Transdisciplinary Engineering Methods for Social Innovation of Industry 4.0
M. Peruzzini et al. (Eds.)

doi:10.3233/978-1-61499-898-3-1135

Investigating into the Risks of Forming Alliance

Matthew COOK[1] and John P.T. MO
RMIT University

Abstract. Many large and highly complex engineering projects present enormous technical and financial risk to organisations. This is especially true in the defence industry where budgets can potentially run into the billions and the project lifecycle may extend over many years. In frequent cases, such projects are too much for a single organisation to undertake. One option that is becoming ubiquitous within contemporary defence projects is to spread the risk by forming an alliance between several organisations. Unfortunately, forming an alliance between several competing organisations brings its own set of challenges and risks. The operating conditions of the business environment are characterised by frequent changes in products, services, processes, organisations, markets, supply and distribution networks. The partners need to work together as an entity to achieve a goal but the relationships within the alliance are often disrupted by the established practices and culture of the individual companies. This paper starts by examining how risks can multiply when an alliance is formed and what potential impacts these risks have on success. A novel 3PE method for modelling the structure of an alliance with the three elements being product, people, process, and their interactions is proposed within an alliance environment. By examining the relationships among the elements, risks are identified, and the key drivers are exposed. Finally, a case study is presented that focused on risks relating to People and behavioural risks exhibited within an alliance.

Keywords. Alliance risks, risk identification, risk structure, risk management, network risks.

Introduction

In the contemporary world many highly complex engineering projects such as aircraft, ships, buildings and bridges have enormous financial and technical requirements to achieve success. These requirements translate into risks that essentially require management/mitigation throughout the entire lifecycle of the project. In many cases this is beyond the capacity of a single organisation and results in technical failings, schedule delays and serious cost blowouts. In frequent cases, one option that is becoming ubiquitous within contemporary defence projects is to spread the risks by forming an alliance between several organisations. This has the benefit of distributing both the financial burden and technical effort across several organisations, ensuring specific attributes and skill sets are exploited in the right areas.

The formation of an Alliance is generally thought of as a risk reduction strategy for sharing the technical challenges, tapping into appropriate resources, ensuring competitive edge and sharing financial burden of large challenging projects. This in

[1] Corresponding Author, Mail: s3315531@student.rmit.edu.au.

turn means risks are essentially spread across two or more organisations. The theory being each organisation should have the attributes essential to meet key project requirements and thus mitigate risks. There are many examples of such alliances and their value has been much publicised in areas like aerospace and defence [1]. These industries tend to undertake extremely technically complex projects that require massive financial investment and commitment over long periods of time.

Unfortunately, forming an alliance between several competing organisations also brings challenges that did not exist before. The operating conditions of the business environment are characterised by frequent changes in products, services, processes, organisations, markets, supply and distribution networks. The organisations form a temporary alliance to deliver a project or product and dissolve when the job is completed. The teams work together as an entity for a goal but the relationships among themselves are often disrupted by established practices and culture of individual companies. Success for achieving the goal therefore demands well-coordinated mitigation of the risks both in the internal and external aspects of the alliance.

Risk is defined in ISO 31000 [2] as 'the possibility that something unpleasant or unwelcome will happen'. When undertaking extensive, highly complex and challenging projects it is essential that any organisation should develop a sound understanding of the risks that may preclude success. This practice is common in industry, but the risk assessment process is too focused on risks within a single organisation where they have ownership and control of the project [3].

However, an alliance brings added complexity to the structure of the project and this leads to a significant increase in the overall risk level of the project. There is growing evidence to suggest that the failure rate of alliance projects is as high as 50% [4]. Many factors that may contribute to these figures may include the complexity of controlling partnership risks, process of how individual partners work, emerging behaviours of alliance partners, etc. Unfortunately, there are no well-established formal methods or processes available to satisfactorily assess the risks in these alliances.

This paper provides insight into research being conducted into how the formation of an alliance can contribute to significant increases in the overall project risk due to the potential opacity between the alliance partners. The paper goes on to propose a model that has the ability to allow managers and engineers to identify and assess how risks can multiply as internal organisation and external project risks are generated and combined. These risks include technical, process, behavioural and cultural issues that can exist and/or develop between organisations increasing the challenge of achieving success. Finally, this novel method of capturing, assessing and modelling alliance risks for major engineering projects is then demonstrated using a case study.

1. Literature review

Many large complex engineering projects are being undertaken by organisations forming alliances. While this approach has obvious benefits, there is growing evidence to suggest it often brings a significant increase in risk to the task that in some cases this outweighs the positives of an alliance. This literature review will focus on understanding these issues and explore any prior arts in assessing risks in alliance managed project.

1.1. Reasoning for alliance formation

According to the Department of Finance and Treasury Victoria [5] the definition of alliancing can be described as: "a method of procuring (where) all parties are required to work together in good faith, acting with integrity and making best-for-project decisions. Working as an integrated, collaborative team, they make unanimous decisions on all key project delivery issues. Alliance agreements are premised on joint management of risk for project delivery. All parties jointly manage that risk within the terms of an 'alliance agreement' and share the outcomes of the project".

As projects become larger and more complicated, and the pressure from various stakeholders increases, alliancing is proving itself as being able to deal with these ambitious targets [6]. Most often the time, if the product is complex and unique a company doesn't have the whole competences to provide the complete product. Depending on the selected partners, different possible innovation level can be reached. This decision also influences the level of risk of the project.

In their research into Australian alliance projects Young et al. [7] conclude that alliancing is a very effective project delivery method which is suitable for projects with particular characteristics, provided they are selected for the right reasons. These characteristics are presented in **Table 1**. It is however acknowledged that limited research has been performed in the areas of barriers to alliancing and the body of knowledge could benefit from further research in this area.

Table 1. Characteristics suitable for Alliancing.

Project Characteristics	Project Characteristics
Tight time constraint/Need for early start	Large project/High cost
Multiple complex stakeholders	Need for innovation
High risk	Tight cost control
High complexity	Environmental challenges
Unclear/Broad scope/Risk of scope change	Need for owner involvement
Complex external threats	Multiple interfaces

Sivunen et al. [8] wax lyrical about managing risks related to functional changes by using a Design Alliance (DA). This is an interesting approach but does not consider the impact on partners when the project fails to achieve milestones or how this can be managed.

1.2. Issues with project alliance risk

There are many aspects of risk introduced by forming an alliance. Cummings and Holmberg [9] propose that when considering Critical Success Factors (CSF) of a project it is useful to include two categories. The first category is identified as 'Alliance risks' and include those risk-related CSFs that stem from engaging in an alliance. The second includes risk to the focal firm that stem from potential alliance activities pursued by others: these are identified as 'not-partnering risks'. While this gives more of a holistic view of alliance risk, it does not assist with identifying what the key risks are.

Das and Bing [10] suggest that two distinctive risks are *relational risk* and *performance risk*. Relational risk being concerned with the probability partners will not complying with cooperation of the alliance, while performance risk refers to the

probability that strategic goals of the project will not be achieved. Ring and Van de Ven [11] have suggested that in an alliance structuring process, the partners are faced with two sets of risk: those regarding future states of nature and those regarding cooperation. While helping to focus on where risks may reside in an alliance, more research is required into actually identifying and managing these risks.

One concerning behaviour of alliance partners is highlighted by Parkhe [12] who reasons that organisations may be motivated to secretly use an alliance to capture resources of partners with shirking, distorting information, stealing skills, clients and personnel all examples of questionable self-interested that can be exhibited by partners. According to Deniaud et al [13], little account is taken of the risks and the strategies to deal with the selection of the collaborators and their repercussions. Cui et al [14] builds on this argument suggesting that some organisations use an alliance to facilitate the identification of partners vulnerabilities and launch competitive strategy to undermine partners weaknesses. It is acknowledged in all papers that further work is required to better understand how risks can be captured, managed and mitigated.

2. Research Approach

When an organisation takes on a large complex engineering project, there are many risks that need to be addressed in order to achieve a successful outcome. These risks require management throughout the project lifecycle and it is essential that a way of organising the risks is established to enable satisfactory control and mitigation. One method of mitigating risks is to form an alliance with appropriate partners, however there is strong evidence to suggest that forming an alliance seriously increases risk and project success may be compromised.

There is a dearth in the literature regarding the methods for managing and controlling alliance risks. Without better identification and understanding of the risks and the continued cooperation of the partners, overall project success can be significantly reduced. In some cases, a potential partner will view an alliance as an opportunity rather than a risk, for example, it may be an opportunity to enter a new field, develop new capability or in more insidious cases look to steal customers, staff and technology from partners. Clearly the formation of an alliance adds significantly to the number, challenge and complexity of the project risks.

This research aims to develop a qualitative baseline which could then be used for both quantitative risk assessment and analysis. An investigation into risks surrounding complex engineering projects was undertaken based on the 3PE model described by Mo [15]. By segmenting the enterprise into three major sectors, it should be possible to identify and even visualise specifically what the key risk drivers are and monitor them throughout the life of the project, see **Figure 1**. The 3P model, or product, people & process, offers a useful way of sorting project risks by their nature and provides a meaningful method of controlling and managing risks. The map in **Figure 1** highlights the relationship between the 3Ps within an environment being the organisation (internal). This environment can be influenced by outside factors including political decisions, changes to policy, technology updates, etc.

With a single organisation, the elements (3Ps) and the interactions between them can be associated with risks. Depending on the complexity of the task, this can lead to a sizeable risk profile. The risk profile indicates the number of risks, types of risk and potential effects of risks an organisation is carrying on a project.

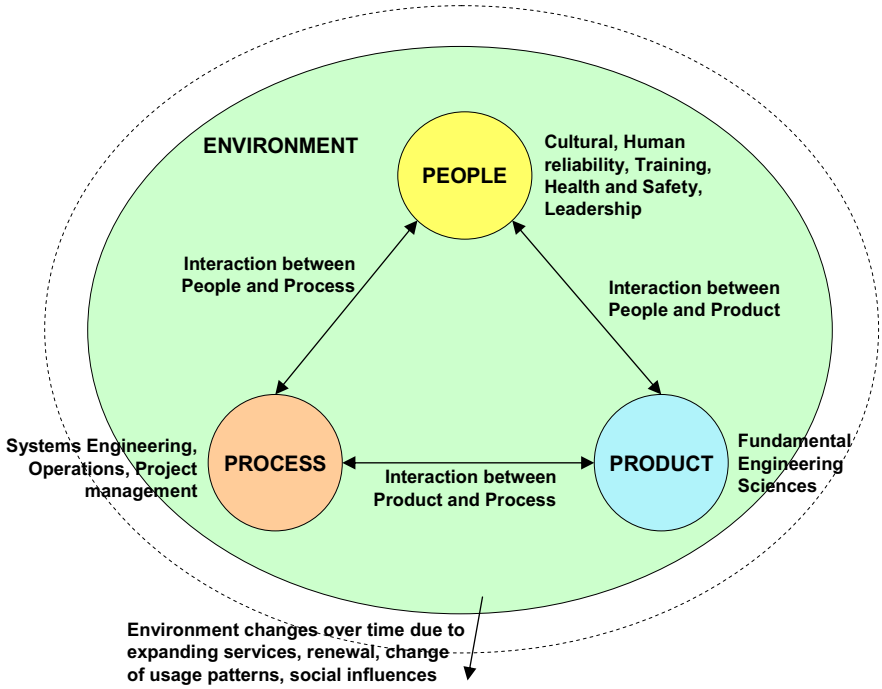

Figure 1. Product Process People Environment (3PE) model.

In large defence projects the technical, schedule and cost challenges can be significant, and both governments and organisations will look to both distribute and spread these risks where possible. Alliances offer the opportunity to involve partners with specific skill sets and capability. This is certainly a positive way of mitigating technical risks and reducing costs. Organisations can also work concurrently, resulting in potential schedule pressure reductions. It is important to note that in some cases, especially with government projects, alliance partners may not always have the opportunity or luxury of choosing/selecting who they enter an alliance with, this in itself can be a significant risk.

When two or more organisations enter into a partnership based on the aforementioned reasoning, if we consider the 3PE model, there are now essentially three or more environments, two or greater organisational environments and the overall alliance environment. The interaction between the three elements both internally and externally grows significantly within these environments. **Figure 2** provides an example of two partner organisations in a project alliance, it is notable that the legs between the elements have now increased from 3 (per organisation) to 9 or 16 (if including internal legs). This increase potentially represents enormous growth in risk factors that will need to be controlled, managed and mitigated throughout the project lifecycle.

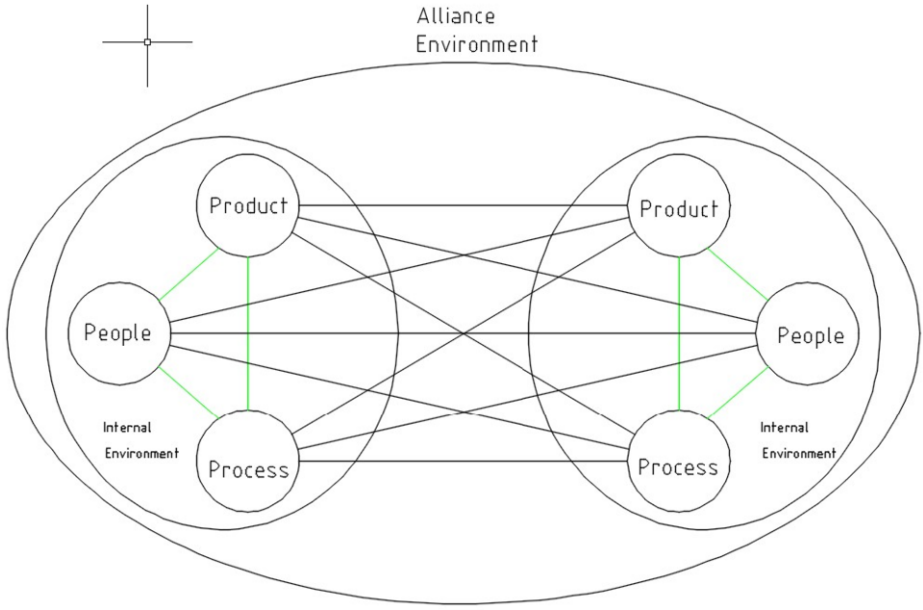

Figure 2. Alliance map with two partner organisations.

Modelling of interactions in the alliance environment including internal organisation environments (systems) can be logically represented by an extended formulation of the 3PE model to multiple enterprise networks. The single enterprise 3PE model has three interaction links, i.e. Pp (People) – Pc (Process), Pp – Pd (Product), Pc(Process) – Pd(Product). However, in a multiple system (alliance) situations, the number of interacting links can expand quickly as given by:

$$l_a = C_2^{3n} \tag{1}$$

where n is the number of systems in the alliance. Moreover, the number of inter-system interactions is given by:

$$l_i = l_a - 3n \tag{2}$$

However, if we examine the links carefully, there are in fact only 6 types of interaction links between systems as shown in **Table 2**.

Table 2. Inter-company's interaction matrix.

		System 1		
		People	Process	Product
System 2	People	(1) Pp – Pp	(2) Pp – Pc	(3) Pp – Pd
	Process	Duplicated	(4) Pc – Pc	(5) Pc – Pd
	Product	Duplicated	Duplicated	(6) Pd – Pd

3. Case Study

Within the defence industry, many engineering and sustainment projects for complex platforms such as ships and aircraft are managed/supported by alliance partners (the value of such alliances has been detailed earlier in this paper). For this case study, the upgrade of a naval ship with a new RADAR was considered, with the OEM of the RADAR to form an alliance with the platform systems integrator and involvement of government and defence force organisations. The customer in this case, ultimately being the Navy.

In order to better understand this, the authors created a risk register to be completed at a workshop with key staff working in the Naval defence industry both in the United Kingdom and Australia. The personnel involved included Engineers, Project Managers, Support Managers and several members of the Executive Team. The members of staff were also chosen based on current and previous work conducted within an alliance. The workshop was split into two sections, firstly a risk review to capture what were considered purely internal organisation risks was conducted. This was followed by a review of a specific alliance risks concerning the overall success of the project holistically. The risk registered generated from this workshop was substantial with risks relating to everything from technical challenges, communication issues, distance between partner firms, financial challenges, etc. Finally, once the risks were established, a three-point 'Project, Evaluation & Review Technique' or PERT estimation of the risk probability/severity was applied. According to PERT, the time for an activity in the project can be represented by a normal distribution. In this research, instead of a time value, a project success level was substituted [16].

In order to make sense of such a sizeable body of data, the 3P model discussed previously in this paper was enforced. Each risk was assessed by its nature against the 3P elements to help identify key risk areas. See **Table 1**. The data from the PERT estimation was then used to rate the risk probability/severity of each 3P element. Due to the size of the data set, the authors have only focus on the people element of the 3P model for this paper.

When organisations enter a competitive alliance contract, it is well established and understood that one of the key attributes each of the partners potentially brings is their workforce which possess specific skills and knowledge (See section 1). Clearly the motivation for creating an alliance is to reduce/mitigate the risk to the project by ensuring the appropriate staff are applied to the project and thus reduce alliance risk. However, as this research has highlighted, alliance partnerships can bring other risks and, in some cases, have extremely detrimental and even catastrophic consequences on the project. Some of the risks established by the working group that related to the people element of the 3P model included:

- Trying to take work away from other partners
- Attempting to recruit/steal partners staff
- Lack of communication between partner staff
- Unwilling to share information
- Undermine reputation of partner staff
- Lack of control over staff
- Responsibility and liability
- Personality clash
- Key staff leaving

- Staff working to different processes
- No ownership of blame

Many of these risks are clearly also internal risks that are ubiquitous across individual organisations and are part of the challenge of being in business. However, as per **Figure 2**, when the 3P model of these internal risks is combined with alliance risks, the size and complexity of the risk carried by the alliance to achieve success can significantly multiply.

In this case study, the 3PE inter-enterprise interactions could be identified and modelled as shown in **Table 3**. Using the 3PE modelling constructs, the two-company interaction table has 9 cells (due to Eqn.1). Three of these interactions are repeating.

$$l_i = C_2^{3\times 2} - 3n = \frac{6\times 5}{2\times 1} - 3\times 2 = 9 \tag{3}$$

Development of new interactions in the systems of the alliance, i.e. the increased working relationship of the partner, helps ensure the new RADAR significantly increased the capability of the platform, support of the integration and ongoing sustainment is achieved.

Table 3. Interaction matrix of risks between two companies in the alliance.

		Company 1		
		People	Process	Product
Company 2	People	Peer to peer: • Bad inter-company staff relations • No knowledge sharing/ transfer between companies	Adaptation: • Staff in Company 2 do not understand engineering process in alliance. • Incompatible engineering processes.	Training: • Personnel in Company 2 cannot operate ship. • The interface of the ship is unclear/ unfriendly
	Process	Duplicated	Negotiation: • Every ship has some minor differences due to adaptation to the required operational environment. • Negotiation between alliance partners is required to ensure the best possible terms acceptable by the customer. • The contracting process involving the alliance and legal services of both sides is an important interaction prior to any further actions to take place.	Exception handling: • The new system design requires upgrade in the field. • Field upgrade for RADARs supplied by Company 2 that were already installed at customers' location had different baseline.
	Product	Duplicated	Duplicated	Engineering change: • New radar cannot be integrated due to obsolete operating system controlling the platform.

Without clear communication between partners, a true willingness to work for a common goal and failure to managing risks between partners will flow on to the

product (in this case the ship) and the customer. The reputation of all partners in the alliance can be irrevocably damaged and the project will be considered a failure.

4. Conclusion

With the ever-increasing complexity of large engineering projects, the burden of managing the technical, financial and schedule challenges is becoming beyond the capacity of one organisation. This has led to the increasing popularity of forming alliance partners to both spread and mitigate the project risks. There appears to be some dearth regarding information relating to project success/failure attributed to alliances. However, as this research has shown, the formation of an alliance can introduce and significantly multiply the project risks and result in a dramatic increase in the risk profile that needs to be management/controlled throughout the projects lifecycle.

This research has attempted to capture and sort alliance risks using a 3PE model and in turn identify the key risk areas. The systematic methodology divides a system (environment within organisation) with 3 elements: People, Process and Product. When an alliance is formed, the interactions of the elements between organisations will become a source of risk. In some cases, interaction between products (compatibility) is an issue. In other cases, interaction between processes (conflicts) is an issue. In other cases, interaction between people of one organisation and the process of another organisation can be a problem.

In order to validate this research further, a comparison between a project completed by a single organisation verses one by an alliance would be of significant value. However, many large and complex engineering projects, especially in defence, happen rarely and occur over many years making such a comparison challenging. One possibility could be to conduct analysis on comparable smaller scale projects that have historically been undertaken by both individual organisations and alliances and use the data to forecast possible outcomes on large scale projects.

References

[1] P. Keller, *Alliance at Risk: Strengthening European Defence in an Age of Turbulance and Competition.* Atlantic Council, Accessed: April, 3 2016, https://www.files.ethz.ch/isn/196263/alliance-at-risk.pdf

[2] N.N., *ISO 31000:2009 Risk Management - Principles and Guidelines*., ISO, 2009.

[3] M. Cook, *Strategic Risk Analysis Modelling in a Naval Marine Environment*, Master of Engineering minor thesis, School of Aerospace, Mechanical and Manufacturing Engineering, RMIT University, 2015.

[4] S.Z. Goa and Z. Zhang, Opportunism and Alliance Risk Factors in Asymmetric Alliances. *IEEE International Conference on Service Operations and Logistics, and Informatics, IEEE/SOLI 2008*, Beijing, China, 12-15 October, 2008, pp. 680-685.

[5] Department of Infrastructure and Regional Development. *National Alliance Contracting Guidelines.* Australian Government, 2015. Accessed April, 3 2018, https://infrastructure.gov.au/infrastructure/ngpd/files/National_Guide_to_Alliance_Contracting.pdf

[6] H.W. Chesbrough, Open innovation the new imperative for creating and profiting from technology. *Research –Technology Management*, Harvard Business Press, July-August, 2003, pp.20-27.

[7] B. Young, A. Hosseini and O. Lædre. The Characteristics of Australian Infrastructure Alliance Projects. *Energy Procedia*, Vol.96, 2016, pp. 833-844.

[8] M. Sivunen, J.-K. Kajander, J. Kiiras and J. Toivo. Managing Risks Related to Functional Changes by Design Alliance, *Procedia Engineering*, Vol. 85, 2014, pp.473-481.

[9] J.L. Cummings and S.R. Holmberg. Best-fit Alliance Partners: The Use of Critical Success Factors in a Comprehensive Partner Selection Process, *Long Range Planning*, Vol.45, No.2-3, 2012, pp.136-159.

[10] T.K.T. Das and B.-S. Teng. Resource and Risk Management in the Strategic Alliance Making Process, *Journal of Management*, Vol.24, No.1, 1998, pp.21-42.
[11] P.S. Ring and A.H. Van De Ven. Developmental Processes of Cooperative Inter-Organisational Relationship. *Academy of Management Review*, Vol.19, No.1, 1994, pp.90-118.
[12] A. Parkhe. Strategic Alliance Structuring: A Game Theoretic and Transaction Cost Examination of Interfirm Cooperation, *The Academy of Management Journal*, Vol.36, No.4, 1993, pp.794-829.
[13] I.F. Deniaud and F. Marmier, D. Gourc. Alliances decision-making in NPD: A risk point of view. *IFAC-PapersOnLine*, Vol.48, No.3, 2015, pp.942-947.
[14] V. Cui, H. Yang and I. Vertinsky, Attacking your partners: Strategic alliances and competition between partners in product markets, *Strategic Management Journal*, January, 2018. Early view: https://doi.org/10.1002/smj.2746
[15] J.P.T. Mo, Performance Assessment of Product Service System from Systems Architecture Perspectives. *Advances in Decision Sciences*, 2012, 19 pages, Article ID 640601.
[16] J.P.T. Mo and M. Cook. Risk Analysis of the Design of a Transportation Enterprise Network System for Time Critical Manufacturing. *Advances in Transdisciplinary Engineering, Vol. 5: Transdisciplinary Engineering: A Paradigm Shift, Proceedings of the 2017 ISPE Inc. International Conference on Transdisciplinary Engineering*, 10-13 July, 2017, Singapore, IOS Press, Amsterdam, pp. 898-905.