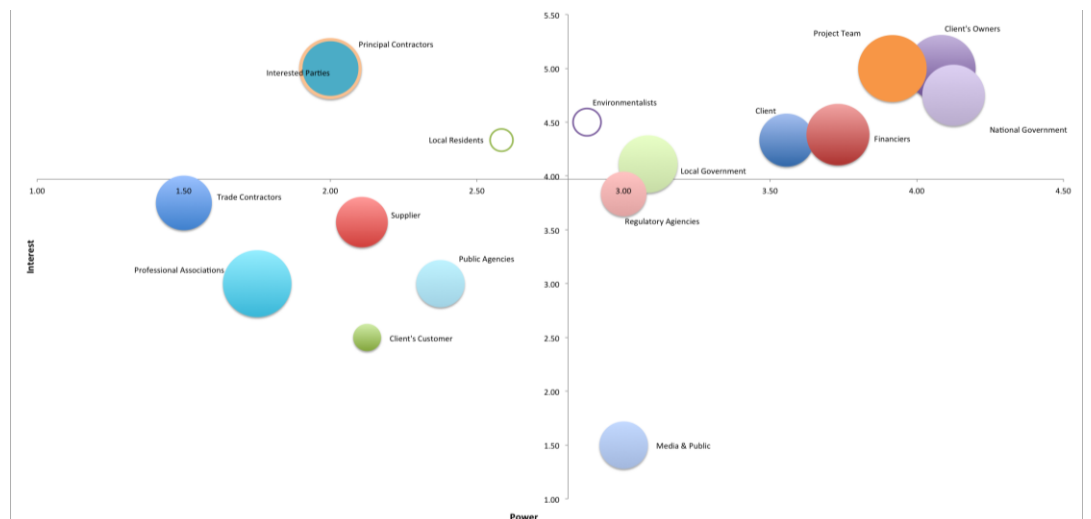

Figure 4: Megaproject Stakeholder Power-Interest-Attitude

A three dimensional grid is certainly more difficult to be drawn but it maps out everything which need to be considered and provides some descriptive labels that can be checked out during the overall process of stakeholder analysis and subsequent on-going stakeholder management. Stakeholder roles classification is reported in Table including some basic conclusions about how to approach them.

Stakeholder class	Megaproject Stakeholders	Managerial Approach
Saviours	Clients, Client's Owners, Project Teams, Financiers and National Governments	These are key players the project manager should pay attention to and keep on project side.
Saboteurs	Environmentalists	Their power derives from other stakeholders like Media or Governments. Project manager may change their attitude providing voice to their claims

		and using clear and transparent communication. If this is not deemed possible, managers should gain other players support to reduce their power.
Friends	Interested Parties and Principal Contractors	Project managers should use them as confidants.
Irritants	Local Residents	Interested in social and environmental aspects, clear and transparent communication, together with attention to safety issues is essential.
Sleeping Giants	Media and Regulatory Agencies	Media are "sleeping" till other actors, normally negative ones, "awake" them for having their claims considered. Managers should act proactively to engage them for supporting the project.
Acquaintances	Trade Contractors, Suppliers, Professional Associations, Public Agencies, Client's Customers	Keep them informed with a transmit-only communication style.

Table 5: Stakeholder classes and managerial approaches

The previous power-interest-attitude framework should be used by managers as a proxy to understand possible future stakeholder's impacts. Power is a proxy of the impact a stakeholder may cause if it undertakes some actions, interest is a proxy of the probability of such actions and attitude a proxy of the direction of action and therefore impact towards positive or negative for the project.

Despite previous matrix positioning gives insights on how a stakeholder could move during the project, it does not provide the certainty that the most powerful and interested stakeholder is the most impacting on the project. Moreover the same stakeholder having a positive attitude towards the project may cause both positive and negative impacts in different performance areas. Therefore the correlation between matrix positioning and overall impacts caused should not be taken for granted but rather analysed considering the real impacts each stakeholder caused despite its positioning.

During interviews project managers were asked to rate the real stakeholder impacts on the five-Ps of project sustainability and on the "Iron Triangle" performance of time, cost and quality. Rearranging these different impact dimensions, the following impact categories can be defined:

❖ Project execution (PE) impact: it is the overall impact on the project execution process and the final delivered product;

❖ 3P impact or sustainability impact: it is the overall impact on project sustainability performance, including planet (or environmental), people (or social), and profit (or economical);

❖ Project management success (PMS) impact: it is the overall impact the stakeholder caused to time, cost and quality performance;

The classification of project stakeholders on the basis of their positive and negative impacts on project has been provided in Table .

	Impact Class	Positive Stakeholders	Negative Stakeholders
Extreme	**1. Total Impact**	Client, Project Team, Client's Owners, National Government, Financiers, Local Government, Principal Contractors	Regulatory Agencies, Principal Contractors
High	**2. PMS, PE Impact**	Regulatory Agencies	Client, National Government
	3. PMS, 3P Impact	Suppliers	Local Residents, Environmentalists
	4. PE, 3P Impact	_	Local Governments, Interested Parties
Medium	**5. PMS Impact**	Public Agencies	Trade Contractors
	6. PE Impact	Professional Associations	Media, Suppliers
	7. 3P Impact	Client's Customers	_
Low	**8. Little Impact**	Local Residents, Trade Contractors, Media, Environmentalists, Interested Parties	Client's Customers, Project Team, Client's Owners, Professional Associations, Public Agencies, Financiers

Table 6: Megaproject Stakeholder Impacts Classification

Positive stakeholders causing high or extreme impacts include stakeholders which should really be engaged with the aim of increasing the probability (interest) and impact (power) through different stakeholder management and communication techniques, like empowerment and participation in project team decisions of few representatives.

Negative stakeholders causing high or extreme impacts are the critical stakeholders to which attention should be paid. These should be monitored; communication should aim at defeating negative views if present and help, in case of errors, provided. In case negative views cannot be defeated, and this could be the case of environmentalists, stakeholder management should aim at decreasing power or interest in the project.

For testing the validity of the previous model some tests of the correlation between stakeholder power and interest and their real impacts on the project have been

conducted. Same way the correlations between stakeholder attitude, positive and negative impacts on a project.

Based on the correlation tests and a Spearman test which helped to understand the relations between impacts on a more detailed level. The results show that all impacts, with few exceptions, are correlated with all types of impacts. For interpreting these measures we consider impacts on process and product as independent variables which influence all other types of impacts. In this way a stakeholder whose interest is to improve project's sustainability performance will intrude in the project delivery phase to have its claims considered and will improve the project final deliverable, causing "side effects" on project management success. What have been stated explains also the resulting correlation between sustainability impacts and "side effects". The previous impact model is therefore considered valid to the extent that there is a cause-effect relationship between impacts on process and products and all the other variables.[1]

---

[1] For more details see for Dunovic, I.B., Colombo, R., Mancini, M., Littau, P. (2015)

Interpretation & Summary

General results / findings:

In the following general results and findings will be listed in a short way. For more information the papers and reports are recommended which are listed under references and are produced by the group members at different stages of this research project.

- **A structured SM-approach to use in megaprojects** and is necessary in order to assure the consideration of all relevant and important stakeholders. Especially all the private NGO-stakeholders play more and more a decisive role in megaprojects because of their huge impact on the society and the environment. It has to start in the early planning phase and to be continued until its completion. The project team needs to be very sensitive for the concerns of the stakeholders, even when they have no (more) formal rights. It seems to be very useful to have a professional PR-group. A structured method has been developed by the research group, which may be very useful for further megaprojects.

- **Natural language analysis** allows to induce stakeholder interactions from the descriptions of their dealings and values (L-F Pau, 2012).

- The analysis, **using gap analysis, and the cultural attributes** which have been designed and tested out, allow to capture largely the cultural factors affecting megaprojects (Pau, L-F, Njaa, O., Langeland, A., 2014; Pau, L-F, 2014a).

- It has been shown (Jääskeläinen, K., Pau, L-F, 2009) that **social network analysis applied to the interactions between internal stakeholders** in large projects, allows altogether to identify power nodes in their interaction graph, and thus to link the conceptual governance style with the actual conduct of stakeholder interactions.

- A related effort (Pau, L-F, 2014b) has shown that **dynamic stakeholder interaction analysis** suggests that some common behaviours exist over time to describe the adjustments in the business flows between stakeholders.

- In summary, **four families of tools and methods have been designed from outside traditional project management, allowing to analyse cultural, external and internal stakeholder relations, and who all point at**

the importance of governance styles in assessing the impact of these relations onto project performances.

- Stakeholder impact can be distinguished in Project execution impact, 3P impact or sustainability impact and project management success impact.

- **Dynamic stakeholder analysis needs to be conducted often**, and therefore a degree of flexibility must be built into the project plans. To allow this important procedure and to allow project changes guided by dynamic stakeholder analysis, the project plans need to have a high degree of flexibility.

- Megaprojects are characterised by **high need for learning** which can be achieved by **regular reviews (internal and external)** and by the use of modern tools of the stakeholder management analysis. The history of megaprojects is strewn with problems, therefore they have high intrinsic margins of improvement. Stakeholder management has a big role in this direction, in fact its modern tools and techniques adoption reduces the probabilities of project failure.

Recommendations

Checklist as eye-opener

Practitioners and academics agree that stakeholder management is a complex task, crucial for the success of the project. The following recommendations, obtained from both the work developed in this action and the previous literature, should to be taken into account for Project Management:

- **Stakeholder satisfaction** should be managed as a key project objective. (PMI, 2013)

- Megaprojects should be focused on providing **a variety of services to the stakeholders**, not just a means of transport, a building, a bridge…). Megaprojects should be managed for **the benefit of all its stakeholders**. Their rights be ensured, and, further, the groups must participate in decisions that substantially affect their welfare. (Aapaoja & Haapasalo, 2014; Newcombe, 2003)

- **Identify the stakeholders in the front-end and review** and update regularly this initial assessment. A comprehensive SM model covering the entire project lifecycle shall facilitate effective stakeholder communication and engagement in subsequent project stages. (Mok et al., 2015; PMI, 2013)

- Project managers bear a fiduciary (trustee) relationship to the stakeholders and to the project as an abstract entity. **They must act in the interests of both the stakeholders (as their agent), and the project (to ensure its survival).** (Newcombe, 2003)

- Project managers should **apply interpersonal skills to manage stakeholders' expectations:** building trust, resolving conflicts, active listening, and overcoming resistance to change.

- Consider the diverse **cultural organization** of both stakeholders and PM organization.

- **Tools for SM:** e.g. Stakeholder analysis, expert judgement (interviews, focus group, surveys, etc.), profile analysis meetings, workshops meetings, social networks, web pages, newsletter.

- Identifying stakeholders, understanding their relative degree of influence on a project, balancing their demands, needs, and expectations, and analyzing and documenting relevant information regarding their interests, in-

volvement, interdependencies, influence, and potential impact on project success, **are critical to the success of the project.** (PMI, 2013)

- Project managers need to **assess stakeholders' probability to act and express their interest in project decisions** and how they are likely to react or respond in various situations (e.g. by a sensitivity analysis), in order to plan how to influence them to enhance their support and mitigate potential negative impacts. Since their interests may be positively or negatively affected by the execution or completion of the project, PM should balance their interests and ensure that the project team interacts with stakeholders in a professional and cooperative manner. (Aapaoja &Haapasalo, 2014; PMI, 2013)

- Stakeholders should be **divided into groups** that better reflect stakeholders' roles in order to be managed efficiently and systematically. Identifying formal groupings of stakeholders is relatively easy; identifying informal groupings is much more difficult. These informal groupings are likely to have a changing membership with ad hoc coalitions springing up in response to specific events. (Aapaoja & Haapasalo, 2014; Newcombe, 2003)

- When establishing the risk management plan and the procurement management plan, the **influence of stakeholders** must be considered. (Bourne & Walker, 2005)

- By anticipating people's reactions to the project, **proactive actions** can be taken to win support or minimize negative impacts. Active management of stakeholder involvement decreases the risk of the project failing to meet its goals and objectives. (PMI, 2013)

- In the planning and designing phases, the **public has to be taken in full confidence** that their involvement will influence the decision making process. The public's concerns in these phases will usually focus on long-term issues and can be of any kind depending on local conditions. (El-Gohary et al., 2006; Stanford, 2000)

- In the construction phase, all stakeholders are involved, but the **way of involvement is different.** Local and regional stakeholders are concerned with the influence of construction activities on their daily routine activities and life style. On the other hand, global stakeholders may be interested in monitoring and evaluating project impacts related to their particular field to make sure that the impact is not greater than what was considered in the planning phase. (Ernzen & Woods, 2001; El-Gohary et al., 2006)

- Establish a **communication plan** which allows stakeholders to understand the current state of the project; the steps taken; and budget, schedule, and scope forecasts. Feedback from stakeholders should be facilitated. Infor-

mation received from stakeholders can be distributed and used to modify or improve future performance of the project (PMI, 2003).

- Establish the desired **level of engagement for each stakeholder** and provide guidance on how the various stakeholders can be best involved in the project. The current engagement level of all stakeholders needs to be compared to the planned engagement levels required for successful project completion. Tool: e.g. Stakeholders Engagement Assessment Matrix (PMI, 2003)

- Create a **record of good practices** to learn from similar projects, not only at the company level but at the sector level.

- Create a **Stakeholder Register** with info about the identified stakeholders and their assessment. The stakeholder register should be consulted and updated on a regular basis, as stakeholders may change—or new ones identified—throughout the life cycle of the project. (PMI, 2003)

Further research:

- **Qualitative data are extremely useful** but difficult to collect. Often it is much easier to find information and data about projects via journals and internet, but quality is often rather weak and unsure. It is strongly recommended to collect data directly from the project owner and the responsible people, especially the project manager. As megaprojects, especially in the traffic and energy sector, take generally two and more decades for planning and construction, the staff changes from time to time or even often. So it is rather painful to insist of this kind of data resources, but it is necessary to understand the data and the background of problems, changes and reasons for cost or time overruns.

- Future research on megaprojects must reach out **to policy analysis and interactions analysis tools, especially dynamic ones,** to be able to analyse stakeholder relations (in social, cultural, and business practices). Statistical ex-post analysis is of little value due to the highly motivation, corporate communications, and governance-driven processes taking place, which obey no statistical models.

- The applied and developed methods are **explaining internal stakeholders' behaviour quite well**. To understand external stakeholders better, further tools have to be tested or developed.

- **Taxonomy of possible indicators** of the behaviour of the stakeholders (more pragmatic than power, interest), to represent the stakeholders. How to objectivize stakeholder out of my company.

- **Evolve traditional planning tools toward real time "social network analysis"** environments including all the resources.

- **Increase the number of project analysed (primary data)**. As megaprojects are very different from each other and national particularities may have a strong influence on them more projects with "qualitative data" (s. above) have to be collected, used and explored in order to have more resilient conclusions as a base for changes in planning and construction of future projects. This needs much resources and time.

References

Produced Publications related to WG Activities

Alfalla-Luque, R. & Medina-Lopez, C. (2015): High-speed rail in Spain. A case study: HSR Madrid-Barcelona-French frontier line. In Press En el libro The Megaproject Portfolio 2nd edition. Ed. University of Leeds (UK).

Alfalla-Luque, R. & Medina-Lopez, C. (2015): High-speed rail in Spain. A case study: HSR Seville-Madrid line. In Press En el libro The Megaproject Portfolio 2nd edition. Ed. University of Leeds (UK).

Alfalla-Luque, R., & Medina-Lopez, C. (2013): High Speed Train (HSR) Seville-Madrid (Spain). En el libro The Megaproject Portfolio. Ed. University of Leeds (UK). ISBN: 978-0-9576805-0-0

Alfalla-Luque, R., & Medina-Lopez, C. (2013): High Speed Train (HSR) Madrid - Barcelona – Figueres (Spain). En el libro The Megaproject Portfolio. Ed. University of Leeds (UK). ISBN: 978-0-9576805-0-0

Burcar Dunovic, I.; Lukasiewicz, A.; Brookes, N. (2014): IN PURSUIT OF A FRAMEWORK TO EXPLORE STAKEHOLDER INFLUENCE IN MEGAPROJECTS THROUGH ISSUES OF SUSTAINABILITY, International Scientific Conference People, Buildings and Environment 2014 (PBE2014) 15-17 October, 2014, Kroměříž, Czech Republic

Castillo Casas, J. and Medina-Lopez, C. (2014) The Influence of Stakeholders in Megaproject Management [La influencia de los Stakeholders en la gestión de megaproyectos]. End-of-degree Project submitted at the Universidad de Sevilla. September 2014.

Dunovic, I.B., Colombo, R., Mancini, M., Littau, P. (2015). A case study approach in megaproject stakeholder analysis through sustainability issues. Paper submission accepted for IRNOP Conference, 2015, London, UK.

Irimia-Dieguez, A., Ruiz Luna, A., Alfalla-Luque, R. & Medina-Lopez, C. (2013): Financial aspects of Megaproject Management. Actas 27th IPMA World Congress 2013, desarrollado en Dubrovnik (Croacia) del 29 de septiembre a 3 de octubre de 2013

Irimia-Diéguez, A.; Medina-López, C. y Alfalla-Luque, R. (2014): Financial Management in Large Projects: a research gap. Actas 3rd World Conference on Business, Economics and Management, desarrollado en Roma (Italia) del 8 al 10 de abril de 2014.

Irimia-Dieguez, A.I., Medina-Lopez, C. & Alfalla-Luque, R. (2015): Spanish metro line: Metro de Sevilla. In Press En el libro The Megaproject Portfolio 2nd edition. Ed. University of Leeds (UK).

Irimia-Dieguez, A.I., Medina-Lopez, C., Alfalla-Luque, R. (2015): Financial Management of Large projects: A Research Gap. Procedia Economics and Finance. In press. ISSN: 2212-5671. Elsevier

Jääskeläinen, K., Pau, L-F (2009): ERP project's Internal Stakeholder network and how it influences the project's outcome, Working paper, SSRN, July 2009, under publication 2015, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1440687

Littau, P.; Adlbrecht, G. (2014): Stakeholder Management in Mega-Project Organizations. In: Proceedings of the 14th EURAM Annual Conference, Valencia, Spain, 2014

Locatelli, G, Mancini, M., Romano, E. (2014): Systems Engineering to improve the governance in complex project environments. In: International Journal of Project Management – Vol. 32, Issue 8, November 2014, Pages 1395–1410. Impact Factor: 1.758 – ABS grade 2

Locatelli, G., Littau, P., Brookes, N., Mancini, M. (2013): Projects characteristics enabling the success of megaprojects -An empirical investigation in the Energy sector, Proceedings of IPMA 26th World Congress – Dubrovnik, Croatia 30 September – 03 October 2013

Locatelli, G., Littau, P., Brookes, N.J., Mancini, M. (2014): Project Characteristics Enabling the Success of Megaprojects: An Empirical Investigation in the Energy Sector, Procedia - Social and Behavioral Sciences, Vol 119, 19 March 2014, pp. 625-634.

Pau, L-F (2012): Summarization of brainstorming notes by natural language analysis: an example, Working paper, 2012, SSRN, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2164451

Pau, L-F (2014a): Cultural values and context issues in Megaprojectrs: results of clustering cultural attributes, submitted for publication; see WG presentation "Cultural values and context issues in megaprojects", COST Megaprojects WG presentation,Milan, December 2014

Pau, L-F (2014b): Discovering the dynamics of smart business networks, Computational Management Science: Volume 11, Issue 4 (2014), Page 445-458

Pau, L-F, Njaa, O., Langeland, A. (2014): Assessing cultural influences in megaproject practices, 2014, https://arxiv.org/submit/990779/view, accepted for publication in 2015

Sözüer, M.; Spang, K. (2012): Challenges in the Planning Process of Infrastructure Projects in Germany. In: H. Cai et al., Proceedings of Construction Research Congress 2012, West Lafayette (Indiana, USA), May 21-23, 2012.

Sözüer, M.; Spang, K. (2014): The Importance of Project Management in the Planning Process of Transport Infrastructure Projects in Germany. In: Procedia - Social and Behavioral Sciences, 2014, 119, S. 601-610.

Spang, K. (2011): Integrated Risk Management in Infrastructure Projects. In: Proceedings of ISEC-6 Modern Methods and Advances Structural Engineering and Construction, Zürich (SUI), 2011a

Other references

Aapaoja, A.; Haapasalo, H. (2014): A Framework for Stakeholder Identification and Classification in Construction Projects. Open Journal of Business and Management, 2, 43-55.

Andersen, E. S. (2008): Rethinking project management: An organisational perspective. Harlow, England: Prentice Hall.

Bonacich P. (1987) Power and centrality: a family of measures. Am J Sociol 92(5):1170–1182

Borgatti, S.P. (200). Centrality and network flow. Social Networks 27 (1), 55–71.

Borsuk, M.(2008).Bayesian networks. The Encyclopedia of Ecology, 307-317

Bourne, L.; Walker, D.H.T. (2005): Visualising and mapping stakeholder influence. Management Decision, 43(5), 649-660.

Carley K. (2002). Computational organizational sxience and organizational engineering. Simulation Practice and Theory, 10, 253-269, doi:10.1016/S1569-190X(02)00119-3

Carley, K., Lee M.J.S., Krackhardt D. (2010). Destabilizing Networks, Connections 24(3): 31-34

Carrington, P.J., Scott, J., Wasserman, S. (2010) Models and methods in social network analysis. Cambridge University Press

de Nooy, W., Mrvar, A., Batagelj, V. (2005): Exploratory social network analysis with Pajek. Cambridge University Press

Dombroski, M.J. and K.M. Carley, October (2002). NETEST: Estimating a Terrorist Network's Structure. Computational & Mathematical Organization Theory, 8, pp. 235-241.

El-Gohary, N.M.; Osman, H.; El-Diraby, T. E. (2006): Stakeholder management for public private partnerships. International Journal of Project Management, 24, 595–604.

Ernzen, J.; Woods, J. (2001): Contractor-led public relations on a design-build highway project. Transport Res Record, 1780, 155–64.

Eskerod, P.; Vaagaasar, A.L. (2014): Stakeholder Management Strategies and Practices During a Project Course. Project Management Journal, 45(5), 71–85.

Forrester, J.W. (1961). Industrial Dynamics. MIT Press, Cambridge, MA. Reprinted by Pegasus Communications.

Forrester,J.W. (1985). 'The model' versus a modelling 'process'. System Dynamics Review1 (1), 133-134.

Forrester,J.W. (1994). Policies, decisions, and information sources for modelling. In: Morecroft,

IPMA. (International Project Management Association). (2006): International competency baseline, 3rd ed. Zurich, Switzerland: International Project Management Association.

J. Barranquero, M. Chica, O. Cordon and S. Damas (2014). Detecting key variables in system dynamics modelling by using social networks measures, SSC'14 Social Simulation Conference, Spain

J.D.W., Sterman,J.D.(Eds.), Modelling for Learning Organizations. Productivity Press, Portland, OR, pp. 51-84

Jepsen, A. L., & Eskerod, P. (2009): Stakeholder analysis in projects: Challenges in using current guidelines in the real world. International Journal of Project Management, 27(4), 335–343.

Lynam, T., Drewry, J., Higham, W., & Mitchell, C. (2010). Adaptive modelling for adaptive water quality management in the Great Barrier Reef region, Australia. Environmental Modelling & Software, 25, 1291-1301. http://dx.doi.org/10.1016/j.envsoft.2009.09.013

Mok, K.Y.; Shen, G.Q.; Yang, J. (2015): Stakeholder management studies in mega construction projects: A review and future directions. International Journal of Project Management, 33, 446–457.

Newcombe, R. (2003): From client to project stakeholders: a stakeholder mapping approach. Construction Management and Economics, 21, 841–848.

Oliveira, M., Gama, J. (2012). An overview of social network analysis. Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery 2(2), 99–115

PMI (2013): A Guide to the Project Management Body of Knowledge (PMBOK® Guide) – Fifth Edition. Project Management Institute.

Stanford, M. (2000): Public involvement: why it's important. Am Water Works Assoc J., 92(1), 74–5.

Voinov, F. Bousquet (2010). Modelling with stakeholders. Environmental Modelling & Software 25 (2010) 1268-1281

Watts, D. (2003). Six degrees: The science of a connected age. New York: Norton.

Winch GM. (2004): Managing project stakeholders. In: Morris PWG, Pinto JK, editors. The Wiley guide to managing projects. New Jersey: Wiley; 2004. p. 321‑39.