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IPD-inspired framework for measuring stakeholder integration in public-private partnerships

Zeina Malaeb
Department of Civil and Environmental Engineering, American University of Beirut, Beirut, Lebanon, and
Farook R. Hamzeh
Department of Civil and Environmental Engineering, University of Alberta, Edmonton, Canada

Abstract

Purpose – In a public-private partnership (PPP), the private sector is represented by a company termed the special purpose vehicle (SPV), which combines different stakeholders including designers, contractors and service providers under one umbrella. Correct SPV team selection is critical to ensure PPP success as the SPV must act as an integrated entity. In fact, unless the SPV takes an active role in developing trust and promoting integration principles, segmentation of interests, highly adversarial atmospheres, loss of value and economic inefficiency will prevail. Absence of awareness of such principles among stakeholders and the scarcity of literature investigating SPV stakeholder integration create great risks that jeopardize project success. Accordingly, to mitigate the aforementioned risks and provide stakeholders with both the knowledge and the tools to instigate and maintain integration, this paper aims to develop and test a framework to measure SPV stakeholder integration, inspired by the correlation between integrated project delivery (IPD) and SPV operations.

Design/methodology/approach – Following a design science research approach, a structured review is conducted to develop the SPV integration metrics and framework. The framework is then validated through face validation by a panel of industry and academic experts to assess its applicability in measuring SPV integration. Finally, the framework is tested on a well-recognized international PPP project to measure the SPV integration level, and the outcomes are discussed and analyzed.

Findings – The framework was able to assess the integration level of the studied SPV highlighting several areas of low-integration settings and providing guidance for achieving better integration.

Originality/value – This research is the first that develops a model to investigate the SPV's integration level, from a holistic IPD perspective, to enable successful relationship management and enhance collaboration success. This study inspires practical recommendations for PPP practitioners to reduce the risks of segregated SPVs and their contribution to PPP failure.

Keywords Partnering, Lean construction, Public-private partnerships, Contracts/PFI, Special purpose vehicle, Stakeholder integration, Collaboration, Integrated project delivery (IPD)

Paper type Research paper

Introduction

A public-private partnership (PPP) is a distinct project delivery route that establishes an association between the public and the private entities for the provision of a public asset or service.

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PPP projects create unique relationships between the different stakeholders, especially at the level of the private entity in charge of delivering the project, termed the special purpose vehicle (SPV).

The SPV is formed specially to undertake the PPP contract and enters into a long-term contractual agreement – usually for 30 or more years – with the public entity for the financing, designing, building, management and operation of a public facility. To fulfill these functions, the SPV is structured as a consortium, combining under one umbrella a number of key stakeholders responsible for project delivery, mainly equity shareholders, designers, construction contractors and operation and maintenance contractors (McErlane *et al.*, 2016).

Correct SPV team selection is critical to ensure PPP success as the SPV must act as an integrated entity (Kumaraswamy *et al.*, 2007). In fact, value on a PPP project is largely generated through the relationships and interactions of stakeholders, which makes stakeholder collaboration pivotal to achieve overall project success (Smyth and Edkins, 2007). This notion proposes a correlation between SPV operations and the integrated project delivery (IPD) system, being a delivery route founded on and aiming at stakeholder integration (Thomsen *et al.*, 2009). Therefore, studying PPP success mandates a comprehensive assessment of the SPV's stakeholder integration efficiency, which would benefit from the projection of collaboration factors from IPD considering the latter to be rich with research on integration (Malaeb and Hamzeh, 2018).

Problem statement

PPP researchers underline the contribution of relational contracting practices and strongly integrated SPV teams to improved project outcomes and overall project success (Kumaraswamy *et al.*, 2007; Ling *et al.*, 2013; Zou *et al.*, 2014). Moreover, researchers have concluded that unless the SPV takes an active role in developing trust and promoting integration principles, segmentation of interests, highly adversarial atmospheres, increased transactional and legal costs, reduced value for money, loss of value and economic inefficiency will prevail (Edkins and Smyth, 2006; Ling *et al.*, 2014; Reeves, 2008). However, awareness about such integration principles is absent among SPV stakeholders, and literature on PPPs is deficient in addressing the SPVs internal stakeholder interactions, its role in stakeholder management and coordination and its integration efficiency (McErlane *et al.*, 2016; Sainati *et al.*, 2017). This current situation creates great risks that jeopardize PPP project success. Accordingly, there is a need to mitigate the aforementioned risks and provide stakeholders with both the knowledge and the tools to instigate and maintain integration to endorse overall PPP success.

Research objectives and contribution

This research addresses this need through developing an IPD-inspired framework to measure SPV stakeholder integration, comprising metrics projected from IPD foundations. The framework is presented in a user-friendly interface, and a rubric is developed to facilitate its practical application on PPP projects. The framework is tested on a well-recognized PPP airport project to assess the level of SPV integration and the results analyzed to identify shortfalls and draw conclusions. This research fills the existing knowledge gap by being the first of its kind that develops a framework to investigate the SPV's integration level, from a holistic IPD perspective, to encourage relationship management, enhance collaboration and promote project success.

Literature review

Significance of stakeholder integration for the special purpose vehicle

Previous research has highlighted the necessity of investing in effective relationship management practices to ensure efficient SPV stakeholder collaboration and integration

(Smyth and Edkins, 2007; Walker and Jacobsson, 2014). Stakeholder integration is formally defined as a setting where different organizations with different goals and cultures combine into a unified cohesive and mutually supportive unit whose core function is effective collaboration for successful project delivery (Baiden *et al.*, 2006). Stakeholder integration is critical for PPP success as this success largely depends on enhanced project cultures and integrated teams (Kumaraswamy *et al.*, 2007). In the absence of integrated SPVs, the adversarial environment and detrimental consequences of traditional transactional procurement routes would triumph (Reeves, 2008).

Correlating special purpose vehicle operations to integrated project delivery foundations

Being the fundamental cornerstone of SPV project delivery, stakeholder integration brings forward the former's correlation to IPD philosophy and systems (Malaeb and Hamzeh, 2018). IPD defines that stakeholder integration stems from three foundations: organization structures, contractual frameworks and operating systems and processes, as detailed by Thomsen *et al.* (2009) and summarized below:

(1) Organization structures:

IPD describes organization structures formed of integrated teams comprising key stakeholders and the early engagement of contractors to collaborate with designers. Decision-making and problem-solving practices involve all stakeholders which develops a project culture that encourages collaborative working as a unified team. IPD converts the project structure from vertical silos into integrated high-performance teams.

(2) Contractual frameworks:

IPD comprises contractual frameworks that align stakeholder goals and objectives with the overall project objectives, through addressing risk allocation and compensation structures among participants. Integrative contractual framework calls for collective risk management. Further, "pain sharing and gain sharing" agreements – whereby all team members mutually share the risk of cost overruns and mutually benefit from cost savings – instigate parties to work toward a unified goal of ensuring overall project success.

(3) Operating systems and processes:

IPD uses technologies that ensure open and effective interaction and communication between participants. IPD further implements project processes and mechanisms to manage the interactions among stakeholders and foster the integration potential of the project. Examples of these processes are: integrated setting of project goals and objectives, collective decision-making and integrated project management, collaborative planning with key project stakeholders and involving the last planner in the planning process.

Research motivation and formal point of departure

Shortcomings of previous research

Previous researchers have used different perspectives and tools in investigating project stakeholder integration. Some have correlated the degree of integration to the quality and quantity of organizational interactions (Pocock *et al.*, 1996) while others have based their quantification on different integration factors (Baiden *et al.*, 2006; Cheung *et al.*, 2006; Harper, 2014; Ibrahim *et al.*, 2013).

However, the developed integration frameworks are not fit to be applied to the SPV, considering the increased complexity and uncertainties inherent in PPP projects, added to the uniqueness of the delivery route and the SPV structure and characteristics.

Formal point of departure

The explored literature reveals that there is a critical need for efficient SPV team selection and integration for successful PPPs. Based on a thorough review of the literature, no studies to date have attempted to evaluate SPV stakeholder integration, and none have based their measurement of project integration on IPD foundations. Therefore, a framework to measure and instigate SPV integration is required to mitigate the risks attributed to segregated SPVs and promote project success. Considering the connection between the SPV and IPD, added to the fact that the IPD field is rich with research on integration, there is an opportunity for projecting IPD concepts onto the SPV evaluation framework.

This research develops an "IPD-inspired framework" to provide a measure of SPV integration. The developed framework is tested on a PPP project, the results analyzed and conclusions drawn on that basis.

Methodology

The methodological approach followed in this study to develop the SPV integration framework is design science research (DSR). DSR develops instrumental, as opposed to conceptual, tools to achieve practical desired outcomes (Van Aken *et al.*, 2016). DSR dictates that the "process" must follow a thorough search scheme and rigorous construction methods to construct the output product. Additionally, the "product" should comprise a viable artifact that is of relevance and proposes a novel research contribution (Hevner *et al.*, 2004).

The research process followed the steps outlined as follows:

(1) Construction and validation of the SPV integration framework:

- Step 1: selection of SPV integration metrics:

The first step comprises the development of input metrics that measure the different aspects of SPV integration. Therefore, a systematic review is conducted with the directed purpose of identifying and developing metrics to measure stakeholder integration, based on the guidelines made by Hong *et al.* (2012) and adopted by Ibrahim *et al.* (2015). Accordingly, the authors performed a selective search to identify articles with the following phrases in subjects, titles, keywords or abstracts: relational contracting, collaborative, supply chain integration, interorganization, project team, IPD and integration. Consequently, a more focused search was carried out, and the abstracts of all articles were reviewed to determine their applicability.

For the subsequent exercise, the authors collaborated with a group of experts in the field PPPs and IPD, who formed part of the expert panel involved in the subsequent step of validation. As such, the established integration factors were selected, filtered and grouped in terms compatible with SPV operations in PPPs. Finally, the factors were organized under a four-level hierarchy along the IPD system's three foundations: organization structures, contractual frameworks and operating systems and processes.

- Step 2: validation of the metrics:

Face validation is used to corroborate the significance of the identified factors. Face validation relies on the input of experts on the issue to evaluate the correctness and reasonability of the constructed framework (Sargent, 2010).

Accordingly, an expert panel is formed from 12 practical professionals and academic experts in the field of IPD, PPPs and collaborative project delivery routes. The experts

assessed the level of significance of the factors of integration identified in the previous step to validate their applicability to the proposed framework. Their feedback was obtained through different means, mainly research workshops, face-to-face and virtual interviews and online surveys.

- Step 3: rating the metrics using the analytical hierarchy process (AHP):

It is necessary to identify coefficients of importance for each input factor as every factor has its own contribution weight to the overall integration level. To satisfy such purpose, the AHP, a multiple-criteria decision-making process that is used to set priorities among different criteria, is adopted (Alharthi *et al.*, 2015). The method has proven to be theoretically sound and consequently has received widespread acceptance demonstrating the capability of producing results that agree with perceptions and expectations (Bhushan and Rai, 2007). As every project and stakeholder structure is unique, the AHP ranking should be applied on a case-to-case basis using the input of the project stakeholders to ensure optimal representation.

- Step 4: presenting the IPD-inspired SPV integration framework:

The final framework formulae and the framework interface on Microsoft Excel are presented.

- Step 5: constructing the rubric for framework application:

A rubric is constructed to ensure consistency in rating the metrics and facilitate the practical application of the developed framework. The rubric specifies the degree of achievement of each integration metric according to adopted practical measures. The rubric is largely based on the measures presented by Baiden *et al.* (2006) and further developed and customized using the input of (a) members of the expert panel who are experienced in PPPs and (b) benchmarks used in previous studies that investigated stakeholder integration.

(1) Results and discussion:

- Step 6: case study application:

The developed framework is tested on a PPP project to investigate the SPV's management success in terms of its achieved degree of integration. The case study involves a well-known PPP airport project, and information is gathered through direct interviews with representatives of the different stakeholders involved within the project SPV.

(1) Rating the SPV integration metrics using the AHP:

The project stakeholders, through an anonymous survey, rated the input metrics using AHP in terms of importance. Subsequently, the results were input into a built-in AHP calculator on Microsoft Excel which underwent the required statistical analysis and generated the coefficient of importance for each factor.

(2) Application of the SPV integration framework:

Discussions with key senior personnel from the project management entity, the SPV contractor and the SPV operator were held to gather facts on the SPV's organizational structures, contractual frameworks and operating systems and processes. After forming a solid understanding of the project background, a self-assessment is conducted, using the developed rubric, to rate the degree of achievement of the different factors. The self-assessment serves to preserve the objectivity of the case study and avoid sensitive issues arising between the different interviewed parties.

- Step 7: conclusions and recommendations:

Finally, the paper presents the conclusions of this research and outlines the relevant significance and contribution of the output framework.

Constructing the integrated project delivery-inspired integration framework

Developing and organizing the special purpose vehicle integration metrics

The identified integration factors obtained from the systematic review of the literature are summarized in Table A1 in the Appendix.

The selected and developed factors for this study are presented in Table 1, classified as per their respective grouping and their level under the hierarchy. Under Table 1, each factor is assigned a specific identification code to facilitate its use in the formulae presented later.

Validation of the metrics

To validate the metrics, an expert panel was formed of senior members from professionals and academics experienced in collaborative project delivery. The profile of the participants is described in Table A2 in the Appendix.

The authors received responses from 12 participants, with 83% of the participants having over 20 years of experience. Following the logic of Coviello and Jones (2004), despite the relatively small number of participants, the feedback of the panel is considered significant as the respondents are drawn from a high-quality experienced group of academic experts and practical professionals.

The members of the expert panel all confirmed that the identified factors are necessary to measure the success of stakeholder integration and are therefore applicable for use in the framework.

Rating the metrics using the analytical hierarchy process

When applying the framework to a case, each input metric will be assigned a degree of importance – reflecting its relative contribution to stakeholder integration – based on the input of the SPV stakeholders on the specific project being investigated. This customization ensures an accurate representation of each project's unique structures and characteristics.

As such, the project participants would compare the different factors under levels 2, 3 and 4 of the AHP hierarchy. This comparison process involves a pairwise assessment of each factor against others of the same level in the hierarchy in terms of their relative importance. The factors of level 4, under each subheading, are compared to each other. Next, the factors of level 3, under the three main headings, are compared within their groupings. Finally, the three headings (level 2) are evaluated against each other. The AHP scale used for comparison is as defined by Saaty (1991).

Presenting the integrated project delivery-inspired integration framework

The formulae for calculating the integration levels under different headings are summarized in equations (1) (1.1–1.4), (2) (2.1–2.3) and (3) (3.1–3.4) below, while the overall formula comprising the integration framework is presented in Equation (4). The coefficients denoted x ($x1$ to $x3$), sub-coefficients ($y1$ to $y11$) and sub-sub-coefficients ($z1$ to $z28$) represent the relative ratings of the factors that would be obtained from using the AHP later on once the case study is conducted.

Equations 1 (1.1 to 1.4): organization structures integration level.

Equation 1: organization structures integration level.

Level 1		Stakeholder integration				
Level 2	O	Organization structures	C	Contractual frameworks	P	Operating systems and processes
Level 3	O1	Single integrated team	C1	Compensation structure	P1	Collaborative systems
	O2	Early involvement of key participants	C2	Collective risk management	P2	Collaborative project management
	O3	Integrated project and stakeholder management	C3	Legal structure	P3	Information sharing
	O4	Strong team relationships			P4	Collaborative culture
Level 4	O1a	Team is co-located	C1a	Pain sharing and gain sharing	P1a	Appropriate technology
	O1b	Qualified organization and leadership	C1b	Compensation incentives	P1b	Integrated design sharing platform
	O1c	Equitable team relationships and opportunities for project input	C2	Collective risk management	P2a	Collective generation of a single team focus and objectives
	O2	Early involvement of key participants	C3a	Presence of a multiparty agreement	P2b	Collaborative decision-making
	O3a	Multidisciplinary project management group	C3b	Withdrawal is discouraged	P2c	Collaborative planning
	O3b	Multidisciplinary relationship management group	C3c	Waiver of claims	P3a	Unrestricted cross-sharing of design information
	O4a	Previous experience in partnering approaches	C3d	Internal dispute resolution	P3b	Accounting documents open to all members
	O4b	Previous history of teams			P4a	Open communication
	O4c	Compatibility of stakeholder teams			P4b	No-blame culture
	O4d	Harmonious interpersonal relationships			P4c	Team commitment and attitudes
	O4e	Participation of top management				

Table 1.
Integration metrics and identification codes

$$Integration\ level\ (O)\ = y1 \times O1 + y2 \times O2 + y3 \times O3 + y4 \times O4 \tag{1}$$

Equation (1.1): O1 integration level:

$$O1 = z1 \times O1a + \ z2 \times O1b + \ z3 \times O1c \tag{1.1}$$

Equation (1.2): O2 integration level:

$$O2 = z4 \times O2 \tag{1.2}$$

Equation (1.3): O3 integration level:

$$O3 = z5 \times O3a + z6 \times O3b \tag{1.3}$$

Equation (1.4): O4 integration level:

$$O4 = z7 \times O4a + z8 \times O4b + z9 \times O4c + z10 \times O4d + z11 \times O4e \tag{1.4}$$

Equations (2) (2.1–2.3): contractual frameworks integration level:
Equation (2): contractual frameworks integration level:

$$Integration\ level\ (C) = y5 \times C1 + y6 \times C2 + y7 \times C3 \tag{2}$$

Equation (2.1): C1 integration level:

$$C1 = z12 \times C1a + z13 \times C1b \tag{2.1}$$

Equation (2.2): C2 integration level:

$$C2 = z14 \times C2 \tag{2.2}$$

Equation (2.3): C3 integration level:

$$C3 = z15 \times C3a + z16 \times C3b + z17 \times C3c + z18 \times C3d \tag{2.3}$$

Equations (3) (3.1–3.4): operating systems and processes integration level:
Equation (3): operating systems and processes integration level:

$$Integration\ level\ (P) = y8 \times P1 + y9 \times P2 + y10 \times P3 + y11 \times P4 \tag{3}$$

Equation (3.1): P1 integration level:

$$P1 = z19 \times P1a + z20 \times P1b \tag{3.1}$$

Equation (3.2): P2 integration level:

$$P2 = z21 \times P2a + z22 \times P2b + z23 \times P2c \tag{3.2}$$

Equation (3.3): P3 integration level:

$$P3 = z24 \times P3a + z25 \times P3b \tag{3.3}$$

Equation (3.4): P4 integration level:

$$P4 = z26 \times P4a + z27 \times P4b + z28 \times P4c \tag{3.4}$$

Equation (4): overall project integration level:

Equation (4): overall project integration level:

$$\begin{aligned} \textit{Overall project integration level} &= x1 \times O + x2 \times C + x3 \times P \\ &= (y1 \times O1 + y2 \times O2 + y3 \times O3 + y4 \times O4) \\ &\quad + (y5 \times C1 + y6 \times C2 + y7 \times C3) \\ &\quad + (y8 \times P1 + y9 \times P2 + y10 \times P3 + y11 \times P4) \end{aligned} \tag{4}$$

Global use of the framework: interface, rubric and application.

Framework interface. The developed framework comprises a construction of identified collaboration factors and a final calibrated formula, assigning various levels of significance to the different factors based on the AHP results. Figure 1 presents the framework interface as a user-friendly model on Microsoft Excel.

The developed model (Figure 1) requires the user to input an "Input Rating" (first column) for each factor in Level 4 in the hierarchy. This "Input Rating" of either "1," "2" or "3" is set based on the rubric described here below. Consequently, the subsequent ratings of the factors of Levels 3, 2, and finally 1 are automatically calculated based on the formulae presented above and in-built into the Excel model.

Framework rubric

Table 2 presents the rubric used to assign grades of achievement of the identified factors. As per the rubric, minimal achievement is assigned the grade of "1," partial achievement is "2" and maximal achievement is "3." Consequently, the achieved overall degree of integration would fall on a scale of 1–3, with 3 being the maximum level of integration and 1 referring to minimal integration.

Framework application. The steps for the application of the framework are as follows:

(1) Step 1: AHP rating:
   - Users (Project Stakeholders) rank input metrics in a pair-wise manner using the AHP scale defined by Saaty (1991).
   - Output: Each metric is assigned a coefficient of importance using a built-in AHP calculator on Microsoft Excel.

(2) Step 2: Tool input rating:
   - Users (Project Stakeholders) assign and input a "grade of achievement" for every metric of Level 4 into the first column (Input Rating) of the tool interface (Figure 1).
   - The grades are assigned using the identified rubric in Table 2.

(3) Step 3: Calculation of stakeholder integration:
   - The tool automatically calculates the grades of the Level 3 and Level 2 factors using the in-built tool formulae.
   - Output: Overall degree of stakeholder integration (Level 1 factor).

Empirical study

Brief project overview

The case study selected for this research involves the rehabilitation, expansion and operation of a well-known international airport in the Middle East region. The specific

ID	Factor	Maximal achievement ("3")	Partial achievement ("2")	Minimal achievement ("1")
O1a	Team is co-located	Single project team where the different stakeholders are located in the same offices	Individually operated subteams but located within single office environment	Individually operated and located subteams
O1b	Qualified organization and leadership	Leadership assigned to most qualified and competent people, with no organizationally defined boundaries	Leadership assigned to qualified people, but within each organization's defined boundaries	Leadership not assigned to qualified and competent people
O1c	Equitable team relationships and opportunities for project input	All members have equal opportunities to contribute regardless of their functional role and equity shares level; contributions are openly invited and embraced	Members contribute partially, but this is limited to their areas of expertise and equity shares level; contributions are not specifically invited	Contribution of team members is restricted to their functional project role and equity shares level
O2	Early involvement of key participants	All major key participants are involved on the project from the start	Most major key participants are involved on the project from the start, but some critical participants are missing	Most major key participants are not involved on the project from the start
O3a	Multidisciplinary project management group	A cross-organizational core group formed of representatives of the different stakeholders, responsible for overall project management	A group responsible for overall project management, but not comprising representatives of the different stakeholders	No individual group exists for overall project management
O3b	Multidisciplinary relationship management group	A cross-organizational core group formed of representatives of the different stakeholders, responsible for	A group responsible for overall stakeholder relationship management, but not comprising	No individual group exists for overall stakeholder relationship management

(*continued*)

Table 2. Developed assessment rubric

ID	Factor	Maximal achievement ("3")	Partial achievement ("2")	Minimal achievement ("1")
		stakeholder relationship management	representatives of the different stakeholders	
O4a	Previous experience in partnering approaches	All participants have previous experience in partnering approaches	Most participants have previous experience in partnering approaches	Participants have no previous experience in partnering approaches
O4b	Previous history of teams	All project teams have previous work history together and are familiar with each other	Some project teams have previous work history together	Project teams have no previous work history
O4c	Compatibility of stakeholder teams	Project teams are compatible and experience no severe work and communication difficulties	Project teams are partially compatible and experience some work and communication difficulties	Project teams are incompatible and experience severe work and communication difficulties
O4d	Harmonious interpersonal relationships	Relationships between the teams are harmonious at the interpersonal level	Relationships between the teams are partially harmonious at the interpersonal level but problems arise often	Relationships between the teams are unharmonious at the interpersonal level and problems are continuous
O4e	Participation of top management	Active participant and support from the top management of the different organizations	Support from the top management of the different organizations but only when requested	Lack of participant and support from the top management of the different organizations
C1a	Pain sharing and gain sharing	Contractual provisions that tie the individual stakeholders' profits and losses to overall project profits and losses	Contractual provisions are there but are partly effective owing to certain loopholes	Lack of provisions that tie the individual stakeholders' profits and losses to overall project profits and losses
C1b	Compensation incentives	Incentives are provided to all participants in return for achieving certain savings to the project	Incentives are provided to some participants in return for achieving certain savings to the project	No incentives are provided to participants in return for achieving certain savings to the project
C2	Collective risk management	The overall team accepts joint	Individual teams focus on managing	Individual teams are concerned with

(*continued*)

Table 2.

ID	Factor	Maximal achievement ("3")	Partial achievement ("2")	Minimal achievement ("1")
		responsibility for identifying and managing risks regardless of their individual scopes	their own risks, but some effort is made toward collective risk management	managing their own risks with no regard to other teams
C3a	Presence of a multiparty agreement	A multiparty agreement combining all major stakeholders is present	A multiparty agreement combining most stakeholders is present	No multiparty agreement is present
C3b	Withdrawal is discouraged	Explicit provisions are present discouraging stakeholder withdrawal	Provisions are present discouraging withdrawal but not explicitly preventing it	No provisions are present discouraging withdrawal
C3c	Waiver of claims	Explicit provisions are present preventing claims between stakeholders	Provisions are present discouraging claims between stakeholders but not explicitly preventing it	No provisions are present discouraging or preventing claims
C3d	Internal dispute resolution	Explicit provisions are present delineating alternative dispute resolution methods and detailing their processes	Provisions are present suggesting some methods of dispute resolution but not explicitly detailing them	No provisions dealing with dispute resolution procedures are present
P1a	Appropriate technology	Technology is chosen specifically to facilitate communication and collaboration between participants	No specific technology is chosen to facilitate communication and collaboration, but the existing technology does not hinder collaboration	The technology used hinders collaboration and communication between participants
P1b	Integrated design-sharing platform	A common platform exists for accessing, sharing and editing design information by all members	No specific common platform for such purpose exists, but design information is shared in other (albeit less efficient) ways	No common platform exists for accessing, sharing and editing design information
P2a	Collective generation of a	Team has a shared vision and common	Team pursues individual objectives but mostly in line	Team members lack a common vision and clear objectives;

(*continued*)

Table 2.

ID	Factor	Maximal achievement ("3")	Partial achievement ("2")	Minimal achievement ("1")
	single team focus and objectives	objectives, defined collaboratively and reviewed regularly	with the overall project objectives	objectives are individually defined
P2b	Collaborative decision-making	All project decisions, both for the overall project and individual scopes, are made collaboratively; all members are consulted before making key project decisions	Upper level project decisions are made collaboratively, but each party still makes individual decisions related to its own scope	Each party makes decisions related to its own scope individually, and there is no collaboration or consultation of members in decision-making at any level
P2c	Collaborative planning	All planning efforts, both for the overall project and individual scopes, are made collaboratively	Upper level project planning efforts are undergone collaboratively, but each party still plans its own works individually	Each party plans its own scope individually, and there is no collaboration in project planning at any level
P3a	Unrestricted cross-sharing of design information	Availability and access to all design information by all teams	Partial availability and access to information by different teams	Information is only available to members responsible for the related section of the work
P3b	Accounting documents open to all members	Transparent and open sharing of the project's financial and accounting information	Partial sharing of the project's financial and accounting information with some attempts to hide information from other team members	No sharing of the project's financial and accounting information
P4a	Open communication	Different teams actively and openly share their knowledge and information with other teams	Different teams communicate information when others need it	Information is only shared on a "need-to-know" basis
P4b	No-blame culture	Collective responsibility for all problems and cooperation in identifying and resolving them	Collaboration is undergone in solving problems, but blame is assigned to individual teams	Individual teams are singled out when problems occur and bear responsibility for solving them
P4c	Team commitment and attitudes	Teams form a single project team with no individual member identity or boundaries	Teams operate individually but make efforts to collaborate with other teams	Alignment and affiliation is only to the respective individual's organization

Table 2.

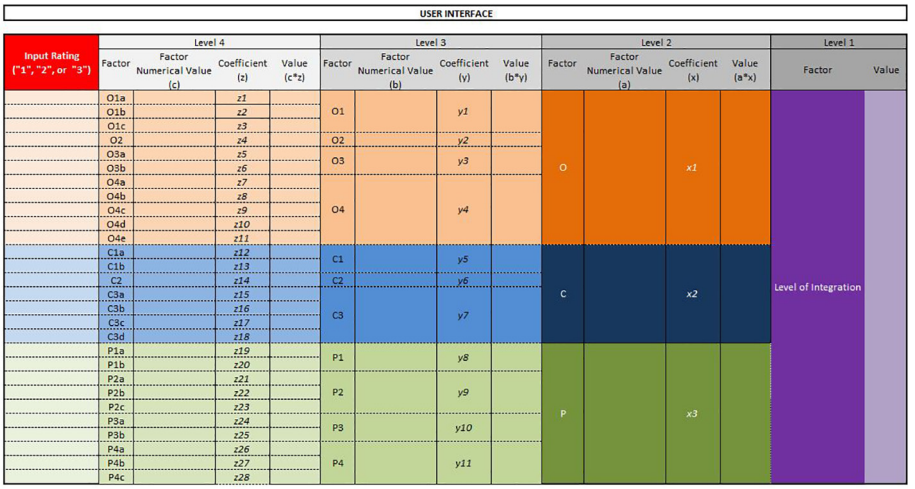

Figure 1.

project name, country, involved stakeholders and case study participants are kept anonymous for confidentiality. The project's procurement route and SPV stakeholder structure and agreements, as described below, provide an apt case to test the developed framework.

The private entity is structured as a consortium of companies, encompassing both the construction contractor and the operating contractor, who are involved in project delivery across all its phases under a 25-year build-operate-transfer contract. The SPV (henceforth referred to as SPV X) is a consortium comprising of: (1) a joint venture of two international contractors (the SPV Contractor), (2) an international airport operator (SPV Operator) and (3) regional and local financial investors (SPV Investors), brought together for their experience in finance, airport operations and construction. Together, these entities assume the comprehensive project delivery responsibilities from financing to building, operation and final transfer to the government.

The main agreements between the involved stakeholders on the project include the following:

- Rehabilitation, Expansion and Operation Agreement between SPV X and the government. This agreement describes the responsibilities of both parties in relation to the financial and technical aspects of project delivery;
- Shareholders Agreement between the shareholders of SPV X. The agreement describes the management operations of the SPV, including the decision-making mechanisms and the revenue sharing schemes;
- Engineer, Procure and Construct Agreement between SPV X and the SPV Contractor for the provision of engineering, procurement and construction services;
- Technical Services Agreement between SPV X and the SPV Operator for the provision of operating and maintenance services; and
- Common Terms Agreement between SPV X and the financing institutions who provide loans to the SPV for project financing.

Empirical application of framework to calculate special purpose vehicle integration level

Analytical hierarchy process survey and application. Through a survey, the project stakeholders used the AHP to rank the relative importance of each input factor of the framework.

In this case study, AHP was only applied to the first three levels in the hierarchy, with factors of Level 4 assumed to carry the same weight. The reason behind that is the presence of a large number of factors which would impose a bulky number of required comparisons and make it cumbersome for respondents to perform the comparison exercise.

Integration framework application. Subsequently, the developed framework was applied to calculate the SPV integration level on the project. Table 3 presents the grading of the different criteria in terms of their degree of achievement, supported with justification. These grades are input into the Excel framework as "Input Ratings."

Discussion of results

Analytical hierarchy process results. Table 4 presents the results of the AHP survey, expressing the factors of Levels 2 and 3 along with their respective coefficients of importance in contributing to stakeholder integration.

Analyzing the results, it is not surprising that the contractual structure of the SPV has the primary effect in achieving stakeholder integration (C = 43.2%) – the chief reason being that the former addresses both the financial and legal functions on the project. The project stakeholders are therefore most motivated by the conditions of payment, the risk management approach and the legal terms that bind them. The organization structures formed on the project also contribute significantly to the stakeholder integration level (O = 37.3%). The formation of unified working teams and integrated management groups added to the early engagement of stakeholders and the nature of the teams' relationships act collectively as solid motivators that prompt integration on the project. As for the engaged operating systems and processes (P = 19.5%), their role appears to be supportive as opposed to the roles of C and O in actively causing integration on the project.

As for the Level 3 factors, it is apparent that the commercial or compensation structure (C1) is the single top controlling factor to the overall result with a 24.24% impact. This is followed by a group comprising the remaining factors under C (C2 and C3) along with the collective factors under O (O1, O2, O3 and O4) which all receive an equivalent contribution level of around 10%. Therefore, the project integration level is most influenced by metrics under C and O. The outstanding factors falling under P (P1, P2, P3 and P4) all reflect contribution levels of under 10%, giving them a much lesser influence and impact on stakeholder integration.

Integration result. The case study application and results are presented in Figure 2.

To analyze the result, a hypothetical integration scale is constructed, with the lower limit (Level of 1) representing "low integration project" settings where each team has its own separate camp, manages its own risks and follows its own aims and objectives. The upper limit (Level of 3) represents "high integration project" settings which reflect an atmosphere of ultimate collaboration, open communication and transparency, sharing of resources and alignment of interests. The PPP project considered in the case study achieves a little more than partial integration (Level of 2.39), falling almost midway between low integration settings and high integration settings and presenting an improvement from the low integration project setting. However, it has yet to reach the ultimate integration level and achieve its full collaboration potential.

All the three main groupings present levels nearing partial integration (O = 2.48; C = 2.44; P = 2.08), and hence the overall project integration level also leans toward partial

ID	Factor	Rating (1–3)	Justification
O1a	Team is co-located	2	Co-located geographically on the project but every SPV stakeholder has its own separate offices building
O1b	Qualified organization and leadership	3	The organization and leadership is dedicated to the most qualified and competent personnel in their respective fields
O1c	Equitable team relationships and opportunities for project input	2	Opportunities for the SPV members' input are available on key project decisions. However, team members' contribution is restricted to their functional project role and contribution of shares in the SPV
O2	Early involvement of key participants	3	All key SPV participants are involved from day 1
O3a	Multidisciplinary project management group	2	There is a project management entity representing the different SPV members. However, it is independent and does not integrate specific representatives from each team
O3b	Multidisciplinary relationship management group	2	There is no specific entity responsible for this function, but the project management entity on the project acts as the group responsible for managing the different stakeholder interactions and relationships. This entity does not integrate specific representatives from each team
O4a	Previous experience in partnering approaches	3	All members of the SPV were experienced in PPP project delivery
O4b	Previous history of teams	1	The SPV members have no previous working history
O4c	Compatibility of stakeholder teams	3	The SPV members were all from separate countries but did not experience severe issues owing to cultural differences
O4d	Harmonious interpersonal relationships	3	The working relationships of day-to-day personnel were harmonious and undisturbed by upper level tensions
O4e	Participation of top management	3	The top management of the different teams provided the required resources and support for project operations
C1a	Pain sharing and gain sharing	3	The Shareholders Agreement contains provisions for pain sharing and gain sharing
C1b	Compensation incentives	2	No specific compensation incentives exist that motivate the SPV contractor to achieve certain goals. However, the SPV operator has incentives in relation to service provision and management
C2	Collective risk management	2	The project management entity manages all project risks collectively. However, every individual party manages its own risks with minimal contribution to overall project risk management
C3a	Presence of a multiparty agreement	3	An SPV Shareholders Agreement was signed between all the involved SPV members

(*continued*)

Table 3.
Case study grading and justification

ID	Factor	Rating (1–3)	Justification
C3b	Withdrawal is discouraged	2	The Shareholders Agreement discourages withdrawal of any SPV member. However, a loophole exists that allows it in case of a uniform consent by all SPV members
C3c	Waiver of claims	3	The Shareholders Agreement disallows claiming between the SPV members (except for cases of professional negligence and illegal acts)
C3d	Internal dispute resolution	3	The Shareholders Agreement encourages dispute resolution within the project environment as alternative to external courts
P1a	Appropriate technology	2	There was no focus on using specific technology that facilitates collaboration between participants. Yet, the technology used did not particularly hinder communication
P1b	Integrated design sharing platform	2	No particular integrative design sharing platform was used, but other less efficient platforms were used for this purpose
P2a	Collective generation of a single team focus and objectives	2	Members pursue individual objectives but mostly in line with the overall project objectives
P2b	Collaborative decision-making	2	Collaborative decision-making exists only for upper level decisions while every SPV member takes its own decisions as related to its works
P2c	Collaborative planning	2	In general, SPV team members plan their own works and collaborative project planning only exists at higher levels
P3a	Unrestricted cross-sharing of design information	3	Parties openly share design information across the SPV
P3b	Accounting documents open to all members	2	Accounting information are shared and accessible to all SPV members, but there are several attempts to hide specific information from certain members
P4a	Open communication	2	Communication mostly follows the traditional procedural formalities and protocols
P4b	No-blame culture	2	This is partially achieved as the general ambience follows the claim-free environment set by the contract. However, the atmosphere of team segregation reflects some aspects of blame appointment to separate teams by others
P4c	Team commitment and attitudes	1	Team commitment is limited as an attitude of segmentation, and team individuality exists between the different SPV stakeholders

Table 3.

integration (2.39). The most influencing groups are the contractual frameworks (43.2%) and the organization structures (37.3%) which have the major share in manipulating the overall integration level. Referring to Table 4 it is apparent that factor C1, Compensation Structures (graded as 2.5), which has the most contribution to integration (24.24%), has greatly swayed the end result. Additionally, the remaining factors under groups O and C, forming the strongest group of influence, also reflect grades nearing partial integration and controlling the end result.

Level	ID	Factor	Overall contribution to integration (%)
Level 2	C	Contractual frameworks	43.20
	O	Organization structures	37.30
	P	Operating systems and processes	19.50
Level 3	C1	Compensation structure	24.24
	C2	Collective risk management	9.63
	O4	Strong team relationships	9.40
	O2	Early involvement of key participants	9.36
	C3	Legal structure	9.33
	O3	Integrated project and stakeholder management	9.33
	O1	Single integrated team	9.21
	P2	Collaborative project management	7.04
	P3	Information sharing	5.79
	P4	Collaborative culture	4.04
	P1	Collaborative systems	2.63

Table 4. Overall integration coefficients of the different factors

Project shortfalls and lessons learned

Adopting integrative commercial frameworks Researchers investigating the rationale behind the successful development of partnering culture in the infrastructure sector of Hong Kong concluded that this success was underpinned by the implementation of incentive agreements, a kind of target cost contract (Chan *et al.*, 2008). This case study project reflects only partial achievement of factor C1, mostly owing to the fact the compensation incentives were not made available to the SPV Contractor. Therefore, providing incentives that tie the contractor's achievement of certain goals to additional reward would aid in addressing the aforesaid shortfall. For example, awarding the contractor a portion of the costs saved when performing value engineering efforts that result in a reduced cost to the project would encourage the contractor to undergo such efforts.

Integrating stakeholders in global project management. The significance of involving all project teams in overall project management, encouraging collaborative planning and decision-making and aligning risk management and sharing efforts is observed in the influence of a number of identified factors on the level of project integration; Factors C2

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Input Rating ("1", "2", or "3")	Level 4				Level 3				Level 2				Level 1	
	Factor	Factor Numerical Value (c)	Coefficient (z)	Value (c*z)	Factor	Factor Numerical Value (b)	Coefficient (y)	Value (b*y)	Factor	Factor Numerical Value (a)	Coefficient (x)	Value (a*x)	Factor	Value
2	O1a	2	0.333	0.6666667										
3	O1b	3	0.333	1	O1	2.33	0.247	0.5763333						
2	O1c	2	0.333	0.6666667										
3	O2	3	1.000	3	O2	3.00	0.251	0.753						
2	O3a	2	0.500	1	O3	2.00	0.25	0.5						
2	O3b	2	0.500	1					O	2.48	0.373	0.9267309		
3	O4a	3	0.200	0.6										
1	O4b	1	0.200	0.2	O4	2.60	0.252	0.6552						
3	O4c	3	0.200	0.6										
3	O4d	3	0.200	0.6										
3	O4e	3	0.200	0.6										
3	C1a	3	0.500	1.5	C1	2.50	0.561	1.4025						
2	C1b	2	0.500	1										
2	C2	2	1.000	2	C2	2.00	0.223	0.446						
3	C3a	3	0.250	0.75					C	2.44	0.432	1.05516	Level of Integration	2.39
2	C3b	2	0.250	0.5	C3	2.75	0.216	0.594						
3	C3c	3	0.250	0.75										
3	C3d	3	0.250	0.75										
2	P1a	2	0.500	1	P1	2.00	0.135	0.27						
2	P1b	2	0.500	1										
2	P2a	2	0.333	0.6666667										
2	P2b	2	0.333	0.6666667	P2	2.00	0.361	0.722						
2	P2c	2	0.333	0.6666667										
3	P3a	3	0.500	1.5	P3	2.50	0.297	0.7425	P	2.08	0.195	0.4055025		
2	P3b	2	0.500	1										
2	P4a	2	0.333	0.6666667										
2	P4b	2	0.333	0.6666667	P4	1.67	0.207	0.345						
1	P4c	1	0.333	0.3333333										

Figure 2.

(Collective Risk Management), O3 (Integrated Project and Stakeholder Management) and P2 (Collaborative Project Management) contribute a significant total of 26% to the overall integration level. In fact, researchers proved that implementing IPD on projects, comprising principles of open communication, co-location of teams and collaborative decision-making, enhances key performance indicators (Andary *et al.*, 2019) and achieves statistically significant improvements in cost, time, quality, changes, stakeholder communication and environmental performance (El Asmar *et al.*, 2013).

Therefore, having an integrated project management entity – which is missing in the case study project – that encourages cooperation of all involved stakeholders in managing the complete project scope and risks is paramount to the realization of partnership on this level. This is a core contributor to aligning interest and achieving the optimal returns of the PPP procurement route.

Empirical study concluding notes

The project has in many ways succeeded in satisfying specific collaboration criteria, achieving a certain level of integration, albeit partial, but either way presenting a development from the low integration project setting. However, as previously detailed, the project has much room for addressing certain cooperation factors that would enable it to significantly improve its achieved levels of stakeholder integration. That is, the need arises for active participation in designing the PPP project's organization structures, contractual frameworks and operating systems and processes. Classifying the project as a success or failure is not practicable as project success does not have one definition and varies depending on the perspective. Nevertheless, as the focus of this research is evaluating the stakeholder integration level, the PPP is not considered fully successful as it is not achieving its full integration potential.

Conclusions and recommendations.

Research summary

The SPV, which combines the stakeholders involved in delivering the PPP project across all its phases, should act as an integrated entity to avoid the pitfalls of segregated teams that contribute to project failure. As PPP practitioners are unaware of the importance of and methods for instigating stakeholder integration and existing literature falls short in investigating integration for the SPV, there is a requirement to fill this gap by underlining methods to quantify and target stakeholder integration in PPPs. Therefore, the research develops metrics and proposes an SPV integration framework to provide the SPV with a tool to measure stakeholder integration, identify and address the shortfalls to increase its integration level. Accordingly, this research introduces the lean vein into PPP research and is the first of its kind that strives to study the SPV delivery route from an IPD perspective.

Research implications and recommendations.

This study inspires practical implications and recommendations to be considered by practitioners in the PPP industry. These recommendations aim to enhance PPP project delivery and service provision and facilitate the success of these projects. The following list comprises recommended practices to be adopted by PPP participants to enhance collaboration success:

- SPV members should recognize the essentiality of stakeholder integration within the SPV from the point of inception, and structure its project delivery mechanisms with the purpose of achieving such goal. The SPV should address collaboration at

the level of the organization structures, contractual frameworks and operating systems and processes.

- SPVs may use the framework developed in this research to calculate the actual integration level on the project and pinpoint areas of weakness that may be appropriately addressed.
- The public entity may adopt the developed SPV integration framework during the tendering process as a means to assess and qualify the integration potential of the bidding consortia.
- The SPV is to use an integrated project management group that comprises representatives from the different SPV members to involve all SPV participants in global project risk management and align their interests with that of the project.

Research limitations and future work.

This research and its application contain certain limitations that provide opportunities for future work, including:

- identifying additional collaboration metrics;
- further analysis of the rating of factors based on the respondents' background; and
- investigating additional case studies.

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Appendix

Table A1. Factors derived and developed from the literature

No.	Factor	Source
Factors derived from the literature		
1	A multidisciplinary team responsible for implementation of relationship management principles	Zou *et al.* (2014)
2	Accounting documents are exposed to every member	Aapaoja *et al.* (2013)
3	Attitudes of loyalty, receptivity and care	Kumaraswamy and Anvuur (2008)
4	Commitment from top management	Ibrahim *et al.* (2013), Ling *et al.* (2013); Zou *et al.* (2014)
5	Compatible organizational culture of the involved parties	Kumaraswamy *et al.* (2005)
6	Creation of a co-located team	Aapaoja *et al.* (2013), Baiden *et al.* (2006); Ibrahim *et al.* (2013)
7	Creation of a single integrated team	Baiden *et al.* (2006), Ibrahim *et al.* (2013)
8	Effective management of health and safety	Ibrahim *et al.* (2013)
9	Equal opportunity for project inputs	Aapaoja *et al.* (2013), Baiden *et al.* (2006); Ibrahim *et al.* (2013)
10	Equitable team relationships	Aapaoja *et al.* (2013), Baiden *et al.* (2006)
11	Familiarity/previous relationships among parties	Kumaraswamy *et al.* (2005)
12	Formation of a cross-functional management team with collective responsibility	Ling *et al.* (2013)
13	Innovation and improvement	Ibrahim *et al.* (2013)
14	Long-term commitment	Ling *et al.* (2013)
15	Mutual trust and respect	Ibrahim *et al.* (2013)
16	Mutually beneficial outcomes	Aapaoja *et al.* (2013), Baiden *et al.* (2006)
17	No-blame culture (focus on solving problems, not on finding out who is guilty)	Aapaoja *et al.* (2013), Baiden *et al.* (2006); Ibrahim *et al.* (2013)
18	Open communication	Baiden *et al.* (2006), Ibrahim *et al.* (2013); Ling *et al.* (2013)
19	Partnering and negotiation skills	Zhang (2005)
20	Previous experience in relational contracting approaches	Kumaraswamy *et al.* (2005)
21	Real gain share/pain share among contracting parties	Ling *et al.* (2013)
22	Rich experience in international PPP project management	Zhang (2005)
23	Seamless operation with no organizational defined boundaries	Aapaoja *et al.* (2013), Baiden *et al.* (2006); Ibrahim *et al.* (2013)
24	Sharing risks	Aapaoja *et al.* (2013)
25	Single team focus and objectives	Aapaoja *et al.* (2013), Baiden *et al.* (2006); Ibrahim *et al.* (2013), Ling *et al.* (2013)
26	Strong interpersonal relations at the individual level	Kumaraswamy *et al.* (2005), Zhang (2005)
27	Team commitment, honesty, openness and trust	Zou *et al.* (2014)
28	Unrestricted cross-sharing of information	Aapaoja *et al.* (2013), Baiden *et al.* (2006); Ibrahim *et al.* (2013), Ling *et al.* (2013)
29	Using an integrated ICT system	Ibrahim *et al.* (2013)
30	Willingness/enthusiasm of the parties	Kumaraswamy *et al.* (2005)

(*continued*)

No.	Factor	Source
Factors developed from IPD literature		
31	Collaborative decision-making and control	AIA (2007)
32	Collective risk management	El-adaway *et al.* (2017), Thomsen *et al.* (2009)
33	Compensation incentives	AIA (2007), El-adaway *et al.* (2017)
34	Core group for project management	El-adaway *et al.* (2017)
35	Early goal definition	AIA (2007)
36	Early involvement of key participants	AIA (2007), El-adaway *et al.* (2017)
37	Intensified planning	AIA (2007)
38	Internal dispute resolution	AIA (2007), El-adaway *et al.* (2017)
39	Joint coordination and monitoring among contracting parties	El-adaway *et al.* (2017)
40	Multiparty agreement	AIA (2007), El-adaway *et al.* (2017)
41	Qualified organization and leadership	AIA (2007)
42	Sharing risks and rewards	AIA (2007), El-adaway *et al.* (2017)
43	Team developed goals	AIA (2007)
44	Trust, fairness and mutual cooperation	El-adaway *et al.* (2017)
45	Using appropriate technology	AIA (2007)
46	Using building information modeling (BIM)	AIA (2007), El-adaway *et al.* (2017)
47	Using the last planner system	Thomsen *et al.* (2009)
48	Waiver of claims	AIA (2007), El-adaway *et al.* (2017)
49	Withdrawal is discouraged	AIA (2007)

Table A1.

No.	Position	Field of expertise	Years of expertise
1	Secretary General of a governmental Council for Privatization and PPP	PPP procurement and management	40 years
2	Project Manager of a governmental Council for Privatization and PPP	PPP procurement and management	25 years
3	Economic Expert of a governmental Council for Privatization and PPP	PPP procurement and management	21 years
4	Senior Transport Specialist at a major finance corporation that finances PPPs	PPP financing	15 years
5	Regional Manager, Head of Transaction Advisory Public Private Partnerships at a major finance corporation that finances PPPs	PPP financing	27 years
6	Investment Officer at a major finance corporation that finances PPPs	PPP financing	22 years
7	Chief Executive Officer of an international SPV	PPP contracting and operation	27 years
8	Chief Technical Officer of an international SPV	PPP contracting and operation	33 years
9	Managing Director of an international SPV	PPP contracting and operation	35 years
10	Management and Business Consultant at a consultancy firm promoting lean methodologies	Lean and integrated project delivery principles	25 years
11	Associate Professor at a US university	Innovative project delivery systems, including integrated project delivery and PPP	13 years
12	Chairman and President of a consultancy firm promoting IPD methodologies	Lean construction, integrated project delivery, alignment and lean partnering	45 years

Table A2.
Expert-panel members' profiles

Corresponding author
Farook R. Hamzeh can be contacted at: hamzeh@ualberta.ca