

# **Information Technology Project Benefit Realization in Military Enterprises of Sri Lanka Using Integrated Fuzzy Dempster - Shafer Algorithm**

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## **Abstract**

There are Information Technology (IT) projects in military organizations of Sri Lanka. However, these projects lack a scientific mechanism to measure and realize project benefits while quantifying qualitative project outcomes. This paper outlines a Fuzzy Inference System (FIS) for measuring the extent to which benefits could be realized. The objectives of the study are firstly, to formulate a fuzzy logic to measure the extent to which the project benefits are realized and secondly, to analyze its impact on benefit policy. The study mainly utilized the quantitative methodology of Dempster-Shafer algorithm to aggregate the selected experts' opinions by filtering similarity of experts. Ninety-five IT project managers representing the Army, Navy and Air Force were selected based on their expertise. The study employed field-based tacit experts to find inputs for each level namely; project, program, portfolio, enterprise and hybrid. The findings of the study posited nine fuzzy rules and five benefit realization levels for organizational projects. Also, the approach pronounced an organizational project policy. The study recommended a strategic benefit approach with policy implications that can be used by managers to monitor the expected project outcomes both on short term and futuristically. The application of the study cannot be generalized to all projects of the technology-domains thereby posing a limitation. Also the study is curtailed in its application to non-IT projects which singularly yield financial benefits. The study can be employed by policy makers to streamline benefit

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process emphasizing government IT infrastructure projects and private sector IT projects with a futuristic value.

**Keywords:** Benefit Realization, Benefit Measurement, Fuzzy Inference Systems, Dempster-Shafer Algorithm, Benefit Policy

## 1. Introduction

Traditionally, projects were marginalized to the old-school thinking of an asset that generates revenue and it is managed by the owner. However, with the surpass of time, project definitions evolved into inventive-thought which profess that project is an asset that is facilitated by technology that deliver gains, benefits, profits and outcome to stakeholders that are either monetary and sentimental in nature (Zadeh & Deshpande, 2017; Zwikael et al., 2018). The new school of thought in the project management discipline has triggered a clash between benefit identification and measurement. The challenge is to effectively measure the project benefits which are ideally aligned with the organizational objectives and vision.

Benefit Management (BM) is a generic term overarching a variety of areas like technology, social, economic benefit management. In this umbrella terminology, project BM is a specific aspect of identifying, planning, monitoring, measuring, evaluation and realizing project benefits and extends to post project benefit approaches (Thiry, 2015; Zwikael et al., 2018). Narrowing down the area, technology project benefit management is a petty, novel area specifically for developing countries (Aubry et al., 2017). Benefits are the fundamental deliverables of a project, the logical flow of value in terms of financial gains, return on investment, profit, customer gain/loss, social-value, non-profit good and organizational value (Martinsuo & Killen, 2014; Zwikael & Smyrk, 2015).

Military projects are defined as a logical combination of a set of investment assets of the Army, Navy, and Air force that facilitate the strategic, tactical, and operational processes (Zwikael et al., 2018; Aubry et al., 2017). In the context of investment-in-change, the benefits are interpreted from the technological perspective. Therefore, the benefit management of IT is the core of the military organizations to implement effective military processes. Military projects can be classified into four main classes. These are data processing, logistics automation, artificial intelligence-driven military enterprise projects, electronic transactions (Dwivedi et al., 2013; Atkinson, 1999).

In military organizations of Sri Lanka, technology is a facilitator of processes in the form of data communication methods, process automation, management information systems, supply chain integrations, fin-tech, functional integration, robotics, software solutions among many other things (Adams et al., 2016; Padalkar & Gopinath, 2016). Although technology serves as the facilitator the stakeholder or expert may not really perceive the exact value of project gains without a systematic

measurement mechanism (Dwivedi et al., 2013; Heeks, 2006; Zwikael & Smyrk, 2015). The issue that arises in the project BM process is fundamentally a substantive concern as the project benefit realization cannot be properly measured. In 2018, the Australian Defence Forces Academy established that 79% of IT enabled defence logistics projects failed to effectively realize the target benefits in the strategic areas of finance, HR, operations, IT and logistics (Ghildhyal et al., 2018). Furthermore, 80% of defence project stakeholders recorded inability to reach a consensus about the extent to which the benefits are realized despite the monetary investment in thirty defence IT projects related to material acquisition, procurement, defence capability, information management and sustainment (Aubry et al., 2017; Thiry, 2015).

In this light, the objective of the paper is two-fold. Firstly, to formulate a systematic mechanism involving fuzzy logic and related socio-mathematical algorithm to measure the extent to which military project benefits are realized. Secondly, to analyze the impact of the proposed methodology on the organizational project benefit policy. While the former objective is an essence of substance in Project Management (PM), the latter is a procedural consideration that facilitates the fairness of the project BM approach.

The significance of the study is of three types. Firstly, the study focused on theoretically understanding the fuzziness of benefits from business and technology dimensions. According to the Multi-Criteria Utility Theory of BM the benefits are classified into business and technology benefits (Parker et al., 2013; Goicoechea et al., 1982). Military project benefits take the nature of commercial gains like financial goals and technical gains like project risk and infrastructure risks. Secondly, the study focused on the methodological significance of analyzing the project benefits and measuring it with fuzzy logic and scientific algorithms. Thirdly, the practical significance is that a consensus-driven collective decision can be expressed on the project benefit realization based on the desired verse actual measurement.

## **2. Literature Review**

The literature section systematically illustrates the theoretical background for the study, definitions and empirical research on project benefit management.

### **2.1. Benefit Management**

BM is the process of organizing and managing complex projects so that the potential gains arising from investment in change are actually realized (Bradley, 2010). Benefit is the flow of value emerging from the project such as profit, returns, cost and people factors (Voss & Kock, 2013). Project is an organizational asset that is logically associated with the dominant objective (Zwikael et al., 2018). Program is a related project that yield value. Moreover, portfolio is a combination of related or non-related projects operationalized at functional levels of the organization. Target is the end-

state of a benefit as it reaches a level of realization (Dwivedi et al., 2013). Realization is the achievement of desired benefit by incremental enlargement of the benefit from deliverable to an outcome (Deshpande, 2013).

## **2.2. Enterprise Benefit Management**

Benefits are an array of values, financial goal, cost, budget, performance, economic gain, and profit as expounded in literature and theory (Ashurt et al., 2008; Ward et al., 1996; Zwikael et al., 2018). Benefit management comprises four processes, namely; benefit identification, benefit monitoring, benefit measurement, and benefit realization with actualization. “Intangible Benefits”, “Expected Benefits” and “Future-oriented Benefits” are drivers of project success and value from a strategic view-point (Martinsuo & Killen, 2014; Young & Young, 2014). The reasons why benefit measurement is the focal point of this paper are twofold. Firstly, timely experiments lack the ability to acknowledge measurement of futuristic project gains (Braun et al., 2009; Deshpande, 2013; Young et al., 2017), and secondly, the need for policy based benefit measurement that judiciously approach benefit management (Breese, 2015; Project Management Institute - PMI, 2014).

## **2.3. Theories on Project Benefit Management**

### **2.3.1. Multi Criteria Utility Theory**

Parker et al. (2013) explained that the projects are viewed through business and technology benefits. Competitive advantage, financial goals, monetary returns are commercial values vested on the stakeholders and the founder assumes that the commercial value is financially quantifiable (Zadeh et al., 2017; Zwikael et al., 2018). It explains that technology benefits are related to strategic alignment between the benefit and the objectives, risk, and infrastructure aspects, both technical and technological (Young et al., 2017). The theory assumes that both benefit dimensions must harmonize to achieve the end-state of the benefit.

### **2.3.2. Complexity Theory**

In organizational projects, the benefits are evolving around technological systems, people, processes and technological mechanisms (Stewart & Mohamed, 2002). In order to effectively realize the benefits, the theory assumes that the complex, uncertain and imprecise organizational environments must harmoniously unite where the physical, human capital and intellectual assets inter-play in unison (Nasir & Sahibuddhin, 2011).

## **2.4. Fuzzy Logic**

It is the scientific approach used to convert the qualitative project deliverables into quantifiable project outcomes with measurable, accountable, numerical values (Zadeh et al., 2017). The application of logic into the technology domain focused on inventive, utility and industrially useful value.

## **2.5. Empirical Research on Project Benefit Management**

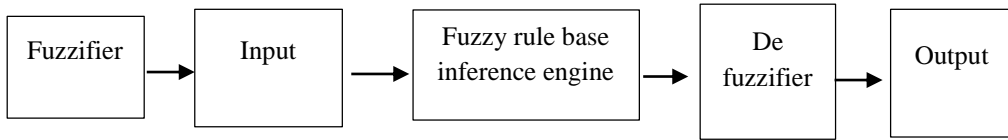
### **2.5.1. Fuzzy Approach to Benefit Management**

Integrated FIS is a tool based on an algorithm which relies on four combined parts, namely; input classification, expert filtering, expert viewpoint solicitation, and benefit realization measuring. The Fuzzy logic application approach was introduced by Lotfi Zadeh in 1965 which subsequently was formed into a concept, and applied in various technology driven public private partnerships (Zadeh, 2016). FIS is frequently used in computer engineering (Sowell, 2005; Zadeh et al., 2017), especially in various industrial fields such as soft computation (Cox, 1995; Dwivedi et al., 2013). The Dempster-Shafer algorithm is designed for measuring and tracking benefits at different levels. It allows you to monitor whether the benefit is realized in a timely manner (Zwikael & Meredith, 2018; Zadeh et al., 2017).

The objectives of FIS include transformation of crisp inputs into fuzzy inputs, identification of membership functions and activation of rules, and conversion of fuzzy output into crisp output. In fuzzy rule formation, there are necessities when it is required to measure the trend of benefit realization across a timeline. The timeline is propagated with words and symbols which are text-based (short-term, medium-term, etc.). In this case, the series have ambiguities, fuzziness and imprecision on the calibrated values and the time horizons (Mendel, 1995; Nasir & Sahibuddin, 2011; Young et al., 2017).

To overcome fuzziness in data-sets, it is imperative to apply expert thinking about the natural behavior of benefits in organizational contexts. The operation of FIS is simulated under conditioned parameters by applying “IF-THEN” rules. The study utilized the power of human and FIS for measuring benefit realization. The evaluation of benefits by project managers and investors is subjective. In industrial projects, stakeholders use R-A-G (Red-Amber-Green) status which is a subjective, biased assessment of measuring benefit realization (Cebeci & Beskese, 2002; Zwikael & Smyrk, 2015). In addition to classical FIS tool, there is a technique to measure every benefit of a project including intangible benefits. The main objective of Dempster Shafer algorithm is to measure the actual delivery of benefits. The method is aimed at combining knowledge of competent experts to determine realization of benefits, an inherent process of the FIS (Zadeh, 2016; Zwikael & Meredith, 2018).

**Figure 01: Fuzzy Inference Logical Approach**



*Source: Constructed based on literature of Zadeh (2016)*

The paper is committed to solving the issue of project benefit measurement for benefit realization. The benefits are loaded into the FIS with subsequent knowledge base creation, with fuzzy rules and logic in measuring benefits at different levels. Benefit measurement is a key process in benefit management. A meaningful input to the analysis of project benefit measurement from managerial perspective was made by Aubry, Sergi, El Boukri, Young, Vodica, and Bartholomeusz (Aubry et al., 2017; Young et al., 2017; Zwikael et al., 2018).

### **2.5.2. Inequities in the Benefit Measurement Approach of Project Benefit Realization**

Benefits are much more than rational thought and analytical thinking of experts or project/program managers. Interestingly, benefits also involve human moods, feelings, desires interpretations regarding versatile categories of benefits (Young et al., 2017). While some work scarcely prevail, still there is limited work at project, program and portfolio (P3M) levels, namely: Benefit at Portfolio level, Benefit at Program level and Benefit at Project level (PMI, 2013, 2014; Zwikael & Meredith, 2018).

P3M is visualized as the pillar of tiers or levels of a project-based enterprise or of an organizational asset where diverse types of benefits are recognized, planned, measured, evaluated and delivered at top, middle and bottom levels of the hypothetical project pyramid representing the projects, programs and portfolio (Enoch & Labuschagne, 2012; Braun et al., 2009). Practically, there is a mixed hybrid enterprise notion in benefit management which encompasses the organizational hierarchies and hybrid project structures of tri-partite levels. Benefit measurement for benefit realization in the changing volatile enterprise involves imprecision, disturbance and uncertainties. Fuzzy logic believes that non statistical data are vague, vulnerable to misunderstanding and fuzzy (Deshpande, 2013; Wu et al., 2015). Uncertainty is forked into conventional stochastic and lexical uncertainties (Cebeci & Beskese, 2002). In most large scale, resource-based enterprise initiatives, it is uncertain whether benefits would be realized, and also there are confusion-led approaches to define benefit measurements to be realized with futuristic value. The concept of a benefit is still fuzzy, where the exact nature of a benefit is ambiguous. The project benefit measurements, evaluation and project performance is weakly

identified (Zwikael et al., 2018; Aubry et al., 2014). Moreover, the computation of a benefit is ambiguous so it is prudent to obtain the consensual perception of benefit experts who are subject-oriented leaders of project benefits like information technology, automation, management information systems, human resource Information Systems (IS) etc. (Dwivedi et al., 2013).

### **2.5.3. Benefit Realization Algorithms**

In this paradigm of benefit realization, it is essential to understand the benefit approach from the domain expert view point and the socio-application of the benefit management process. There are pre-defined algorithms in the space of benefit realization. Out of the main focus, the Dempster Shafer expert filtration and the socio-fuzzy consensus approach are key algorithms of interest in this paper. The expert filtration is footed on using a pre-tested logic to filter the domain experts' views (Deshpande, 2013; Ghildhyal et al., 2018).

The wider-scoped socio-fuzzy consensus approach is premised on the fact that a collective application based on formula will resolve the benefit realization in the collaborative organizational aspect (Nurmi, 1981; Kacprzyk et al., 1992). The logic from a linguistic quantification such as "most of the experts believe that the benefits are almost achieved" is a symbolic indication of the socio-fuzzy application. This approach is a more balanced method to ascertain the summation of the domain experts' opinions and perceptions on benefit realization. This inquisitive approach focuses on the fuzzy winning application in order to establish the related fuzzy winner and is the opinion leader with regard to the fuzzy responses in the organization-based project. Hence, the optimum approach is the fuzzy consensus winner who relates to the project benefit in order to achieve the realization.

### **2.5.4. Military Project Benefit Evaluation**

With the advent of technology-enabled projects the military services have been transformed into desired objectives and a renewed vision (Aubry et al., 2017; Chen & Cheng, 2009). Large-scale projects are on the verge of initiation with multiple desired benefits in the army data archiving, military-healthcare, infrastructure, aero plane spare part replenishment, logistics sectors and naval marine vessel automation (Voss & Kock, 2013; Ghildhyal et al., 2018). The management of the project is minimalistic in terms of human-skills, intellect, economics or physical resources. The desired state is the realization of project benefits and in achieving this objective project benefit measurement is the antecedent, a lagging crucial aspect in BM. The flow of value visible to the stakeholders is conveniently measurable, but the rest of the gains or dis-benefits that are inherently latent is not perceivable (Zwikael & Meredith, 2018; Martinsuo & Killen, 2014; Ghildhyal et al., 2018). Subsequently, the benefit management process comprising of benefit identification, realization

planning, benefit measurement and realization (Ward et al., 1996) are completely hampered, redundant and leading to a dented evaluation process of the benefits.

### **3. Methodology**

With the use of quantitative approach, 40 IT project managers from Sri Lanka Army and another 40 IT managers from Sri Lanka Navy and 15 IT managers from Sri Lanka Air Force were selected from the total population of IT project managers of 250 armed forces in civil and 125 military capacity. The sample was selected based on judgement sampling method where managers were selected on the basis of their expertise in project benefit management. Using a standardized questionnaire, data were collected. The collected data were analyzed using fuzzy MATLAB software and interpreted using fuzzy logic, evidence and belief functions and IF-THEN topology. The trustworthiness was assured by site triangulation where experts from tri-services were taken for testing based on tech-based divisions, regiments and brigades in the field of infantry, naval logistics, and military air defence capability, in order to understand the similarities. Additionally, data reduction and critical incident analysis were used from a qualitative data analysis paradigm to interpret the expert's perceptions by reducing qualitative variables to quantitative crisp values by socio fuzzy consensus logic. The benefit analysis approach was done in four phases as posited by Ward et al. (1996), namely; benefit identification, realization planning, measuring and realization. Profit-oriented benefits, cost-oriented deliverables and intangible outcomes were the benefits of the criteria further operationalized into three dimensions, namely; direct tangible, direct intangible, and indirect tangible.

### **4. Analysis and Discussion**

In this section, the study illustrates the analysis of solicited project variables, fuzzy simulation and benefit realization for military IT projects. Moreover, the study explains data reduction, critical incident analysis, discrete behavior analysis, reliability and validity for solicited variables and expert opinion filtering for domain expert views, and analysis of impact of fuzzy approach on the organizational project benefit policy. The discussion is carried out with related scholarly findings.

#### **4.1. Analysis of Solicited Variables**

Solicited means the benefit variables that affect the measurement of benefit realization. Among the total sample of the study, which is 95 experts from tri-forces, 79% agree that operation automation and customer engagement are realized at portfolio level. In Army, Navy and Air Force, 94% of experts indicated that time and human resource cost are realized at program level. Among the total sample 81% of experts mentioned that profit and staff performance are realized at project level.

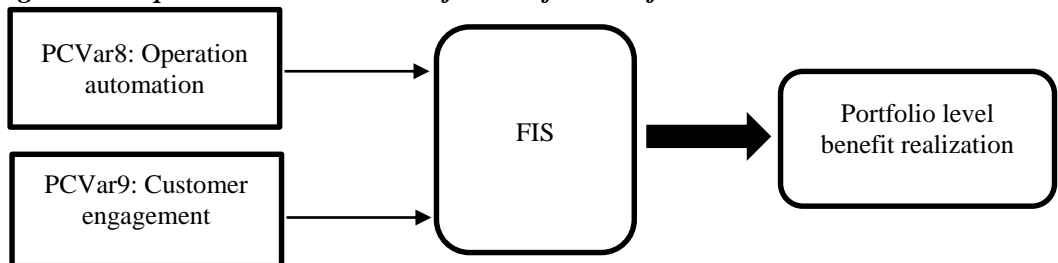


Similarly, at project level financial goals and cost savings are realized as voiced by 92% of experts in tri-services. Among Army, Navy and Air Force, nearly 90% of experts mentioned that the return on investment and value for money are project benefits realizable at enterprise level. Almost all (99%) of experts agree that capability and stakeholders are benefits that are realized at the project, program or portfolio levels. Capability is the facilitation of organizational processes with the use of IT in operational Defence projects (Ward et al., 1996). Furthermore, stakeholder are interest groups who impact the benefit measurement of the IT projects that include project owners, suppliers, clients, benefit assessors and experts of defence projects (Ghildhyal et al., 2018; Bellman & Zadeh, 1970).

#### 4.2. Fuzzy Benefit Simulation and Realization

Fuzzy simulation was conducted to ascertain a quantifiable crisp value with linguistic meaning for qualitative benefits in determining the extent to which the benefits were realized (Zadeh, 2016). The FIS identified two variables at a given opportunity for measuring benefit realization at portfolio, program, project, enterprise and hybrid levels. Pair-wise input variables are modelling into the FIS as depicted in figure 02. Table 01 and table 02 illustrate the fuzzy rules and knowledge base for fuzzy rules in measuring benefit realization at the respective levels of the project. There are nine fuzzy rules commonly formulated and five linguistically valued degrees of benefit measurement are derived. Rules were derived from the fuzzy quantization logic that designates possible nature of occurrence for pairwise project variables. Three distinct granulations are modelled for variable ‘x’ (operation automation) and variable ‘y’ (customer engagement) in pairwise combination (figure 02). Granulation is the logical process of linguistic interpretation of stages that a variable can attain and reach in the target reachability approach. Therefore, in the benefit realization process each variable can be assigned a crisp fuzzy linguistic quantification with three distinctions of ‘low’ =1, ‘medium’ =2 and ‘high’ =3. The knowledge base in table 02 indicates the plausible combinations of linguistic values, a benefit can realize when “IF-THEN” logic is applied (figure 03).

**Figure 02: Input Variables and Fuzzification for Benefit Realization**



Source: Constructed based on literature of Aubry et al., (2017) and Zadeh, (2016)

**Table 01: Fuzzy Rules in Measuring Portfolio Level Benefits**

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Rule 1: If PCVar8 is low AND PCVar9 is high,  
 THEN contribution to benefits realization is *sometimes*.

Rule 2: If PCVar8 is low AND PCVar9 is medium,  
 THEN contribution to benefits realization is *seldom*.

Rule 3: If PCVar8 is low AND PCVar9 is low,  
 THEN contribution to benefits realization is *never*.

Rule 4: If PCVar8 is medium AND PCVar9 is high,  
 THEN contribution to benefits realization is *on most occasions*.

Rule 5: If PCVar8 is medium AND PCVar9 is medium,  
 THEN contribution to benefits realization is *sometimes*.

Rule 6: If PCVar8 is medium AND PCVar9 is low,  
 THEN contribution to benefits realization is *seldom*.

Rule 7: If PCVar8 is high AND PCVar9 is high,  
 THEN contribution to benefits realization is *always*.

Rule 8: If PCVar8 is high AND PCVar9 is medium,  
 THEN contribution to benefits realization is *on most occasions*.

Rule 9: If PCVar8 is high AND PCVar9 is low,  
 THEN contribution to benefits realization is *sometimes*.

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*Source: Based on field data analysis*

**Table 02: Knowledge Base for Fuzzy Rules in Measuring Portfolio Level Benefits**  
**PCVar9: Customer engagement**

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		<b>Low</b>	<b>Medium</b>	<b>High</b>
<b>PCVar8: Operation automation</b>	<b>Low</b>	Never	Seldom	Sometimes
	<b>Medium</b>	Seldom	Sometimes	On most Occasions
	<b>High</b>	Sometimes	On most Occasions	Always

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*Source: Based on field data analysis*

### 4.3. Data Reduction

The study conducted a data reduction in order to extract and rearrange the data while integrating to form a theory (Yin, 2009; Miles & Huberman, 1994). Table 03 depicts the critical incidents, themes, justifications and codes that precipitated for project benefit realization.

**Table 03: Data Reduction Approach**

<b>Excerpts</b>	<b>Critical incident/data display</b>	<b>Themes</b>	<b>Codes</b>	<b>Theoretical justification</b>
Army under officer training	Classification of project gains/benefits	<ol style="list-style-type: none"> <li>1. Project focus on the next step of continuing to invest in the project asset.</li> <li>2. Gains emerging off the project must be classified in order to achieve the end goal.</li> </ol>	“Army under officer training”	Classification of project gains/benefits
Navy data processing project officer	Benefit measurement	<ol style="list-style-type: none"> <li>1. It is important to understand how to quantify the project gains and goals.</li> <li>2. It is not only the project gains but also the different aspects relating to the project.</li> </ol>	<p>“Project benefit evaluation”</p> <p>“Benefit measurement”</p>	Multi-criteria utility theory by Stewart and Mohamed (2022)
Air Force IT project manager	Target realization and end of the project	<ol style="list-style-type: none"> <li>1. See the project as a bundle of good-will.</li> <li>2. Must reach a point of win/win while attaining the final goal.</li> </ol>	<p>“Auxiliary benefits”</p> <p>“Project goal attainment”</p>	Concept of stratification by Zwikael et al., (2018)

*Source: Based on field data analysis*

#### **4.4. Critical Incident Analysis**

The army project manager emphasizes that classification is essential in achieving the success of the project at the end. In line with the benefit approach of benefit identification, planning, monitoring and realization (Ward et al., 1996), the first phase is the benefit identification, that is the antecedent of effective benefit management and the precursor to the good benefit realization. Monetary value is the investment to commence the project and thereafter sustain the gains, benefits and the final outcome. If stakeholder invests in the project as an asset they must consider the type of the project benefit whether it is tangible or intangible, quantifiable or not. The navy project manager is interested in the measurement of the project benefits. As pronounced by the multi-criteria utility theory, the project benefits are either business or technology in nature. The benefit must be measured, monitored and evaluated in order to justify the project success to the stakeholders (Zadeh et al.,

2017; Zwikael et al., 2018). The project measurement is subsequent to the benefit planning stage as precipitated in the benefit approach.

The Air Force manager expects to visualize the good-will of the project towards the stakeholders. Auxiliary benefits are focusing on the intangible, side-lined project benefits like the customer satisfaction or employee time. This is viewed through the concept of stratification which means that the benefit is to be achieved via the target, the target reachability and target realization and incremental enlargement. The end-state of the benefit is the target achievement resulting in benefit realization of the project. This opinion posits that the benefits must be first classified appropriately and then achieved in order to attain the benefit from a measurability view point.

#### 4.5. Discrete Behavior Extraction

In discrete behavior extraction the data was examined based on the precipitated knowledge (Kassarjian, 1977; Singh, 2015). The critical behaviors for Army, Navy and Air Force project managers were 40, 40 and 15 respectively and the discrete behaviors were 80, 80 and 30. The respondents recorded a wide range of critical behaviors that explained their perceptions and expert opinions toward the benefit realization and benefit policy. Therefore, “project’s monetary value”, “benefit classification”, “benefit measurement”, and “project goal attainment” are four specific behaviors types that represented the four overarching categories of events in the benefit approach as discussed by Ward et al. (1996). Benefit measurement was further separated into five categories namely, ‘very high’, ‘high’, ‘medium’, ‘low’, and ‘very low’ and analyzed in table 04.

**Table 04: Fuzzy Values with Linguistic Interpretations**

Crisp fuzzy value	Fuzzy linguistic quantifier	Fuzzy denominator for the fuzzy model for benefit realization
1	Very low	Never
2	Low	Seldom
3	Medium	Sometimes
4	High	On most occasions
5	Very high	Always

*Source: Based on field data analysis*

#### 4.6. Reliability and Validity of the Quantitative Study

Inter-judge reliability is a measurement that is inter-subjectively ambiguous and is achieved by rigorous classification (Hunt, 1983). The inter-judge reliability averaged .84 and no individual coefficients were lower than .80. Two confirmation samples (hold-out samples from the original 95 samples) of 190 discrete behaviors were

sorted into classification schemes. No new categories emerged, pronouncing that the set of analyzed critical incidents forms an adequate representation of the precipitating events of IT project benefit measurement, evaluation and realization.

#### 4.7. Expert Opinion Filtering

The identified experts drew fuzzy sets for the defined parameters based on their ideas on benefit realization. The similarity coefficients were categorized in possibility levels, that is the extent to which experts agree about benefit realization. Those experts who satisfied, for example, 0.95 possibility was considered in further investigations in decision research. The basic belief/evidence assignment of the identified, for example, seven experts (out of, about 95 experts who finally agree with 0.95 possibility level) is shown in table 05, where A is “Very High Benefit Received”, B is “High Benefit Received”, C is an “Acceptable Level of Benefit Received”, and D is “Benefit not Received”. The fuzzy equivalence explained that except one (E3) all others satisfied 0.95 possibility level and agreed benefit realization. The evidence/belief plausibility is obtained by Demspter Shafer algorithm that consensually collaborate the experts’ opinions and to ascertain whether or not the benefit is realized.

**Table 05: Normalized Values of the Evidence/Belief Function of Discipline-Experts**

<b>Focal element no.</b>	<b>Basic belief/evidence assignment</b>	<b>E-1</b>	<b>E-2</b>	<b>E-3</b>	<b>E-4</b>	<b>E-5</b>	<b>E-6</b>	<b>E-7</b>
1	A	0.04	0.14	0.15	0.04	0.09	0.10	0.10
2	B	0.75	0.12	0.05	0.75	0.08	0.08	0.09
3	C	0.01	0.02	0.14	0.01	0.02	0.03	0.02
4	D	0.02	0.00	0.03	0.03	0.01	0.01	0.02
5	AUB	0.08	0.14	0.07	0.09	0.10	0.10	0.10
6	AUC	0.05	0.09	0.15	0.04	0.05	0.18	0.07
7	AUD	0.05	0.08	0.05	0.07	0.06	0.06	0.04
8	BUC	0.07	0.08	0.08	0.08	0.08	0.06	0.06
9	BUD	0.09	0.05	0.02	0.08	0.04	0.05	0.05
10	CUD	0.02	0.02	0.05	0.02	0.02	0.02	0.02
11	AUBUC	0.09	0.10	0.10	0.10	0.10	0.10	0.10
12	AUBUD	0.10	0.08	0.03	0.10	0.11	0.17	0.10
13	AUCUD	0.08	0.03	0.05	0.09	0.08	0.05	0.10
14	BUCUD	0.11	0.02	0.03	0.06	0.03	0.03	0.04
15	AUBUCUD	0.10	0.01	0.01	0.10	0.11	0.12	0.10

*Source: Based on field data analysis*

*E-1 to E-7: Experts opinion on projects*

The evidence/belief plausibility is obtained by Demspter Shafer algorithm that

consensually collaborate the experts' opinions and to ascertain whether or not the benefit is realized. According to table 05 the numbers denote the similarity coefficient among the experts' ideas. It depicts the possibility levels of the extent to which the experts agree about the benefit realization. A sample of seven experts out of ninety-five who finally agree with 0.95 possibility level was considered further for investigation of benefit decision and output is displayed, where A is "Very High Benefit Received", B is "High Benefit Received", C is an "Acceptable Level of Benefit Received", and D is "Benefit Not Received". The union of the four benefit realization possibilities are designated by  $A \cup B \cup C \cup D$ . The fuzzy equivalence explained that except E3 all other satisfied 0.95 level and agreed the benefit realization.

#### **4.8. Benefit Policy Approach**

The findings are analyzed by extracting normative and practitioner literature in justifying the benefit measurement views of the experts.

##### **4.8.1. Benefit Planning with Profit Orientation**

The identified benefits can be deeply analyzed through the lens of a specific policy. The policy is a set of guidelines that would govern and regulate the benefits stakeholders' futuristic project decisions. The policy is not a simple tool or terminology but a practical framework that is applicable to organizational and national projects in measuring project benefits transparently and with accountable to all stakeholders (Padalkar & Gopinath, 2016). When benefits are coupled as an input to the fuzzy model, it could derive nine rules and five benefit realization states known as the target reachability of project benefits (Aubry et al., 2014).

The target reachability of these benefits is based on the extent to which the benefit realization is measured. So, it can be assumed that there can be business-related or technology-based project deliverables and outcomes. Moreover, some are financial and easily measurable while others permit a qualitative interpretation extending to fuzzy-based value generation. In all project benefit realization, a crisp, meaningful, unambiguous value is attained and the expert interpretation with tacit knowledge is applied. The study reveals that an organization or country can have different tiers of benefits. These are project, portfolio, program, enterprise and hybrid gains and deliverables.

##### **4.8.2. Project Benefit Liabilities with Intangible Outcome**

Benefits are by nature fuzzy, imprecise and uncertain. Nevertheless, the computation of benefits through words or numbers resolves the issue faced by benefits to a certain extent. The researcher's perspective of benefit behavior is subjective against the

ideologies and experience of project managers, stakeholders and essentially evolving experts. In this paradoxical point, a common consensus must be reached because the diverse opinions can cause departure from logical thinking, accepted norms and desired scientific approaches.

It is contributory to knowledge when the negative gains (dis-benefits) are extensively analyzed. Thus, for examples if the system derived that when stakeholders are short-term and capability is low the contributory effect of the two couple benefits on benefit realization is calibrated as 'never'. It is a turning point for a decision maker because it is a 'black swan'. Black swan is a project terminology to indicate the yielding of losses, dis-benefits, disadvantages and project failures despite of investment. The project managers and top management must proactively think about the project functionalities before the project returns negative effects.

#### **4.8.3. Dissecting the Gains from the Losses Incurred in Projects**

Similar to black swans in hybrid project benefits approach the dis-benefits can be ascertained at enterprise, project, program and portfolio levels as well. At the enterprise level of benefit categorization, if return on investment is unstable and value for money is poor then the benefit realization is never. Accordingly, at a project level point of view if profit is insignificant and staff performance is poor then the benefit realization is never. Similar analogy explains at the program level that when time is low and human resource cost is low the benefit realization is never. At the portfolio benefit category, it can be mentioned that when operation automation and customer engagement are low the benefit realization is never. In the propagation of project dis-benefits the manager's tendency is to ignore the probabilities of project losses. However, the project stakeholders are impacted and managers are liable for possible risks, damage, harm and hurt to parties whether monetary or sentimental.

#### **4.8.4. Contributory Project Benefit Measurement with Cost Orientation**

In the future, project managers will be focused on expectancy approach befitting the project policy. Project owners must manage the act and the outcome that is the project investments and the return on investment, the project HR costs and the liability of the project on consumers or even the project operation automation and the project time expended by stakeholders.

#### **4.8.5. Policy Approach to Benefit Measurement**

In this light, the policy makers must focus on the project benefit justice which is the overall perception by the managers and the beneficiaries about what is fair, legitimate and reasonably just. Policy guideline is essential because there is a disparity between what is perceived by the managers and desired by the beneficiaries. Project benefit

justice is dichotomous in nature as there are procedural justice and distributive justice. Procedural justice emphasizes the fair process used to determine the distribution of benefits and the distributive aspect demonstrates the fairness in quantifying the benefit as an amount and the allocation of project returns among the beneficiaries.

The operation automation and customer engagement benefits relate to automating business processes, paperless data entry, reducing error by value electronic follow-ups, mobile-enabled environments, etc. The issue arises regarding how to fairly distribute the automation deliverables among the owner, consultant, technician, contract manager and other parties. Capability and stakeholders relate to a social-political benefit emerging from the project.

Profit and staff performance take the shape of organizational benefit. Organizational benefit as discerned by the project managers and experts is comprising several facets like project risk control, workforce performance, decision support, process and policy improvements, enterprise culture and unity and IT infrastructure improvement. These components are the target benefits in reaching the end state of benefit realization from the profit and staff performance perspective. These facets are more intangible in character and the reachability of end benefit state is challenging. Benefit policy approach can restructure the measurability, evaluation and aspect of manageability. The project customer may not agree in the distribution of project end benefits and the amount of benefits that are allocated to the contractual parties.

## **4.9. Discussion**

### **4.9.1. Benefit Planning of Direct Tangibles**

Similar to the findings of this study, many scholars have empirically observed business and technology factors affecting the benefit planning and realization, its extent and the variation of levels of benefit realization. Dwivedi et al. (2013) and Breese (2015) explored that benefit realization in technology projects occur at five degrees, namely; never, seldom, sometimes, most times and always. Aubry et al. (2017) and Adams et al. (2016) pronounced that capability and stakeholders are mixed level benefits and are observable at different tiers of organizational projects entailing a hybrid aspect to benefit realization.

### **4.9.2. Project Benefit Liabilities of Direct Intangibles**

Hybridization was observed by Deshpande (2013) as cited in Aubry et al., (2017). Enterprise level benefit realization was confirmed by Zadeh et al. (2017) and PMI (2014) in terms of value for money and return on investment. Profit and staff performance are observable at the project level as revealed by Voss and Kock (2013) and Dwivedi et al. (2013). Moreover, the financial goals and cost savings were captured as project-level realizable benefits by Martinsuo and Killen (2014); Thirty



(2015) and Chen and Cheng (2009). Time and HR cost are program-level variables that are achievable as concluded by Nasir and Sahibuddin (2011) and Aubry et al. (2017). The same findings were confirmed by Badewi (2016) as a cost-oriented deliverable.

#### **4.9.3. Dissecting the Gains from the Losses Incurred in Projects of Indirect Tangibles**

The operation automation and customer engagement are realizable at portfolio level as pronounced by Zwikael et al. (2018, as cited in Atkinson, 1999); Zwikael et al. (2018) and Young et al. (2017) as an intangible outcome. The policy perspective of projects was accustomed to the commercial and non-commercial value emerging from a project as discussed by Zwikael and Meredith (2018). Dwivedi et al. (2013) and Ghildhyal et al. (2018) categorically explained that financial goals, cost savings, return on investment and profit are benefit factors of projects with a commercial business value. This was confirmed by Ward et al. (1996) and Aubry et al. (2017) in seminal studies with the augmented view that commercial value of projects has a financial indicator and is measurable implying direct tangibility.

#### **4.9.4. Contributory Project Benefit Measurement**

The non-commercial business value of projects in organizations is influenced by benefit factors like stakeholders, capabilities, staff performance, automation, customer engagement, time, HR cost and value for money as postulated by Bradley (2010); Chih and Zwikael (2015) and Zwikael and Meredith (2018). Young and Young (2014); Zwikael et al. (2018) and Nurmi (1981) rationalized that non-commercial business value of projects are attributed to non-financial, rarely measurable and non-pecuniary indicators with weaker ability to quantify project benefits by project managers due to intangibility (direct intangibles). Furthermore, the intangibility of non-commercial business project factors was confirmed by previous scholars, namely; Hill (2004); Heeks (2006); Adams et al., (2016); Ashurt et al., (2008) and Hubbard (2010). However, Zadeh (2016) and Nurmi and Kacprzyk (2000) contradicted this view and critiqued that measurement techniques are emerging in order to quantify intangible project benefits by fuzzy benefit approaches and novel scientific methods.

#### **4.9.5. Policy Approach**

Finally, policy for project benefits are developing today with three main perspectives, namely; benefit planning, liability measurement to stakeholders and incurred loss evaluation as analyzed by Aubry et al. (2017); Young et al. (2017) and Ghildhyal et al. (2018). Aubry et al. (2014) and Zadeh (2016) previously had expressed concern

about a need for benefit policy in order to justify benefit measurement, monitoring and realization.

## **5. Conclusion and Recommendations**

The study was conducted based on IT projects in the Army, Navy and Air Force. Comparatively the study analyzed the tri-forces projects to identify the business and technology factors affecting the benefit measurement at the end of a project. The study found that the measurement of benefit realization occurs at five levels namely; project, program, portfolio, hybrid and enterprise levels. Moreover, the benefit realization occurs at five granulations. These are ‘never’, ‘seldom’, ‘sometimes’, ‘on most occasions’ and ‘always’. The study yielded nine benefit realization rules. Specifically, operation automation and customer engagement are realized at portfolio level. Time and HR cost are realized at program level, while the study found that profit and staff performance are realized at project level. Similarly, at project level financial goals and cost savings are realized. At enterprise level the return on investment and value for money are realized, and capability and stakeholders are realized at hybrid project level. The study found that there is a policy aspect to benefit realization in terms of analyzing project benefit planning, evaluating project liabilities, and assessing the incurring of project losses. It could be concluded that the benefit realization of IT projects in military enterprises is significant in Sri Lanka. Finally, recommendations for tri-forces IT projects to augment the existing benefit approach are presented as follows.

### **5.1. Recommendations**

Policy guidelines for IT projects of tri-forces of Sri Lanka to augment the benefit realization will be suggested. The project stakeholders should be influenced to monitor benefits throughout the lifecycle. The management should be supported by implementing a sound benefit realization framework in the IT-enabled departments. Additionally, an environment of concern should be created for the operational, tactical, and strategic level employees to identify and measure the benefits emerging from a project by categorizing benefits, measuring, and monitoring at different organizational levels. Also, a disciplined project environment should be sustained by developing a project policy document with contractual terms and conditions for project parties.

### **5.2. Specific Recommendations to Tri-forces**

A benefit planning strategy should be designed by including the project categories, timelines and beneficiaries such as project owners, clients and third parties. Furthermore, a benefit measurement strategy should be developed to give a tangible value and interpretation for the diverse benefits emerging from projects that will

holistically govern and regulate all project parties and to implement a benefit realization action-plan by including a scientific mechanism to holistically evaluate the actual versus desired benefits.

## 6. Limitation and Further Research

The time horizon of the study was cross sectional. But the study can seek future research to extend to longitudinal nature and understand the benefit realization of military projects from a post-project perspective. Moreover, the generalizability of findings to other public service sectors may not be reasonable. Future research could be undertaken regarding the rest of the public service organizational projects and infrastructure projects facilitated by IT. Furthermore, benefit realization and measurement from clients and suppliers side in IT projects of private sector is a futuristic scientific endeavor in the IT project benefit approach.

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