Benefits Realization Approach to Project Management Using Social Fuzzy Consensus Group Decision Support

Ru. D Perera, A. Ghildyal, and E. Chang

Abstract In recent years there is an upsurge in the adoption of the Benefit Approach to Project and PPP (Project, Program, and Portfolio) management in the Government sector and large business particularly in the area of procurement, commercial grade contracts, IT governance, innovation investment space. However, our studies show that 80% of project benefits laid out in the procurement contracts are intangible benefits and benefits comprise an unclassified broad range of indirect achievable, and unquantifiable tangible and intangible benefits that require theoretical interpretation and empirical weightage so that such a Benefit Approach to project or PPP approach can contribute to the long-term project success. Setting measurable achievable benefits is not an accident as the nature of benefits is fuzzy, evolving, and dynamic and rarely supports benefit monitoring and evaluation. In this paper, we address two substantial issues. Firstly, the nature and scope of intangibility cause vagueness in the definition of the Benefits. Therefore, a consensus on the agreed achievable tangible and intangible benefits and their measurement metrics are accepted among stakeholders. These are underpinned by theoretical interpretation of the achievable benefits. Secondly, the measurability and quantification of achievable benefits particularly intangible benefits is new and emerging. The lack of a systematic approach may lead to accountability and governance failure as the project evolves over time. In this study, we use consensus-reaching group decision support techniques to quantify the achievable benefits which are a prerequisite to long-term project success.

Ru. D Perera
Defence University, Colombo, Sri Lanka
e-mail: dhinesha_drp@kdu.ac.lk

A. Ghildyal
Department of Defence, NNSO, Navy, Canberra, ACT, Australia
e-mail: amit.ghildyal@defence.edu.au

E. Chang (✉)
Defence Logistics Innovation Group, IIIS, School of ICT, Griffith University, Queensland, QLD, Australia
e-mail: e.chang@griffith.edu.au

Sh. N. Shahbazova et al. (eds.), *Recent Developments and the New Directions of Research, Foundations, and Applications*, Studies in Fuzziness and Soft Computing 422,
https://doi.org/10.1007/978-3-031-20153-0_12

Keywords Benefit approach · Project benefits realization measures · Fuzzy consensus · Group decision support

1 Introduction

The recent emergence of high demand on enterprise consulting for project management has resulted in the emergence of new academic discipline development in Project, program & portfolio (PPP) in many institutions worldwide [1, 2]. This is due to the fact that customers such as government departments are not aware of the benefit that has been identified or presented in a project contract or as part of PPP offered by the providers. This lack of achievable to quantifiable has led to only 2% of digital transformation projects succeeding (CIO group, 2022). It is generally viewed that the performance of the portfolio is based on its programs' performance and each program's performance is contributed by the performance of its projects. Therefore, in terms of benefits identification in PPP, the benefits are transferable to the upper layers of the PPP, where the benefit in PPP is the composite of the projects and programs' benefits and must be in line with the Organization or Enterprise objectives or goals [3].

Our recent field studies and practical PPP evaluation of the benefit approaches in PPP showed that although tangible benefits such as cost saving, Return on Investment, etc can be identified and measured, approximately 80% of benefits identified in the project contracts or projects are Intangible benefits, such as capability, efficiency, etc and no significant measurement or techniques or tools are available to date to deal with them in the Benefit Approach to PPP. This paper provides our studies and proposals on how to measure those intangible benefits in PPP, to achieve "what gets measured gets delivered". The benefits (Tangible and intangible) are largely identified in the context of strategic intent, social economic drivers, industrial inventive steps, or futuristics [4]. Due to the vagueness and imprecision of benefit concepts, particularly intangible benefits, there are no solid measurement techniques and tools available to help customers or large government organizations to **realize** the benefit resulting in repeated high costs in procurement, contracts, IT and investment. We have previously [5, 6] drawn upon the methodologies in Stratification (CST), Fuzzy inference system (FIS), and Computing with Words an Evidence-based approach to developing a scientific analytics and measurement framework to quantify intangible benefits in order to overcome the vagueness, fuzziness, and imprecision of intangible benefits in Project or PPP management. The output of intangible benefits measures is presented as a realization value that is mapped to the direct and indirect project value with financial and non-financial values. Our previous work relies on the opinions of experts. However, an important aspect of providing an acceptance of the results is agreement between the different stakeholders about the realized benefits. To provide this important dimension in our benefits realization approach, we utilize the fuzzy consensus-based approach in this paper.

2 Reaching Consensus on Benefit Approach in PPP

In technology related IT Projects the benefits are usually captured easily but its measurement is vague and fuzzy. The study focused on IT related projects used in companies or the public service to make efficient functions in the organization at different strategic functional units namely, HR, finance, sales, marketing, compliance, process automation etc. (Table 1).

The public sector explains that benefits management in terms of intangible benefits is counter intuitive and needs to be effectively governed and regulated. Only 23% of identified benefits are measurable and realizable from a quantifiable perspective [7]. The Department of Prisons & innovative industries in unison explains that the benefit approach to measure intangibles is fuzzy, weak and uncertain. It is a timely and pertinent to approach project benefit measures without compromising the utility value emerging from IT driven projects [8]. The specific project under study is a supply chain automation project which integrates e-governance into its operational process optimization. The supply chain that caters to the Defence industry from an enterprise viewpoint comprises of sourcing, processing and final product manufacturing from an upstream and customer delivery, customer development and after sales services from a downstream point of view. Each stage of the supply chain is computerized, and automation is crucial as a business process reengineered application. The system has periodical user testing and upgrades by the intervention of domain experts, project managers and customers or system end users. Thereby the project can be classified as a system user project of medium scale and the target benefits are stated as; short term deliverables at initiation and growth phases (3–6 months from system development), medium termed deliverables at maturity phases (6 months –2 years) from system implementation and long-term outcomes at stability phase (2–5 years).

Whilst financial consideration was the baseline for most project managers in the past, today the project benefit managers are not the only ones who are interested in the project but there are other parties namely, the domain experts and the larger interest groups like the stakeholders. Benefit realization is usually measured at individual level of each of the interested groups and the aggregate consensus leads to the project level (Table 2).

In the light of fuzzy set theory and related principles we approach the representation of our case study. Most(Q) of the relevant(B) project contract managers (y′s) agree (F) as to almost all of the decision support process. The general notation and expression can be exemplified as:

$$\mathrm{Q}y's \text{ are } F \tag{1}$$

where, Q is the linguistic quantifier (eg: Almost), Y = {y} is a set of objects (eg: projects) and F is a property (eg: merchantable quality)

In developing the essence we may assign a different importance such as a specific characteristic B, to the particular y set of objects yielding an expression

Table 1 Operationalization

Variable	Dimension	Mathematical expression	Social Fuzzy Preference statement by StakeH
Product Benefit (PC VAR PRODUCT BENEFIT)	Product Requirement 1	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(psi) \wedge \mu F(psi)]}{\sum_{i=1}^{p} \mu B(psi)} \right)$	The most of the relevant project sponsors (ps) agree as to almost all of the product function 1
	Product Requirement 2	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(ci) \wedge \mu F(ci)]}{\sum_{i=1}^{p} \mu B(ci)} \right)$	The most of the relevant project clients (c) agree as to almost all of the product function 2
	Product Requirement 3	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(ei) \wedge \mu F(ei)]}{\sum_{i=1}^{p} \mu B(ei)} \right)$	The most of the relevant project experts (e) agree as to almost all of the product function 3
	Product Requirement 4	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(ei) \wedge \mu F(ei)]}{\sum_{i=1}^{p} \mu B(ei)} \right)$	The most of the relevant project experts (e) agree as to almost all of the product function 4
	Product Requirement 5	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(ei) \wedge \mu F(ei)]}{\sum_{i=1}^{p} \mu B(ei)} \right)$	The most of the relevant project experts agree as to almost all of the product function 5
	Product Requirement 6	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(ei) \wedge \mu F(ei)]}{\sum_{i=1}^{p} \mu B(ei)} \right)$	The most of the relevant project experts agree as to almost all of the product function 6
	Product Requirement 7	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(ei) \wedge \mu F(ei)]}{\sum_{i=1}^{p} \mu B(ei)} \right)$	The most of the relevant project experts agree as to almost all of the product function 7

(continued)

Table 1 (continued)

Variable	Dimension	Mathematical expression	Social Fuzzy Preference statement by StakeH
	Product Requirement 8	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(ei) \wedge \mu F(ei)]}{\sum_{i=1}^{p} \mu B(ei)} \right)$	The most of the relevant project experts agree as to almost all of the product function 8
Time to Market (PC VAR TIME TO MARKET)	Budget plan	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(psi) \wedge \mu F(psi)]}{\sum_{i=1}^{p} \mu B(psi)} \right)$	The most of the relevant project sponsors (ps) agree as to almost all of budget plan
	Contingency Budget plan	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(ei) \wedge \mu F(ei)]}{\sum_{i=1}^{p} \mu B(ei)} \right)$	The most of the relevant project experts agree as to almost all of contingency budget plan
	Time overrun and projection report	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(cmi) \wedge \mu F(cmi)]}{\sum_{i=1}^{p} \mu B(cmi)} \right)$	Most of the relevant project contract managers (cm) agree as to almost all of the time overrun and projection report
	Delivering the project within the budget	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(ei) \wedge \mu F(ei)]}{\sum_{i=1}^{p} \mu B(ei)} \right)$	The most of the relevant project experts agree as to almost all of the project is delivered within the budget
Project Cost benefit (PC VAR PROJECT COST BENEFIT)	Overall Budget planning report	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(cmi) \wedge \mu F(cmi)]}{\sum_{i=1}^{p} \mu B(cmi)} \right)$	Most of the relevant project contract managers (cm) agree as to almost all of the overall budget planning report

(continued)

Table 1 (continued)

Variable	Dimension	Mathematical expression	Social Fuzzy Preference statement by StakeH
	Budget overrun report	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(psi) \wedge \mu F(psi)]}{\sum_{i=1}^{p} \mu B(psi)} \right)$	Most of the relevant project contract managers agree as to almost all of the overall budgets overrun report
	Resource overrun report	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(pmi) \wedge \mu F(pmi)]}{\sum_{i=1}^{p} \mu B(pmi)} \right)$	Most relevant project managers agree to most of the resource overrun report
Business or operation benefit (PC VAR BUSINESS OR OPE BENEFIT)	Return on investment	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(psi) \wedge \mu F(psi)]}{\sum_{i=1}^{p} \mu B(psi)} \right)$	Most relevant project sponsors agree to almost all of the return on investment
	Business Cost Saving	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(sci) \wedge \mu F(sci)]}{\sum_{i=1}^{p} \mu B(sci)} \right)$	Most relevant project subcontractors (sc) agree to most of the business cost saving
Organization Benefit (PC VAR ORG BENEFIT)	Risk Control and Management	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(sci) \wedge \mu F(sci)]}{\sum_{i=1}^{p} \mu B(sci)} \right)$	Most relevant project subcontractors agree to most of Risk control and mgmt
	Decision Support Process	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(cmi) \wedge \mu F(cmi)]}{\sum_{i=1}^{p} \mu B(cmi)} \right)$	Most relevant project contract managers agree to most of decision support process
	Enterprise Culture and Unity	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(cmi) \wedge \mu F(cmi)]}{\sum_{i=1}^{p} \mu B(cmi)} \right)$	Most relevant project contract managers agree to most of Enterprise Culture and Unity

Table 2 The social fuzzy consensus approach for individual benefit groups

Variable	Dimension	Mathematical expression	Social Fuzzy Preference statement by StakeH
Product Benefit (PC VAR PRODUCT BENEFIT)	Product Requirement 1	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(psi) \wedge \mu F(psi)]}{\sum_{i=1}^{p} \mu B(psi)} \right)$	Most relevant project sponsors (ps) agree to most of the product function 1
	Product Requirement 2	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(ci) \wedge \mu F(ci)]}{\sum_{i=1}^{p} \mu B(ci)} \right)$	Most relevant project clients (c) agree to almost all of the product function 2
	Product Requirement 3	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(ei) \wedge \mu F(ei)]}{\sum_{i=1}^{p} \mu B(ei)} \right)$	Most relevant project experts (e) agree to almost all of product function 3
	Product Requirement 4	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(ei) \wedge \mu F(ei)]}{\sum_{i=1}^{p} \mu B(ei)} \right)$	Most relevant project experts (e) agree to almost all of product function 4
	Product Requirement 5	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(ei) \wedge \mu F(ei)]}{\sum_{i=1}^{p} \mu B(ei)} \right)$	Most relevant project experts agree to almost all of product function 5
	Product Requirement 6	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(ei) \wedge \mu F(ei)]}{\sum_{i=1}^{p} \mu B(ei)} \right)$	Most relevant project experts agree to almost all of product function 6
	Product Requirement 7	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(ei) \wedge \mu F(ei)]}{\sum_{i=1}^{p} \mu B(ei)} \right)$	Most relevant project experts agree to almost all product function 7
	Product Requirement 8	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(ei) \wedge \mu F(ei)]}{\sum_{i=1}^{p} \mu B(ei)} \right)$	Most relevant project experts agree to almost all product function 8

(continued)

Table 2 (continued)

Variable	Dimension	Mathematical expression	Social Fuzzy Preference statement by StakeH
Time to Market (PC VAR TIME TO MARKET)	Budget plan	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(psi) \wedge \mu F(psi)]}{\sum_{i=1}^{p} \mu B(psi)} \right)$	Most relevant project sponsors (ps) agree to almost all of budget plan
	Contingency Budget plan	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(ei) \wedge \mu F(ei)]}{\sum_{i=1}^{p} \mu B(ei)} \right)$	Most relevant project experts agree to almost all of contingency budget plan
	Time overrun and projection report	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(cmi) \wedge \mu F(cmi)]}{\sum_{i=1}^{p} \mu B(cmi)} \right)$	Most relevant project contract managers (cm) agree to almost all of the time overrun and projection report
	Delivering the project within the budget	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(ei) \wedge \mu F(ei)]}{\sum_{i=1}^{p} \mu B(ei)} \right)$	Most relevant project experts agree to almost all of the project is delivered within the budget
Project Cost benefit (PC VAR PROJECT COST BENEFIT)	Overall Budget planning report	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(cmi) \wedge \mu F(cmi)]}{\sum_{i=1}^{p} \mu B(cmi)} \right)$	Most relevant project contract managers (cm) agree to almost all of the overall budget planning report
	Budget overrun report	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(psi) \wedge \mu F(psi)]}{\sum_{i=1}^{p} \mu B(psi)} \right)$	Most relevant project contract managers agree to almost all of the overall budgets overrun report

(continued)

Table 2 (continued)

Variable	Dimension	Mathematical expression	Social Fuzzy Preference statement by StakeH
	Resource overrun report	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(pmi)^{\wedge} \mu F(pmi)]}{\sum_{i=1}^{p} \mu B(pmi)} \right)$	Most relevant project managers (pm) agree to almost all of the resource overrun report
Business or operation benefit (PC VAR BUSINESS OR OPE BENEFIT)	Return on investment	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(psi)^{\wedge} \mu F(psi)]}{\sum_{i=1}^{p} \mu B(psi)} \right)$	Most relevant project sponsors agree to almost all of the return on investment
	Business Cost Saving	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(sci)^{\wedge} \mu F(sci)]}{\sum_{i=1}^{p} \mu B(sci)} \right)$	Most relevant project subcontractors (sc) agree as to almost all of the business cost saving
Organization Benefit (PC VAR ORG BENEFIT)	Risk Control and Management	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(sci)^{\wedge} \mu F(sci)]}{\sum_{i=1}^{p} \mu B(sci)} \right)$	Most relevant project subcontractors agree as to almost all of the Risk control and management
	Decision Support Process	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(cmi)^{\wedge} \mu F(cmi)]}{\sum_{i=1}^{p} \mu B(cmi)} \right)$	Most relevant project contract managers agree as to almost all of the decision support process
	Enterprise Culture and Unity	$\mu Q = \left(\frac{\sum_{i=1}^{p} [\mu B(cmi)^{\wedge} \mu F(cmi)]}{\sum_{i=1}^{p} \mu B(cmi)} \right)$	Most relevant project contract managers agree as to almost all of Enterprise Culture and Unity

$$\text{QB}y's \text{ are } F \tag{2}$$

"*Almost (Q) all 'ICT' (B) project benefit evaluators (y's) are convinced (F), that almost all enterprise culture that emerge with time*" or

$$\mu Q = \left(\frac{\sum_{i=1}^{p} \left[\mu B(yi)^{\Lambda} \mu F(yi) \right]}{\sum_{i=1}^{p} \mu B(yi)} \right)$$

Most (Q) of the important (B) project evaluators (we need stakeholders here, not just expert) (y's) are convinced (F) about the emerging project benefit.

Both Q *y's* are F&QB *y's* are F are rather fuzzy and contain doubt and requires simplicity while justifying its truthfulness. However, underpinned by the epistle of prominent authors in seminal literature we can support the known truth (y is F) meaning stakeholders of the project who impact the project are also being impacted by the outcome of the project. Stakeholders of the project are convinced, or project yields merchantable quality benefits [9, 10]. The manifestation of the mathematical model is explainable through Zadeh's method, a fuzzy linguistic quantifier Q is assumed to be a fuzzy set defined in [0,1]. For instance Q= "most" may be given as:

$$\mu most(x) \begin{cases} 1 \; for \; x \geq 0.8, \\ 2x - 0.6 \; for \; 0.3 < x < 0.8, \\ 0 \; for \; x \leq 0.3, \end{cases} \tag{3}$$

With another quantifier of 'important experts' we can extend the belief to an analogous discussion that project or program or portfolio managers with the experience of 15 years or more in the company will satisfy the condition of important experts by means of competencies, knowledge and conceptual thinking.

In the case of "*Almost (Q) all 'ICT' (B) project benefit evaluators (y's) are convinced (F) that almost all enterprise culture that emerge with time"; the fuzzy representation for Q= "almost all*" could be:

$$\mu almost\ all(x) \begin{cases} 1 \; for \; x \geq 0.8, \\ 2x - 0.6 \; for \; 0.3 < x < 0.8, \\ 0 \; for \; x \leq 0.3, \end{cases}$$

Further representing the fuzzy perspectives Property F is defined as a fuzzy set in Y. For instance, if Y = {X,Y,Z} is a set of experts and F is the property 'satisfied', then F may be explicitly written as

F = 'satisfied' = 0.1/X+0.6/Y+0.8/Z; Which means expert X: the project manager, expert Y: the program manager and expert Z: the portfolio manager are satisfied to degree 0.1, 0.6 & 0.8 respectively that the social benefit will be yielded at the end of the project lifecycle. In the light of project cost, quality, time constraints the project triangle explains, the experts are also satisfied to varied degrees how the project benefits, program benefits and portfolio benefits will be satisfied in the foreground

of social project value. If the different types of benefit experts are satisfied about the realization of benefits then, $Y = \{y_1,\ldots y_p\}$ it is assumed that the truthful (y_i is F) = $\mu_F(Y_i)$, I = 1, ……,p. The value associated for truth (Q y's are F) is determined by two devised steps of Zadeh [9].

3 Social Fuzzy Preference Relation for Group Decision Support for Benefit Approach

In this area we focus on defining agreed benefit particularly intangible benefit, measure and realization. In the continuum comprising of different stakeholders from client, supplier and third party individuals (need to be stakeholders of the project, not just experts, as here we deal with consensus and the agreed project "Benefits" and that is measurable when the 'important' expert criteria and parameter is added, B is defined as a fuzzy set in Y, and $\mu B(y_i) \in [0,1]$ is a degree of importance of y_i: 1 is important to 0 is unimportant, through all intermediate values. For instance, B='important' = 0.2/X+0.5/Y+0.6Z means that Expert X (Project manager) is important (relevant) to degree 0.2; Expert Y (Program manager) is important to degree 0.5 and Expert Z (Portfolio manager) is important to degree 0.6. In the case study, the Macro level project-level decision making by a Senior Manager aligning with the broader perspectives of organizational objectives like innovation, creative thinking by implementing the e-governance system shall be 'important' for project managers but unimportant or rarely important for program managers and portfolio-level benefit managers. In the instance of a related or non-related projects that are logically combined such as disseminating technology infrastructure to 75% or more rural citizens that will aim at achieving the objective of strengthening rural engagement to procure and acquire raw materials to perform supply chain operations through binding contracts and implementing digital strategy are 'important' for program managers like middle managers, but unimportant for other experts in the benefit management process. In the case of portfolio, the discipline-based subdivision for hierarchical management of departments like document filing, e- documentation processing, money payments are under the purview of portfolio managers like the line managers or supervising project officer. The expert decision is thereby important for portfolio-level managers but unimportant for project and program managers. Supply chain quality (o1), customer equity and fairness (o2), public enterprise good-will (o3) and stakeholder justice (o4) are a few of the intangible outcomes that a project manager must specifically recognize. The senior manager is engaged in a process of identifying and choosing an option [11] as to which intangible benefit in the collection is more essential for the success of the project. Moreover, the benefit manager can position these o1-o4 as a set of alternatives yielding different outcomes (eg: quality can yield financial goals, customer equity can yield customer satisfaction, good will can yield enterprise trade name value, stakeholder justice yields stakeholder satisfaction etc.,) and among these a best option (good, feasible or acceptable) is to be found.

The decision-making process entails a final choice which may be implemented in this case if customer equity and fairness is to be desired the challenge is to implement the stated, agreed benefit which includes its measurement and realization. As a non-financial- intangible benefit it is a benefit with indirect monetary value. The decision process is underpinned by various decision styles used by the benefit manager. The rational and collaborative style of decision-making is crucial for the senior manager in this context to identify, measure and later realize the 'agreed', 'target' or 'stated' benefit with intangible properties in nature. In vertical collaboration the strategic (T1), tactical (T2) and operational (T3) levels of the hierarchy takes centric value in Project Benefit as the projects are designed in PPP management in accordance with the structure. In the T1, T2 & T3 levels, the Benefit can be shared benefits at T1 level, at T2 level and at T3 level, that are synergized toward the broader objectives and vision of the organization. With shared or collaborative benefits, deliverables and project outcomes there is a need for managers to think about collaborative decision making to systematically approach benefit management. Let us assume that the e-governance (If there are 2 case studies, each needs to be described and discussed before using them) project focus is on 'accountability and transparency' which are the broader objectives of the organization at T1 tier. The strategic level project manager can adopt a decision-making style that is conceptual that implies the decision is creative and long-term oriented. This broader project goal can be achieved through customer equity and fairness which is a defined agreed project-level benefit (o2). There are related or non-related projects at T2 tier which emphasize on "customer awareness systems like 'know your customer better' " and 'customer trends and like analysis' which are both projects that are well-coordinated and logically combined to achieve the organizational objectives. In this T2 tier the program managers are crucial decision-makers as their collaboration among themselves and with the project managers at T1 is useful and directly impacts the organizational benefit management. With the essence of portfolio, at T3 tier the faculties such as 'document filing', 'document processing', 'vetting of customers', 'customer services', 'information providing' are few of the championing portfolio of the e-governance project that are cross-functional in nature. Each of the arms ideally has a portfolio benefit manager and their collaboration among one another and the other tier managers are important and crucial for the success of the project from an overall perspective. The understanding from an industrial perspective rooted in Kacprzyk's scholarship explains that at the lower-levels of the organization, tier T3, the decisions made are structured in character and tenor as the decisions are routine-based, operational and decision makers are bound by definite procedure. On the other paradigm, at higher levels the decision making is unstructured, tier T1, where the decision maker must provide judgement, evaluation, and insights into the problem definition and then the solution. Hence, the project overview is in the perspective of the senior project manager who can comment on the issues, problems and outcomes.

While multiple criteria decision analyses, or group decision making analyses are decision-making techniques involving the novel approach of several individual experts raising their voice or voting towards a common understanding or consensus; the process is a collection of logically united steps that lead to a project decision

outcome when followed ideally. The process is a coarse classification of four stages namely; intelligence, design, choice and implementation In this range of rational decision-making the real decision making is done collectively, interdependently and persuasive jointly. Hence, the group decision making adheres to a behavioral style of decision-making characterized by multiple goals, multiple decision makers and multiple stages. In the case of meeting of minds of the project benefit stakeholders or their consensus the decision by consensus takes a definite path of evaluation.

A set of m agents $E = \{e_1 \ldots e_m\}$ comprising of E = {Proj_mgr, Prog_mgr,Portf_mgr,Enterprise_mgr} I believe "Agent" here are project stakeholders, including customers. who are competent and experienced to provide testimonies over a set of n options, $O = \{o_1 \ldots o_n\}$ to say O = {quality[b_1], investment[b_2], goodwill[b_3], justice[b_4], equity and fairness[b_5]}, as individual fuzzy preference relations, $R_1 \ldots\ldots R_m$. At t = 0, the agent's initial fuzzy preference relation, $R_{K\,K} = 1,2,\ldots_m$ on the set of options, may differ to a large extent so that the degree of consensus is likely to be lower. The project, program, portfolio and enterprise managers views and thoughts about the benefit b_2 at the point of investment may differ to a larger extent as their individual perception is different and contextual factors like the project interest is diverse. In relation to financial investment the insights of strategic benefit level is at a higher-order while the tactical level is relatively lower. In the case of goodwill, b_3, will be perceived at divergent levels like in case of top level management seek higher about the project's reputation compared with lower level management as it aligns with the strategic outcome of the organizational project.

The individual benefit's such as time, HR cost etc (should be at the benefit var level, the aggregate these is for the project, and that can be automated computed) functionalities are multi-faceted and the mediating parties are crucial for consensus at the project level. The project decision is ideally championed by a significant industrial party/ stakeholder like the organizational leader. In most occasions it is the project owner or funder who has the overview, brainchild and insights of the project, its benefits and after-effects or consequences. Thus, a majority prefers the intervention of a pioneering project expert to streamline the decision-making process, playing the role of a mediator. A super-agent takes the role of the moderator who initializes the exchange of ideas, facilitates the arguments in a networked setting. An expert like a Chief Project Officer with the authorization of the board of directors or majority shareholders facilitate effective decision-making. In the light of project failures, unsuccessful programs and project disbenefits [12, 1] it is a loss for stakeholders.

The process of consensus driven decision making is a focused, unbiased, respected ideology of giving equal share of concern to the views of all experts. In the case of stakeholder **justice** [o4] and approaching to decide if it is practically attained; the decision making process is gauged and substantiated by a degree of 'soft consensus' which is equated with the truth value [13–16]. "Most of the competent {knowledgeable, reliable} project experts agree upon as to almost all of the dimensions of stakeholder justice is observable in the project at different intervals of the lifecycle".

Zadeh's approach is to inspire the logic that explains each project expert agrees to give the consent to the decision reached even if it is not in oneness with his/her

individual perspective. Moreover, the individual expert is free to modify his/ her testimony while each intellectual view, insight and idea is valued, heard and considered. The quantifier 'most' is approximately analogous to a unanimous decision among the experts.

3.1 The Derivation of the Degree of Consensus

The first step is to compute a degree of agreement as to the preferences between all relevant pairs of options for the pairs of agents (Tables 3 and 4).

In the scientific approach of voting system of variables, one should apply the social fuzzy consensus methodology. For social consensus, a step wise approach in the consensus reaching process uses a fuzzy preference relation and reaches a social fuzzy preference relation, at consensus. In compliance with democratic voting standards, if more than a half or 2/3 ^{rds} of the experts group votes in favor of a preference option [PC VAR PRODUCT BENEFIT; PC VAR TIME TO MARKET; PC VAR PROJECT COST BENEFIT; PC VAR BUSINESS OR OPE BENEFIT; PC VAR ORG BENEFIT; PC VAR SOC-CUL POL BENE] the majority rule is applied with provision for bad outcome of the decision as well. If the majority project experts vote in favor of two but abstains on one variable, then it may undermine the benefit process as procedure of allocation rewards is ignored deliberately by the group of experts or stakeholders of the project. Hence, rational decision-making must consider the balance of probabilities. The benefit measurement using social fuzzy preference relates to the characteristic, explanation, measures and the fuzzy relation of each expert. Accordingly, the variables in the process of benefit realization it is necessary to quantify and evaluate the values from a linguistic perspective. Therefore, we need to quantify some values that cannot be directly quantified. The Project Component variables (PC var) are hybrid as it has both tangible and intangible aspects. The intangible benefit realization (y) cannot be

Table 3 Degree of consensus

Pairwise stakeholders	Options in pairwise combination	Degree of consensus
P_Sup & P_client of Product benefit and time to market benefit	PC VAR PRODUCT BENEFIT & PC VAR TIME TO MARKET	Full {strict agreement}
P_client & P_exp of project cost benefit & product benefit	PC VAR PROJECT COST BENEFIT & PC VAR PRODUCT BENEFIT	Partial {sufficient agreement}
P_Sup & P_exp of product benefit and soci-cul benefit	PC VAR PRODUCT BENEFIT & PC VAR SOC-CUL POL BENE	Partial {sufficient agreement}
P_exp & P_client of orga benefit and time to market	PC VAR ORG BENEFIT & PC VAR TIME TO MARKET	Full {strict agreement}
P_client & P_sup	PC VAR PRODUCT BENEFIT & PC VAR SOC-CUL POL BENE	Partial {sufficient agreement}

Table 4 Degree of agreement

Stakeholder pairwise	Option pairwise	Linguistic quantifier	Aggregate degree of consensus
P_Sup & P_client of *Product benefit & time to market benefit*	PC VAR PRODUCT BENEFIT & PC VAR TIME TO MARKET	Always	Full {strict agreement}
P_client & P_exp of *project cost benefit and product benefit*	PC VAR PROJECT COST BENEFIT & PC VAR PRODUCT BENEFIT	Often	Partial {sufficient agreement}
P_Sup & P_exp of *product benefit and socio cul benefit*	PC VAR PRODUCT BENEFIT & PC VAR SOC-CUL POL BENE	Sometimes	Partial {sufficient agreement}
P_exp & P_client of *org' benefit and time to market benefit*	PC VAR ORG BENEFIT & PC VAR TIME TO MARKET	Rarely	Full {strict agreement}
P_client & P_sup	PC VAR org BENEFIT & PC VAR SOC-CUL POL BENE	Not	Partial {sufficient agreement}
P_client& P_EXP			

directly measured and hence we need to estimate y based on available information and known values of related quantities $x_1,\ldots,x_n$, and the estimating algorithm is expressed $y = f(x_1,\ldots,x_n)$ (Table 5).

Table 5 Benefit measurement using social fuzzy consensus measurement

Characteristic	Explanation	Measures
Set of n; $n \geq 2$ options	$O = \{o_1 \ldots o_n\}$	PC VAR PRODUCT BENEFIT PC VAR TIME TO MARKET PC VAR PROJECT COST BENEFIT PC VAR BUSINESS OR OPE BENEFIT PC VAR ORG BENEFIT PC VAR SOC-CUL POL BENE
Set of m; $m \geq 2$ agents	$E = \{e_1 \ldots e_m\}$	supplier_side (P_Sup), client_side (P_client), expert_side (P_exp)
Individual fuzzy relation of each expert e_k $k = 1,2,\ldots m$	R_k μRk	– if PC VAR PRODUCT BENEFIT is definitely preferred to PC VAR SOC-CUL POL BENE – if PC VAR PRODUCT BENEFIT is slightly preferred to PC VAR SOC-CUL POL BENE in the case of indifference – if PC VAR PRODUCT BENEFIT is slightly preferred to PC VAR SOC-CUL POL BENE – if PC VAR PRODUCT BENEFIT is definitely preferred to PC VAR SOC-CUL POL BENE

Realization of the benefit to the stakeholders = f(average of product benefit[× 2], average of time to market benefit[x_3], average of project cost benefit[x_4], average of business or operation benefit[x_5], average of organization benefit[x_6], average of social, cultural and political benefit[×7]) Does it become the most important consideration for benefit realization. The relevance of options, relevance of pairs of options, importance of experts, importance of pair of individuals all contributes towards the degree of agreement and determination of options [17]. Strict agreement and sufficient agreement are the fundamental degrees of agreement among the experts with reference to options and the outcome or project decision. Accordingly the relevance of options with norm values s_i: from 0 standing for 'Not' to 1 for 'always' through all intermediate values. When measuring 'stakeholder BR' the PRODUCT BENEFIT could be definitely relevant/Always Product benefit = '1' & product cost benefit = '1' with Product social benefit = '0'. The relevance of pairs of options notational are measuring the compatibility among the options $b^B_{prod_{ben}/proj_{cost}ben} = b^B_{proj_{costben}/prod\_ben}$ are straightforward relevant and $b^B_{prod_{ben}/prod\_ben}$ s is irrelevant as the notation explains that it is the same option.

One should establish benefit realization decision making in terms of accurately estimating between actual and desired variable values and understand the distinction between benefit and intangible benefit at higher order levels of projects as the benefits are rather fuzzy and uncertain. In our case the project component variables are the actual values as perceived by the project stakeholders to be the realism of benefit approach. The estimated achieved values are the desires of the stakeholders which are the ultimately achievable benefit realization. It is further describable that the actual benefit realization is the possibility or probability of attaining the said benefits to reach the end realization of the target. On the other hand, desired value is the extent to which the benefit is actually realized and estimated as a target reachability at mid-point and final review of the benefit realization. The following is the fuzzy representation of fuzzy control case variables (Table 6).

The ultimate purpose of concepts and degrees of consensus models based on fuzzy majority is to ensure group decision-making and consensus models fits closer to reality and is human consistent [8, 15]. This thereby aims at accounting for a fuzzy majority represented by a fuzzy linguistic quantifier [9, 10, 15, 16]. The three types of benefit STAKEHOLDERS {k = supplier(1), client(2), pro_expert(3), enterpriseM(4)} express the fuzzy preference relation for a pairwise options relating to the realization of stakeholder benefits of projects levels of the public and corporate enterprise project namely, product_benefit; time to market, project cost benefit, project operation, organizational benefit and socio-benefit. For the same 'individual fuzzy preference relation' we can impute & determine the decision-making using the 'social fuzzy preference relations'. The core of this approach is useful to obtain a social fuzzy preference relation based on Nurmi [18]. It is also has an intuitive appeal to conceptualize and apply the fuzzy consensus winner extended further as a fuzzy majority expressed by a fuzzy linguistic quantifier (Fig. 1).

The application of social consensus can be reflected and recalled by the social fuzzy preference relation: In the context of a common manager known as a benefit

Table 6 Application of fuzzy uncertainty to solve the benefit realization of estimated PROJ COMP v values

Quantity of interest	Actual value	Available value	Accuracy in Estimation to determine the realization of intangible benefit
PC $_{\text{VAR PRODUCT BENEFIT}}$	y = f { PC $_{\text{VAR PRODUCT BENEFIT1}}$,… PC $_{\text{VAR PRODUCT BENEFITn}}$ }	$\tilde{y}$= f{PCVARPRODUCTBENEFIT1, …, PCVARPRODUCTBENEFITn}	"and"- operation for "and" "or"- operation for "some OPTIONAL" benefits
PC $_{\text{VAR}}$ TIME TO MARKET BENEFIT	y = f { PC $_{\text{VAR TIME TO MARKET1}}$,…, PC $_{\text{VAR TIME TO MARKETn}}$ }	$\tilde{y}$= f {PCVARTIMETOMARKET1, …, PCVARTIMETOMARKETn}	
PC $_{\text{VAR}}$ PRODUCT COST BENEFIT	y = f { PC $_{\text{VAR PROJECT COST BENEFIT1}}$,…, PC $_{\text{VAR PROJECT COST BENEFITn}}$ }	$\tilde{y}$= f {PCVARPROJECTCOSTBENEFIT1, …, PCVARPROJECTCOSTBENEFITn}	
PC $_{\text{VAR BUSINESS OR OPERATION BENEFIT}}$	y = f { PC $_{\text{VAR BUSINESS OR OPERATION BENEFIT1}}$,…, PC $_{\text{VAR BUSINESS OR OP BENEFITn}}$ }	$\tilde{y}$= f {PCVARBUSINESSOROPERATIONBENEFIT1, …, PCVARBUSINESSOROPBENEFITn}	
PC $_{\text{VAR ORG BENEFIT}}$	y = f { PC $_{\text{VAR ORG BENEFIT1}}$,…, PC $_{\text{VAR ORG BENEFITn}}$ }	$\tilde{y}$= f {PCVARORGBENEFIT1, …, PCVARORGBENEFITn}	
PC $_{\text{VAR SOCIAL BENEFIT}}$	y = f { PC $_{\text{SOCIAL BENEFIT1}}$,…, PC $_{\text{VAR SOCIAL BENEFITn}}$ }	$\tilde{y}$= f {PCVARPROJECTSOCIALBENEFIT1, …, PCVARPROJECTSOCIALBENEFITn}	

Supplier_M= $\begin{matrix} 0 & 0.3 & 0.7 & 0.1 \\ 0.7 & 0 & 0.6 & 0.6 \\ 0.3 & 0.4 & 0 & 0.2 \\ 0.9 & 0.4 & 0.8 & 0 \end{matrix}$	Client_M= $\begin{matrix} 0 & 0.4 & 0.6 & 0.2 \\ 0.6 & 0 & 0.7 & 0.4 \\ 0.4 & 0.3 & 0 & 0.1 \\ 0.8 & 0.6 & 0.9 & 0 \end{matrix}$
Expert_M= $\begin{matrix} 0 & 0.5 & 0.7 & 0 \\ 0.5 & 0 & 0.8 & 0.4 \\ 0.3 & 0.2 & 0 & 0.2 \\ 1 & 0.6 & 0.8 & 0 \end{matrix}$	BENEFIT MANAGER= $\begin{matrix} 0 & 0 & 1 & 0 \\ 3/4 & 0 & 3/4 & 1/4 \\ 0 & 1/4 & 0 & 0 \\ 1 & 3/4 & 1 & 0 \end{matrix}$

Fig. 1 Fuzzy consensus winner

manager, the social fuzzy preference relation abiding the group decision making by the experts and the fuzzy preference consensus of individual experts of project managers is considered. Hence, the implication of the method is to obtain a 'social fuzzy preference' & 'consensus winner' in decision making over the options of benefits that are determined by the experts. If we presume that Q= 'always', and S= then we obtain;

$$W_{always} = 1/15/s1 + 11/15/s2 + 1/s4 :$$
$$W_{0.8/always} = 1/15/s1 + 11/15/s4 :$$
$$W_{S/always} = 2/15/s1 + 11/15/s2 + 1/s4$$

In case of $W_{always,}$ benefit option s1 belongs to the fuzzy Q core to the extent of 1/15, option s2 to the extent of 11/15 and benefit option s4 to the extent of 1. Examining of individual fuzzy preference relations also exemplified and deconstructed into the analogous aspects of $W_{0.8/\text{ 'always'}}$ and $W_{S/\text{ always'}}$ relating to a benefit. The aspect will be acquired by the different stakeholder-oriented managers or experts of project benefit realization.

The results of the data analysis can infer the following findings FROM THE GENERATED Tables. The actual vs target benefits of the six project component variables can be summarized into six situational occurrences below.

(1) Proj component variables 01 & 02 always achieved with a full agreement by expert stakeholders
(2) Proj component variables 01 & 03 is often achieved with partial agreement
(3) Proj component variables 01 & 06 is sometimes achieved with partial agreement
(4) Proj component variables 02 & 05 rarely achieved with full agreement
(5) Proj component variables 05 & 06 not achieve with partial agreement
(6) Proj component variable 01 & 04 sometimes achieved with partial agreement.

Benefit realization in the benefit approach at the consensus levels will be dynamic at the stages of mid review and the final review phases. The degree of consensus and aggregate degree of consensus are both regarded as diverse opinions at a social fuzzy consensus level. The go- and no-go decisions are that project components 01, 02, 05 are to proceed with value from product benefit, time to market benefit and org' benefit are regarded to be 'go" decisions without a schedule overrun, and the

project busi-operation benefit, social value and proj cost benefit related indicators are contributory to 'no-go' projects that will lead to failure. Therefore, these are operationally non-functional, ignorable projects with a probability of failure [12, 16]. Failure means not merely the tangible profit value but also the non-tangibles, that account for malfunctioning, misfortune, limitation of benefits, unaccountable and liability driven projects.

4 Conclusion

We proposed a consensus-based approach to dealing with the input of different stakeholders in the realization of both tangible and the fuzzy intangible benefits. Although social cultural and political aspect of benefit is targeted and desired, the experts affirm that the benefit managers are in a transition stage yet to desire the actual realization of the project benefit. Business operation benefits are also a similar aspect with partial agreement and hence regarded to be a much-needed foreseeable focus for future consideration.

References

1. Zwikael, O., Chih, Y., Meredith, J.R.: Project Management Benefits: setting effective target benefits. Int. J. Project Manage. **36**, 650–658 (2018)
2. Aubry, M., Sergi, V., El Boukri, S.: Opening the black box of benefits management in the context of projects. In IRNOP. Boston, MA (2017)
3. Ghildyal, A., Ru D., Yapa, S., Uthumange, A., Chang, E., Joiner K., Despande A.: "Conceptual Framework for Measuring Project Benefits using Belief—Plausibility and Type1 Fuzzy Inference System" (Chapter 20) in Studies in Fuzziness, Vol. 393 (2020)
4. Fedrizzi, M., Pasi, G.: Fuzzy logic approaches to consensus modeling in group decision making. In: Ruan, D., Hardeman, F., Meer, K.V.D. (eds.) Intelligent Decision and Policy Making Support Systems, pp. 19–37. Springer, Berlin-Heidelberg (2008)
5. Ruwanthi, D., Yapa, S., Uthumange, A., Deshpande, A., Chang, E.: Stratification and fuzzy inference system for measuring project benefits. 10th International Conference on Soft Computing and Intelligent Systems & 19th International Symposium on advanced intelligent systems. Japan (2018)
6. Ruwanthi, D., Yapa, S., Uthumange, A., Ghildyal, A., Chang, E., Despande, A.: Measuring project benefit using an integrated fuzzy-shafer algorithm, "soft computing: new directions in foundations and applications". J. Bus. Res. (JBR), Elsevier publications (2020)
7. Shahbazova, S.N. et al. (Eds.): Recent Developments and the New Direction in Soft-Computing Foundations and Applications, 978-3-030-47123-1. (2020). https://doi.org/10.1007/978-3-030-47124-8_20
8. Fedrizzi, M., Kacprzyk, J., Nurmi, H.: Consensus degrees under fuzzy majorities and fuzzy preferences using OWA (ordered weighted average) operators. Control. Cybern. **22**, 71–80 (1993)
9. Zadeh, L., Chang, E., Deshpande, A.: Fuzzy inference approach. J. Bus. Res. **23**, 567–546 (2017)
10. Zadeh, L.A.: Stratification, target set reachability, and incremental enlargement principle. Inf. Sci. 354, https://doi.org/10.1016/j.ins.2016.02.047 (2016)

11. Sahakian, B., LaBuzetta, J. N.: Bad moves: How decision making goes wrong, and the ethics of smart drugs. New York, NY: Oxford University Press. (2013)
12. Dwivedi, Y.K., Ravichandran, K., Kartik, M.: IS/IT project failures: a review of the extant literature for deriving a taxonomy of failure factors. Int. Fed. Inf. Process.**402**, 73–88 (2013)
13. Herrera-Viedma, E., Cabrerizo, F.J., Kacprzyk, J., Pedrycz, W.: Review of soft consensus models in fuzzy environments. Inf. Fusion. **17**, 4–13 (2014). https://doi.org/10.1016/j.inffus.2013.04.002
14. Herrera-Viedma, E., Alonso, S., Chiclana, F., Herrera, F.: A consensus model for group decision making with incomplete fuzzy preference relations. IEEE Trans. Fuzzy Syst. **15**(5), 863–877 (2007)
15. Kacprzyk, J., Fedrizzi, M.: A 'human-consistent' degree of consensus based on fuzzy logic with linguistic quantifiers. Math. Soc. Sci. **18**(3) 275–290 (1992)
16. Zadeh, L.A.: Fuzzy sets. Info. Control **8**(3), 338–353; Zadeh, L.A.: Probability measures of fuzzy events. J. Math. Anal. Appl. **23**(2), 421–427 (1965)
17. Kacprzyk, J., Fedrizzi, M., Nurmi, H.: Group decision making and consensus under fuzzy preferences and fuzzy majority. Fuzzy Sets Syst. **49**(1) 21–31 (1992). https://doi.org/10.1016/0165-0114(92)90107-F
18. Nurmi, H.: Approaches to collective decision making with fuzzy preference relations. Fuzzy Sets Syst. **6**, 249–259. (1986)
19. Cabreizo F.J.: Building consensus in group decision making with an allocation of information, granularity, Fuzzy sets and systems, **255**, 115–127 (2014)