Implementing systems thinking to manage risk in public private partnership projects

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Abstract

The complexity of public private partnership (PPP) projects ensures that risks can arise and spread in unpredictable and sometimes catastrophic ways. Systems thinking is often proposed as a potential solution to this problem but has not been widely adopted in practice. To explore the reasons for this, interviews were conducted with sixteen senior construction professionals with experience of PPPs. The results show that the main barriers to the adoption of systems thinking are: conflicts of interest within PPP projects; confrontational contracts; resistance to change; lack of time and resources; perceptions of complexity; unknown legal implications of sharing risk; and external validation of existing risk management practices. It is concluded that in moving to a systems thinking approach, deeply imbedded ontologies, path dependencies, confrontational practices, and traditional linear and reductionist risk management practices will need to be challenged. Five key questions are also proposed for future research in this area.

Keywords: Risk management; Public private partnerships; Systems thinking

1. Introduction

Public private partnerships (PPPs) generally refer to projects where a private sector consortium contracts to finance, design, construct and operate public infrastructure against defined service standards (Eadie et al., 2013; Grimsey and Lewis, 2000; Yescombe, 2007). In a PPP the public sector contracts to buy a stream of services rather than an asset, as in traditional public procurement, and the private sector consortium is responsible for deciding how to supply those services in line with detailed service-level agreements and key performance indicators. The private sector generates income by operating the asset over a concession period, being paid (or abated) for the service provided on the basis of patronage or availability. The private sector takes a wide range of risks over long periods of time (normally up to thirty years although some PPPs run for longer) and at the end of the concession period returns the asset to the public sector in a specified condition (Chang, 2013).

Although there is a burning debate about the pros and cons of PPP’s, proponents argue that by accessing private finance, PPPs allow the public sector to procure projects which would otherwise be impossible, although it is also acknowledged that the in-house skills to manage these projects is often deficient (Devkar and Kalidindi, 2013; Osborne, 2000). Furthermore, by having a single point of responsibility over an asset’s life, there is an incentive for the private sector provider to minimise life-cycle costs, produce a more efficient asset and maintain it more effectively into the future (Siemiatycki and Farooqi, 2012). Focussing on outputs rather than inputs also produces advantages in creating an incentive (not present in traditional procurement) for the private sector to up-front engineer the design, construction and FM solutions to deliver higher quality services (Cheung et al., 2010; Engel et al., 2008). Finally, by transferring risk to the private sector, there is a greater incentive to innovate in providing...
these services and the public sector can access greater management expertise in providing them (Eadie et al., 2013; Morse, 2010).

Construction is a complex and dynamic industry and all construction projects involve significant risk (Loosemore et al., 2005; Smith et al., 2014). However, the duration, scope and complexity of PPP projects introduce many additional risks: political; financial; technical; operational; sponsor; market; network and interface; industrial relations; and regulatory (Akbiyikli and Eaton, 2004; Akintoye et al., 2000; Grimsey and Lewis, 2000; Infrastructure Australia, 2008; Medda, 2006; Ng and Loosemore, 2006; Victorian Department of Treasury and Finance, 2001). Typically, these risks are presented in simple linear checklists which tend to obscure the fact that in reality, risks in PPP projects rarely present themselves in such neatly defined and independent ways. As Howick et al. (2009) and Bousabaine (2013) point out, PPP projects are complex, last over many years and involve many parties in dynamic relationships with a multitude of interdependencies. According to Kouabatis and Schönberger (2005) one of the defining characteristics of such complex organisations is that risks can propagate through numerous pathways, spreading quickly and rapidly in unpredictable and contagious ways. Helbing (2013) argues that if left undetected and unmanaged, such risks can ensure that a relatively minor and localised problem can lead to multiple cascading failures with potentially disastrous and unbounded effects.

This cascading effect is evident in the accounts of many failed PPP projects around the world. Take for instance the unstoppable insolvencies of numerous user-funded PPP projects in Australia such as the Sydney Cross City Tunnel, the Sydney Airport Rail Link, the Lane Cove Tunnel, the Adelaide to Darwin Railway and the Brisbane Airtrain road project (Hayford, 2013). Many PPPs are also highly politicised and can collapse suddenly due to changes in government and policies. For example, in 2009 the South Australian Government scrapped a plan to build new prisons near Murray Bridge, compensating three consortiums more than $10 million for wasted bidding costs. Finally, the complex financing requirements of many PPPs also make them vulnerable to the unpredictabilities of world equity markets. This was vividly illustrated during the global financial crisis which led to the deferral and cancellation of numerous PPP projects such as the Sunshine Coast hospital in Australia and the South Australian Prisons PPP. This is not just an Australian phenomenon. Tiwari and Ashish (2013) document many failed and cancelled PPP projects in India, Hall (2008) does the same in the EU and the World Bank has recently documented hundreds of cancelled and distressed PPP projects in developing countries around the world (WBPPID, 2013).

While it is important to acknowledge that there have also been many successful PPP projects, authors like Akintoye et al. (2000), Loosemore et al. (2005) and Jefferies and Megeorge (2008) argue that many of these failures can be put down to the surprisingly unsurprisingly unsophisticated, linear and reductionist way in which risks were identified, assessed and managed. The problem with current approaches is that they are based on the assumption that risks arise from singular root causes which in-turn result in linear, traceable and predictable effects. Indeed, such assumptions are critically important in the distinct and clear allocation of risk in such projects. However as Jaafari (2001), Stahl et al. (2003) and Kouabatis Kouabatis and Schönberger (2005) argue, risks in complex systems rarely arise in such neatly traceable ways. Rather, complex systems are inherently unstable and characterised by multiple elements which are so interlinked that it is rarely possible to trace a risk event back to one singular event. Furthermore, as Lehtiranta (2013) points out, the scope of traditional risk management is normally limited to one organisation, whereas risks in complex PPP projects depend on interactions between many organisations and are not manageable or identifiable by one organisation alone.

In proposing a solution to this problem, authors like Nyagwachi (2008), Masafumi (2009), Aragao and Nascimento (2010), Jing (2010) and Xu et al. (2012) argue that a ‘paradigm shift’ is needed in the way we analyse and manage risks in PPP projects. To overcome the inherent limitations of current reductionist methods, they advocate a more holistic ‘systems thinking’ approach which recognises the complex interdependencies which exist between people on these projects. However, as Meadows (2008) points out, this requires a very different way of thinking and while the value of this approach has been well established in theory, the challenge facing many organisations is how to apply it in practice. It is within this context that the aim of this paper is to explore the current barriers to adopting a systems thinking approach to managing risk in PPP projects. More explicitly, in addressing this gap in knowledge around the practical application of systems thinking in construction projects, we aim to reveal the reasons why systems thinking isn’t more widely adopted and how this could be changed in practice. This research is important because without some understanding of the barriers to implementation, arguments being put forward for a paradigm shift will fall on deaf ears and fail to be implemented in practice. This will mean that PPP project risks will continue to be considered using linear and reductionist thinking and that the inherent instability in PPP projects, arising from their complexity, will fail to be allowed for in risk management plans.

2. Using systems theory to understand project risks

Systems theory represents the philosophical basis of systems thinking and was the theoretical foundation which informed our research. The founders of systems thinking such as von Bertalanffy (1976), Meadows (2008) and Checkland (1981, 2012) define a system as an entity (natural or anthropogenic) which consists of many interconnected elements, organised in such a way to achieve a specific function for a particular purpose. From an organisational perspective, Kapsali (2011) describes ‘systems thinking’ as a holistic approach which views organisations as a series of interconnected subsystems of people, processes and technologies that cooperate towards the achievement of a common goal. Instead of studying the parts of a system in isolation (as in traditional linear thinking), systems thinking seeks to understand how these parts interact. It does...
this by focussing on ‘relationships’ within a system rather than its individual ‘parts’ and on the cyclical effects of relationships rather than linear cause-and-effects (Sterman, 2000). When used in the context of risk management, systems thinking helps us to understand the important property of ‘self-organization’ (the ability of a system’s connections and interdependencies to change, adapt and develop on their own without the influence of external managers). Systems researchers have shown that the property of self-organisation ensures that complex systems tend to settle at a ‘critical edge’ where a small change in the system can lead to catastrophic changes in the overall system through ‘cascading interdependencies’ which exist between different parts of a system. This characteristic of systems is called ‘self-organised criticality’ Kampmann (1999).

The field of Systems Dynamics (SD) has developed to operationalise systems thinking (Sterman, 2000). By modelling and simulating complex system interdependencies, SD enables managers to understand and model the structure and dynamics of complex systems allowing them to experiment, in a virtual world, with different risk control strategies to optimise project outcomes (Martinuzzi and Kopp, 2010). In ‘one-off’ and small-batch production environments like construction projects, this is very powerful since such experiments are problematic if not impossible in the real world. For example, Nyagwachi (2008) developed a systems-based PPP model for planning and implementation of PPP projects in South Africa. Aragao and Nascimento (2010) used SD to help stakeholders to decide about the bankability of infrastructure projects. Jang (2010) used SD to explore the dynamic risk interactions and interdependencies over project construction and operation of a PPP transport project. Most recently, Xu et al. (2012) used SD to develop a model for determining a rational concession price for PPP highway projects based on pro forma financial statements developed during the feasibility study period. It is not the aim of this paper to describe the SD process in detail and test its potential in the context of PPP projects. This has already been done by these researchers. Instead, below we simply summarise the essential elements of the SD approach, so that readers can understand the practical process that PPP practitioners are being asked to adopt.

In simple terms, the SD methodology consists of four main stages: Qualitative reflection; Computer Model Formulation and Simulation; Simulation Testing & Evaluation and; Simulation Policy and Interaction Experiments (Zagonel, 2002). As illustrated in Fig. 1, in contrast to the linear processes documented in widely used risk management standards and processes, SD is far from linear and involves multiple feedback loops which facilitate learning and refinement as the process evolves. Taken literally, there is in fact not start or end to the SD cycle, implying that the process of understanding and managing risk is a continuous one.

2.1. Stage one

The first stage of qualitative reflection usually happens in a workshop of key stakeholders who are asked to describe the system under consideration, its critical resources (organisations, people, money, natural, intellectual and physical) and their dependencies (hierarchical, informational, financial, social). The aim of this process is to create an aggregated model of the system which is often presented in the form of a rich picture diagram (RPD) which is simply a pictorial multi-layered representation of the real world using symbols to represent sub-systems and their relationships within a defined system boundary (Patching, 1990). For example, Chow et al. (2012) use a RPD to explore how the operation phase of a PPP hospital project could potentially be affected by a force majeure risk (in this case an extreme weather event such as a heatwave). While their results were valuable in exploring the complex risk interdependencies at play in a hospital system when exposed to an extreme weather event, they also point out the exhaustive and time-consuming process involved in creating a RPD and the challenges of bringing together multiple stakeholders from a disconnected part of an organisation who are often in conflict with each other. Given the time constraints, numerous stakeholders, multiple variables, long timeframes and complex

Fig. 1. SD methodology (Source: adapted from Zagonel, 2002).
interdependencies which typify most PPP projects, building a representative RPD is likely to be a very challenging process.

2.2. Stage two

Following the ‘Qualitative Reflection’ stage, the “Computer Model Formulation and Simulation” stage involves converting the RPD into a dynamic map of stocks and flows (a stock and flow diagram) to show their underlying physical and feedback control structure (Sterman, 2000). In simple terms, stocks represent accumulations of money, materials and information in the system and flows represent the rate of increase or decrease in those stocks over time as the system operates. Chow et al.’s (2012) research, which is described above, showed that this stage of the SD process requires specialist skills and experience. Stock and flow diagrams take an enormous amount of time and effort to build and involve multiple re-iterations and feedback interactions with all key stakeholders in the system. Furthermore, in the context of a PPP project, the accurate representation of stocks and flows over long periods of time and between so many stakeholders can be very problematic and is likely to be accompanied by very large margins of error. Given inevitable changes in the nature of the built asset, its operating environment and the stakeholders involved over a concession period of thirty years, such models would need to be subject to frequent review and updating if they were to be of any value at all.

2.3. Stage three

During the third “Simulation and Testing” phase the stock-and-flow model is progressively refined with stakeholders to ensure that it accurately represents the behaviour of the system. When a representative model is built which all stakeholders are happy with, then the system variables can be manipulated under different risk scenarios to understand how they affect the achievement of the desired outcomes. In the case of a PPP project, the outcomes would be the defined service standards (key performance indicators) against which the consortium will be paid.

2.4. Stage four

In stage four of the SD process, managers conduct ‘virtual intervention experiments’ to explore under the different scenarios how alternative management strategies can minimise impacts on KPIs, testing them using the SD model. The alternative policies, strategies and structures tested will rest on the imagination, experience and skill of the system stakeholders and the SD model will show which options are ‘likely’ to mitigate risks to KPIs and produce the best combined outcomes for the stakeholders involved.

3. Method

As discussed above, there is considerable evidence that in theory at least, SD holds significant potential in advancing our current linear and reductionist understanding of risk in PPP projects. Nevertheless, our guiding proposition in this research was that this represents a very unfamiliar way of thinking for most people and is potentially challenging to implement in the complex and dynamic environment of PPP projects. This important proposition has been largely ignored and we currently have very little understanding of the challenges people may encounter in adopting this new approach to managing risk.

To explore our proposition, we undertook semi-structured face-to-face interviews with sixteen experienced and senior professionals in Australia who had worked in a variety of roles on numerous PPP projects and had intimate involvement in the risk analysis and management process (see Table 1 for respondent details). Given the multidisciplinary and interactive nature of the SD process, we stratified the sample into four professional groups to obtain a variety of professional insights into the research questions. Respondents were sampled randomly by contacting firms which were listed on Infrastructure Australia’s website http://www.infrastructureaustralia.gov.au/public_private/ which is Australia’s peak infrastructure body which has the primary function of providing advice to Australian governments, investors and owners on all matters relating to Australia’s social and economic infrastructure future needs and priorities. We asked the firms to pass our request to the people in their business who were responsible for analysing risk and the sixteen professionals who agreed had collectively worked on over 100 PPP projects around the world (both social and economic infrastructure) over a period of 15 years with a combined value of over AU$20 billion.

Our semi structured interviews lasted for an average of 1 h and consisted of five key questions. Since we were asking our respondents to talk about past projects they had worked on, we sought to minimise recall error by following the recommendations of Gall et al. (2003) and Turner (2010) and used the first two questions to ‘jog’ our respondent’s memories of the PPP projects they had worked on. The first question asked them to describe some PPP projects they had worked on in the last 5 years and the second question enquired about the main risks and challenges that had arisen on those projects and how they had been identified and analysed. We then asked the respondents three simple questions:

1. If a systems dynamics approach had been used, what would have been the challenges involved?
2. How could systems dynamics have benefited the identification and management of risks in these projects?

<table>
<thead>
<tr>
<th>Table 1 Sample structure</th>
<th>Number of research participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project managers (responsible for the overall management and delivery of the project)</td>
<td>3</td>
</tr>
<tr>
<td>Quantity surveyors (responsible for the management of costs)</td>
<td>3</td>
</tr>
<tr>
<td>Risk management professionals</td>
<td>4</td>
</tr>
<tr>
<td>PPP consultants/advisors (responsible for the up-front financial feasibility, funding and financing of the project)</td>
<td>6</td>
</tr>
<tr>
<td>TOTAL</td>
<td>16</td>
</tr>
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</table>
3. What are the reasons why the traditional risk management approach is still used?

We used a semi-structured face-to-face interview approach because we wanted our respondents not only to be guided in their answers but also to talk generally about the challenges they saw in moving to a completely new approach. We also knew they would have questions for the researchers about the SD approach. So the interview process became a two-way interaction where both researcher and respondent could agree on their common understanding of what is being said. As Opdenakker (2006) shows, the advantage of this approach to interviewing is that it enables the respondent and researcher to interact in the exploration of subjects that may be unfamiliar to one or the other. In the case of this research, this was important because it was inevitable that our respondents had variable familiarity with the SD approach. Another advantage of this approach is in exploring issues where there is no previous insight and research, as was the case in this research. In this research, while numerous authors had proposed that an SD approach might be useful to assess risks in PPP projects, there was no indication of what the barriers to adoption might be. In line with this exploratory approach our analysis involved using the narrative of the discussions rather than reduce the data to quantitative counts of variables via content analysis. There are two reasons for this. First, we did not seek to test the relationship between any independent and dependent variables. We simply wanted the respondents to tell us about their experiences and insights which would then allow us to generate more specific insights which could be tested in the future. Second, we wanted the results to retain the full richness of insight contained in the narratives we collected from our respondents, so that readers can draw their own conclusions from what was said. As Meisel and Karlawish (2011: 2023) note, the power of narrative is in translating respondent accounts into data that people can comprehend. Clearly, it is not possible to recount everything that was said in this paper. So what is presented below are the main points which were issues of agreement across all the interviews in relation to each question asked.

4. Discussion of results

In this section we present representative quotations from the interview narratives. The results are organised into three sections:

1. What are the challenges in introducing a systems thinking approach into PPP projects?
2. How can systems thinking potentially benefit the identification, analysis and management of risks on PPP projects?
3. Why isn’t systems thinking used in practice?

4.1. What are the challenges in introducing a systems thinking approach into PPP projects?

Most participants believed that breaking habitual industry practices and traditional ways of thinking would be the biggest challenge in introducing a systems approach.

“We'll, I think the big challenge is actually getting people to think systemically.” (Resp #1).

“Because people have a resistance to change and they tend to want to do things the way they’ve done them before. The old argument in any aspect of business “Oh no, we haven’t done that before!” That becomes the greatest barrier to change.” (Resp #4)

“I think in the construction industry there’s a lot of old dogs still. ... And there are people out there not willing to change at all.” (Resp #14)

A number of respondents also felt that the SD approach was overly complex and that the relational risk data required to implement it in practice on PPP projects was not commonly available.

I think it could benefit by simplifying it for a lot of people. If it’s simpler, then people will adopt it. (Resp #8)

“As systems thinking requires people to understand the complex project as a whole, it is a difficult challenge to get all the appropriate information and data into a timely manner ....” (Resp #6)

“The difficulty with that is getting all the appropriate information and data in a timely manner... Normally we just sit down with a group of experienced people who understand what we’re trying to do and we go through and say that’s a risk because we’ve experienced. ... There just needs to be a lot more information that needs to be available to go into that [an SD process]”. (Resp #7)

Some respondents argued that an SD approach might be resisted because it would require breaking down existing power and communication structures on PPP projects.

“... the challenge is how do you bridge those different interests in the process over time .... It’s also communication. Not just from the initial design intent through to operation but back the other way as well, from the operational functional need back to those who are conceiving and designing.” (Resp #6)

“More challenges will arise if every individual wouldn’t easily interact with other disciplines unless they are given the authority to do so. This is particular obvious in government bodies, where inter departmental communication will be limited to senior level. Without direct access to other discipline, it’s hard to explore the available solution.” (Resp #7)

Unfamiliarity with the SD approach and a lack of guidelines to follow was also an issue raised by our respondents.

“The main challenge I think is that it’s not currently widely adopted within the infrastructure space.” (Resp #4)
“... the first challenge would be for me to understand what that systems approach really means. When we put together a risk register, we do try and think about the overall picture. ... I don’t know whether that can be regarded as a systems approach ...” (Resp #9)

“If there’s some sort of background of information, guidance, what needs to be done, standards. What we’re doing is based on the ISO 31000 and that standard, that’s world documented.” (Resp #13)

More education around SD was seen as crucial to bringing about its acceptance in the construction community.

“... it would require a bit of education still to the executive management team and participation I think amongst a broad spectrum of employees involved in projects ...” (Resp #11)

“The other problem is you’ve got to have more general, holistic education rather than individual subjects because systems thinking goes across many subjects so you need to change the way you teach individual disciplines.” (Resp #5).

“Part of the problem is that ... it’s very rarely taught in any universities. It’s not embedded in anyone’s psyche. We just don’t think that way.” (Resp #1)

Some respondents pointed to the legal implications of moving to a systems perspective and defended current approaches.

“One of the benefits of the current more narrow approach is more rigid allocation of risk and that means that one party is usually then accountable for a loss in the event that that risk arises. One of the challenges for adopting a slightly broader approach is to then say ... Well, haven’t you actually then blurred who’s actually responsible for that risk and shouldn’t you actually be trying to hold parties accountable for the specific roles etc. that they’ve actually taken on?” (Resp #2).

“... one cannot easily identify what is the actual effect of any particular action, as the combined impact can be quite complex.” (Resp #12)

There were also concerns about public perceptions of accountability if an SD approach was to be used. This was perceived to have held back approvals for PPP projects in the past and therefore could be a significant issue.

“The real problem you actually face with that is you’ll lose financial discipline over who’s responsible for managing costs within the agreed budget and the criticism that has been given to by some people in the marketplace is that unless people are accountable for particular cost outcomes, and agree to a pricing regime upfront, you’ll actually simply have a project being delivered on a cost-plus type basis and that you will lose that degree of incentive for people to minimise cost, they’ll just try and pass it through to government.” (Resp #5)

Finally, there was a sense that SD would not be adopted because it was not yet proven in practice.

“It’s not yet proven in practice.” (Resp #7)

“It’s got to be a proven, tried methodology. It’s not an accepting thing. It’ll come with time if you can prove that this methodology or approach can do all that the current risk assessment standard can.” (Resp #10)

“Prove it to me and then prove it to me again and then I might adopt it. I think in identifying the barriers you probably need to do a bit of side research and look at barriers to change. It’s that generic.” (Resp #11)

4.2. How can systems thinking potentially benefit the identification, analysis and management of risks on PPP projects?

Despite the many barriers described above most saw the SD approach as having significant potential value for better understanding of risks on PPP projects.

“... what you’re describing in terms of a system based approach to risk assessment, I think would be crucial to looking at projects holistically. Too often our industry looks at things in a fragmented approach.” (Resp #6).

“... the current model requires individual identification of risk... you allocate to one party or another and that tends to lead to a somewhat adversarial outcome... If you had, a broader systems based approach, it may be possible to have both parties working more collaboratively where they’re both taking responsibility for managing the risks together ....” (Resp #8)

To support their opinions, our respondents provide numerous examples of problematic PPP projects which might have benefited from an SD approach.

“The best example where systems thinking wasn’t applied was on the Cross City Tunnel. The tunnel basically runs from east to west across the city. They put a toll on it with forecast traffic projections which were wrong. And then everybody started using what they call “rat runs” just to avoid it and go through the backstreets of Kings Cross and so started blocking the streets. That could have been foreseen if someone had used a systems thinking approach and looked at it holistically on what’s going to happen if you put a toll on this road and what alternatives they had.” (Resp #2)

“There’s always going to be a need for the big picture. One example would be the Lane Cove Tunnel. Marvellous piece of infrastructure, it was built well by the private sector, it charged tolls, but at the end of the day the amount of traffic that was actually using that particular facility didn’t actually
reach the levels that the private sector was hoping for. No one predicted that because the causes were too complex and as a result of that, the company that was actually operating the concession went bankrupt.” (Resp #5)

4.3. Why isn’t systems thinking used in practice?

The majority of respondents believed that traditional linear approaches to risk management persist because of people’s familiarity with the standard risk management process, the fact that it is simple, easy to understand and straightforward and that it is supported by an international standard.

“I think people can understand it. It’s structured, it’s straight to the point and you can do it. ... People who know a project can do that relatively easily. And it’s quite logical — you identify the risk, you work out what can I do to mitigate that risk. The tables are all there, you plug the numbers into an excel spreadsheet and it works it all out for you.”

“There is a standard to guide behaviour “Under AS4360,” you identify issues or indeed outcomes and you look at the likelihood of the event and its resulting consequences and that’s how you rate risks. It at least gives us a language and a framework to work with.” (Resp #7).

“It’s an accepted international ISO standard so it’s not just Australia — it’s international. It’s been around for a while. It’s a proven methodology. It’s got history on its side and it keeps evolving.” (Resp #12)

Our respondents also indicated that traditional methods give people certainty over allocation of risks and responsibilities and therefore greater accountability, whereas an SD approach might confuse this.

“The risk management approach deals with risk items separately and therefore seems to be more accountable and measurable. In a management point of view, one would like to see a straight forward result of his/her adopted strategy, rather than to see a mixture of impacts that becomes so remote to one’s direct effort.” (Resp #7).

“Well, I probably feel it’s because it gives people some comfort over cost outcomes and allocation of responsibilities.” (Resp #15)

Finally, it was clear that most people felt comfortable with the linear thinking required by the traditional approach.

“Familiarity is part of it. ... It’s what they know and people are trying to get projects to fit within their known learning or systems ... there is that assembly line thinking which is all about efficiency and having found a system people will tend to maximise the efficiency of that system before they’ll change that system.” (Resp #1)

“It’s pretty much idiot proof. People understand that matrix of low, medium, high and extreme. The way it’s presented and coloured. I think that it’s very transparent. .... It allows people to schedule what the problems are. I’m a person that likes lists. Even when I come in during the day, I’ll have a list of what to do and prioritise them. And once you put in the likelihood of all the risk issues, it lists them in order of the problems. So in doing that it kind of gives people an attack list. The risk actually becomes actionable. So it allows people to do things about risks rather than just accept them for what they are.” (Resp #11)

5. Discussion of results

Given the lack of application to SD by our respondents, the above findings indicate that in PPP projects there is a tendency to treat people in isolation when managing risk, rather than look at the relationships and interdependencies between them. This supports the work of Meadows (2008) who argued that most people are simply not used to thinking holistically about problems, but tend to split them into their smaller component parts and study them separately. According to Meadows, this in turn would mean that important system characteristics which could lead to project failure (such as self-organised criticality) would be invisible to project managers. Our results indicate that in a PPP project context there are a number of important reasons why this is the case. First, pedagogically, our respondents admitted that systems thinking required a very different way of thinking which they had not been taught to do in practice, training or education. Second, our respondents felt that they had no choice to think in this way since traditional contracts that used to distribute risk on PPP projects focus where ever possible on allocating them to individuals, rather than sharing them. This in-turn forces people to ignore risks that might arise from the interdependencies which link parties together in favour of those which can be neatly allocated to individuals. In contrast to systems thinking which fundamentally questions the ability to identify neat cause-and-effect relationships when things go wrong, existing contracts are based on the opposing belief that it is possible to deterministically identify the root causes of problems and clearly allocate blame. So it is not surprising that our respondents felt that by changing existing practices to highlighting risks that fall ‘between’ project participants rather than ‘on’ them, there would be a perceived loss of accountability if problems arose, raising difficult legal questions about who would take responsibility for any associated losses. Furthermore, our findings suggest that the trust which is necessary to share risk information to enable more holistic thinking to occur, is absent from most PPP projects. In other words, the data is simply not currently present to enable risk interdependencies to be understood and managed. At the moment, the most common form of PPP risk data relates to frequencies of individual risks which have largely occurred in isolation, rather than chains of interdependent risks which have developed over time. So our results suggest that people on PPP projects have been conditioned to think in linear ways by the
ways in which traditional contracts distribute risk. It therefore follows, logically that more relational and collaborative type contracts such as alliances, might be more sympathetic and conducive to a systems thinking approach — an interesting question which needs to be tested in future research.

Our findings also support the views of Kapsali (2011) and Lehtiranta (2013) who have both highlighted the path dependencies which lock people into established ways of managing risks. However, it also extends their work by highlighting how strongly people rely on published guidelines and standardised methodologies to guide the way they work and how reluctant they are to adopt new approaches that might place them outside established industry norms and practices. Our respondents clearly felt protected by international standards and guidelines around risk management and conversely, would feel exposed to possible blame if they try something else. Our results suggest that unless systems thinking is enshrined in international standards and guidance, then it is unlikely to be widely adopted throughout the industry, regardless of how much research shows that it is of value. This is a second interesting research question worthy of further exploration in future research.

Our results would also seem to support the recent work of Kahneman (2011) who demonstrates that people tend to rely on heuristics as a way of simplifying complex multidimensional problems. Our respondents suggest that this may be due to the unfamiliarity and perceived complexity of the SD approach and a general lack of resources, time and expertise in PPP projects to put it into practice. Kahneman (2011) calls this ‘System 1 thinking’ and argues that heuristics are not simply a sign of mental laziness but a human survival mechanism for situations when decisions need to be quickly or when there is simply too much information to absorb and assess. As Herbet Simon (1956) found in his famous explorations of ‘bounded rationality’ in human decision-making, the rationality of individuals in making decisions is constrained by the cognitive limitations of their minds and the finite amount of time that they have to make a decision. So when faced with a complex problem that they cannot understand, people will reduce problems to simple principles and solutions rather than spending the time and effort to optimize their decision (a process called satisficing). Since Simon’s (1956) early work, numerous heuristics have been identified by psychologists such as Tversky, Kahneman and Koehler (Tversky and Kahneman, 1974; Tversky and Koehler, 1994) which raise the question of not only whether heuristics are being used to assess and manage risk in PPP projects but what form these heuristics may take. This represents a third interesting question for future research in this area.

Our findings also support the work of Nyagwachi (2008), Masafumi (2009), Aragao and Nascimento (2010), Jang (2010) and Xu et al. (2012) who have all conceptually demonstrated the potential value of a systems thinking to overcome this problem in PPP projects. Our results show that practitioners believe that there are potentially significant practical benefits to be gained from what has so far been a largely theoretical discussion about the value of SD in managing risk on PPP projects. Our respondents believed that an SD approach would enable a holistic view of the complexities and life-cycle implications of PPP projects to be better understood. They also agreed that the SD approach better aligns with the aspirations of a partnership approach. Our results appear to support Yingying and Loosemore’s (2013) research into opportunistic behaviour on PPP projects which asserts that many PPPs are partnerships in name only and that it in many cases they have simply represented a rhetorical device to transfer as much risk as possible down the contractual chain. This brings us to a fourth important question for future research of whether the adoption of a systems approach might facilitate the sorts of behaviours that would typify an effective partnership. This question would also have to address the fundamental question of whether it is the system of thinking that influences the way that people behave or whether it is the other way around.

Finally, given all the barriers that have been identified in this research to the adoption of a systems thinking approach, it would appear that a paradigm-shift in the way that practitioners think and manage risk in PPP projects is required. In indicating what this paradigm shift might look like, Senge’s (1990) formative work which advocates systems thinking as a mechanism to integrate the five disciplines of what he refers to as a “learning organization” (personal mastery, mental models, building shared vision and team learning) might be useful. Certainly, a paradigm shift in thinking is needed if the recommendations of researchers like Nyagwachi (2008), Masafumi (2009), Aragao and Nascimento (2010), Jang (2010) and Xu et al. (2012) were to be implemented in practice. However, while this may be easy to ask for in theory, it is important to ask what this may mean in practice. To this end, Blanche and Durrheim’s (1999) work is useful because it defines a paradigm as a system of thinking which consists of two main dimensions: ontology and epistemology. First, from an ontological perspective, moving to a systems thinking perspective would involve moving from an objectivist to constructivist position. While objectivism assumes that there is one true reality that can be understood through scientific methods such as those which guide traditional risk management thinking, constructivism views that there are multiple realities which are socially constructed from the individual and interactional perspectives of different roles and professions on a PPP project. Epistemology, this means that practitioners on PPP projects would need to adopt an interpretive methodology which would require them to interact closely with different project stakeholders to understand their individual perceptions of risk and how their relationships might produce different project outcomes. It is clear from Blanche and Durrheim’s (1999) definitions that paradigm shifts are not easy, which brings us to our last important question for future research of whether and how it is possible to bring about the desired change in existing risk management paradigms in PPP projects.

6. Conclusion

The aim of this paper was to explore the current barriers in adopting a systems thinking approach to managing risk in PPP projects, to explore the reasons why systems thinking isn’t more widely adopted in the construction risk industry and to propose how this could be changed. This research was set within the context of growing calls in the PPP research literature for the adoption of systems thinking as a way to better manage risk in
these complex projects. After exploring the literature on systems thinking and undertaking interviews with sixteen practicing professionals we have provided a better understanding of the barriers which have to be overcome in implementing such an approach. The main barriers to the adoption of systems thinking are: conflicts of interest within PPP projects; traditional connotational methods of managing risk; resistance to change; lack of time and resources; perceptions of complexity; unknown legal implications of sharing risk, and external validation of existing risk management practices. It is clear that while PPP projects create the need for systems thinking, they do not appear to create the project culture which allows it to be adopted in practice. It is concluded that in moving to a systems thinking approach, deeply imbedded ontologies, path dependencies, confrontational practices, perceptions and ways of thinking will need to be challenged.

Our results have also identified important questions for future researchers to address in better understanding how we implement a systems approach in practice:

1. Do relational type contracts produce more holistic ways of thinking about risk?
2. Do we require systems thinking to be enshrined in international standards and guidance for it to be adopted in practice?
3. Are heuristics being used to assess and manage risk in PPP projects and if so, what form do they take?
4. Would the adoption of a systems approach facilitate the sorts of behaviours that would typify an effective partnership?
5. Is it possible to bring about a paradigm shift in risk management thinking in PPP projects?

The practical implication of our research is that people involved in PPP projects need to be thinking in new ways which reflect the time-scales, complexities and interdependencies of such projects. Moving people to adopt a systems thinking approach will require a more trusting environment where people feel comfortable sharing risk-related information in an open and transparent way without fear of legal exposure or of losing accountability. The development of guidelines and standards to support this approach is essential to give people the confidence to think differently. It must also be pointed out that SD is only one way to operationalise the systems theory, and one of the most complicated. Due to the significant obstacles we have uncovered, it might be sensible to start with systems thinking only as a way of thinking first, and to move to the full model of SD as second step. Finally, our findings have implications for the way that construction management is taught at universities. In particular, students need to be taught to think about projects and risks in ‘joined-up’ rather than ‘deterministic’ ways. Instead of splitting projects into smaller-and-smaller parts and treating them in isolation, educators need to take a more holistic approach which conceptualises projects as a collective whole and which recognises the implications of the complex and dynamic interdependencies between the many professionals which contribute to them.

Finally, it is important to note the limitations of this research and the need for further investigation into this risk management technique. First our sample size was relatively small and we did not seek to delineate the responses of the different professional groups on our sample. To do this sensibly would require a greater sample size and some statistical analysis, which was not the intention here. In terms of further research, it is also interesting to note that the issues of costs and gains were not raised by our respondents despite SD being complex, time consuming, needing specialists and the collaboration of many high-paid staff from different companies. It would be interesting to know: how much the application of SD costs an average PPP construction project against the potential gains in terms of better risk assessment or risk avoidance.

Conflict of interest

There is no conflict of interest.

References


