MILITARY MISSION COMBAT EFFICIENCY ESTIMATION SYSTEM

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Military infantry recruits, although trained, lacks experience in real-time combat operations, despite the combat simulations training. Therefore, the choice of including them in military operations is a thorough and careful process. This has left top military commanders with the tough task of deciding, the best blend of inexperienced and experienced infantry soldiers, for any military operation, based on available information on enemy strength and capability. This research project delves into the design of a mission combat efficiency estimator (MCEE). It is a decision support system that aids top military commanders in estimating the best combination of soldiers suitable for different military operations, based on available information on enemy's combat experience. Hence, its advantages consist of reducing casualties and other risks that compromises the entire operation overall success, and also boosting the morals of soldiers in an operation, with such information as an estimation of combat efficiency of their enemies. The system was developed using Microsoft Asp.Net and Sql server backend. A case study test conducted with the MECEE system, reveals clearly that the MECEE system is an efficient tool for military mission planning in terms of team selection. Hence, when the MECEE system is fully deployed it will aid military commanders in the task of decision making on team members' combination for any given operation based on enemy personnel information that is well known beforehand. Further work on the MECEE will be undertaken to explore fire power types and impact in mission combat efficiency estimation.

Key words: *military mission, combat efficiency estimation, military team, enemy team, decision support system.*

1. INTRODUCTION

Annually governments expend millions of dollars on work force pooling in the military to ensure national security, through well-staffed military. New recruits, although trained, lack experience in real-time combat operations, leaving top military commanders with the tough task of deciding, the best blend of inexperienced and experienced personnel for military operations, based on available information on enemy strength and capability. Conventional decision methodology either adopts the strategy of only choosing personnel that is most combat experienced and holds known record of success, or a combination of highly combat experienced and non-experienced personnel.

The risk of losing a soldier is not just considered an ordinary loss of human life, but a collateral damage to the entire nation, due to the cost incurred by recruitment, training, death compensations, and all other types of settlement for the deceased's family and which does not provide adequate output to the nation.

Hence, an automated decision support system has become a stringent requirement. Decision Support Systems are otherwise referred to as technologies which support delivering the appropriate knowledge to the appropriate decision makers at the appropriate time, format and cost (Burstein et. al., 2008). This research paper aims at developing a military mission combat efficiency estimation system known as MCEE. The MCEE is a decision support system that aids military top commanders in estimating the best combination of soldiers suitable for different military operations, based on available information on enemy's combat experience. This will reduce casualties and other risks that compromise the entire operation overall success, while also boosting soldiers' morals in such operations given handy estimated information on their combat efficiency against their enemies. This research paper is divided into five sections. The first section comprises a brief introduction, statement of problem advantages of the proposed system. The second section presents the mathematical model developed for simulating and estimating combat efficiency of both military and enemy personnel involved in an operation. The third section is the design and implementation of the MECEE system. The fourth section is a case study test of MECEE system. Finally, the last section is the conclusion of findings.

1.1. Statement of problem

Wrong combination of infantry soldiers for any military operation goes a long way in deciding the fate of the entire team, and success of the operation at large. Also, effective manpower utilization is top priority to military asset utilization, deployment, and management. Hence for effective decision on the best blend of infantry

soldiers for a military operation team, a computerized decision support system is imminent.

1.2. Literature overview

Decision support systems application in human resource management has attracted researchers and industries' interest over the years, with the sole objective of automating and managing human resources in organization effectively (Tripathy, 2012). Tripathy (2012) highlighted the use of decision support systems as a better tool for effective organizational management, using Birla Corporation India as a case study. The designed employee management system was used to plan and execute leaves, promotion, and appraisal. Also, Maria (2012) emphasized the importance of decision support systems as a tool helping managers in effective decision making, citing a simulation of employee gross current value using Microsoft excel spread, as a fast and effective decision support tool for easy computation of overwhelming calculation task. In addition, Yaseminet.al.(2012) examined the effectiveness of Management information systems and human resource information systems using structured questionnaires that result in the overwhelming importance role-played by information systems in human resource management, although they did not deal with the subject of human resource deployment. Also Bongani (2013) examined the impact of decision supports systems use in human resource management in some Zimbabwe tertiary institutions. The result of their study reveals more positive response from tertiary intuitions management staff, which is a positive indication that decision support systems have significantly improved human resource management since it was first introduced in Zimbabwe tertiary institutions. However, the aforementioned study did not consider the subject of human resource deployment.

Similarly, Nana et.al. (2013) developed an automated smart human resource management decision support system that automates the entire employees' management of an organization from the date of appointment to expected retirement day, promotions, pay history, etc. The system focuses on human resource management and not deployment.

In addition, Gmeenakshi (2012) designed a performance evaluation decision support system using fuzzy logic. The system is quiet novel but does not deal with the subject of human resource deployment, which is an integral part of human resource management. Furthermore, Deepika (2013) developed a mono-agents three-layer hierarchical decision support system for human resource management. The proposed architecture seemed novel and effective once implemented, but it did not deal with effective human resource deployment.

Most of the reviewed decision support systems applications in human resource management are yet to take into consideration the risk associated with poor human resource deployment, an important aspect of human resource management that requires a critical approach in decision making. There is a risk prevention decision support system already developed (Raul et.al.,2011) but it concerns real estate investment risk analysis forecast and aims at enabling well informed decision on real-estate investment and not on human resource management. Furthermore, Jing et. al. (2007) delved into the design of a military human resource management using a fuzzy model for military personnel appraisal. This attempt was quiet novel and the results seem promising in automating military personnel's appraisals and effective human resource management. In addition, Elena (2012) elaborated on the possibilities and challenges involved in the development of decision support systems that are intelligent enough to support top military commanders in making real-time scientific decision at the appropriate time under reasonable cost. Also, Andreas et. al.(2000) conducted a study within the German army on the impact of decision support systems. The results of this study indicated that decision support systems are fast becoming an integral part of the military to aid speedy commanders 'decision and the implementation of decision support systems that are already feasible in practice. Furthermore, Jens (1999) designed a multi-agent command and control system in collaboration with the Marine Corps warfighting laboratory to test new concepts in military command and control. The system is a distributed system primarily designed to provide general tactical images.

1.3. Motivation

Existing literature reviewed so far supports the claim that decision support system are necessary for effective decision making in various scenarios (investment, education, civil organizations etc). Although none of the reviewed literature dealt with the subject of military human resource deployment management and the associated risk of poor human resource deployment in military mission motivates this research project that delves into the design and implementation of an automated military mission combat efficiency estimation system that computes and represents the military combat efficiency of all possible team members selected for any mission and that of their enemy mathematically. To determine the best optimum and efficient blend of military team members for an operation, while keeping in mind efficiency is to focus on human resource deployment and mission success.This system serves as decision support system for top military commanders saddled with the responsibility of deciding who is to be part of mission team or not.

1.4. Advantages of MEECS

The advantages of estimating military team and enemy team combat efficiency in a mission are:

- Enhancing the decision making process related to team selection for an operation, giving endless possibilities of combination of soldiers with varying years of combat experience;
- Optimizing team selection in the military, as many possibilities of team combinations are available with higher combat efficiency;
- Enhancing military manpower resource deployment for operations;
- Directly reducing the possibility of team casualty, as team members with optimum performance are to be selected;
- Ultimately, boosting the morale of soldiers, and their confidence in out rightly crushing their enemies, without envisaging any casualty.

2. METHODOLODY

In conducting the research, we employed a two-stage approach. First, a mathematical model was constructed to compute the combat efficiency of all possible military and enemy team. Next, we devised a simple optimal solution selection algorithm for selecting the most optimal military team. The implementation of this model was done with Microsoft ASP.Net using visual basic and Microsoft SQL server as the backend for the application. Finally a test case was simulated with the application to ascertain the working of the system

2.1. Combat efficiency estimation methodology

In this research, a mathematical model is first developed and latter transformed into a software logic for computing the military and enemy team combat efficiency using Visual Basic development tool and microsfot SQL server database. Data for system validation where case study simulation. While the analysis of the Case study data was done with descriptive statistical methods.

2.2. Recruitment training combat efficiency of friendly forces (military)/enemy

A. Military: The estimation of the military recruitment training combat efficiency is key to determining the combat efficiency of military recruits and ascertaining the overall training efficiency of combat experienced soldiers. We consider formal education, military drill with weapon training, and simulated war practice as constant indicators in the military. Each indicator scoring one point, totaling constant three (3) points for military training. Thus, the mathematical formulae for estimating the combat efficiency for military training is given below:

$MTCE = \sum TD[NOR]*3*NOR$ eq (1)

WHERE

MTCE= military training combat efficiency

Training Duration= TD

Number Of Recruits=NOR

3 = the constant point representing all military training components (formal education, weapon education and combat education)

B. Enemy: The enemy recruitment training combat efficiency estimation is obtained by primarily considering the components of the enemy training, which are commonly weapon skill, and fighting skill, for example al-Qaida terrorist will not consider formal education in recruiting fighters).. Hence accumulating 2 points. The mathematical formulae is shown in eq(2) below, compared to the three points in military training combat efficiency.

$$ETCE = \sum TD[NOR]*2*NOR \quad \text{eq (2)}$$

WHERE

ETCE=Enemy training combat efficiency

Training Duration= TD

Number of Recruits=NOR

2 = the constant point representing all enemy training components/ indicators (weapon education and combat education)

2.3. Combat efficiency of experienced soldiers/enemy per group

A. Military: Simulating and expressing combat efficiency of experienced military personnel in figures using a mathematical formula was achieved by finding the combat efficiency for all training per personel with accumulated training duration, using eq(1). We further group the soldiers into four groups by dividing the maximum number of years in military service into four equal sets. The combat efficiency of accumulated training for a group is obtained by multiplying the number of experience soldiers in a group with the accumulated training duration of personnel's in the group. This result is added to the result of multiplication of Corresponding Point on Years of Experience, number of experienced soldiers and years of combat experience. The corresponding point on years of experience is on a five-point scale for the military encompassing no vulnerability to kill trauma, death trauma, maneuvering, skills accumulation for different weapons and promotions. These points are in increment of 5point for each year an experienced soldier has accumulated. The number of experienced soldiers is the total number of experienced soldiers per group, while the years of combat experience are expressed in months rather than years. Since, the total years of active service in military are usually fixed for a maximum 35years globally, to obtain better results, during the system simulation and design experienced soldiers were grouped into four categories by years of combat experience from 1 to 9, 10 to 18, 19 to 27 and 28 to 36 as maximum. Therefore, to obtain the estimated combat efficiency of experienced soldiers, computation is performed in four different groups. We exclude other possibility that are highly probabilistic, such number and nature of personnel arms and

ammunition, which vary from mission to mission. The simulation only assumes that all parties are well armed. The combat efficiency for experienced soldiers is obtained by the mathematical formulae below

CEOESPG = ∑ (((TD [NOCES]*3)*NOCES) + (YOCE*CPOYOE) * NOCES)

WHERE

Combat Efficiency of Experienced Soldier Per Group = CEOESPG

Years of Combat Experience = YOCE

Numbers Of Combat Experienced Soldiers= NOCES

Corresponding Point on Years of Experience = CPOYOE (ranges from +5 for each year)

B. Enemy: The combat efficiency of enemies are obtained, in a similar grouping faction, as with the military, using the same equation, but slightly different , with the constant 2, which is the value for training, due to the lack of formal education in enemy

CEOEEPG = ∑(((TD[NOCEE]*2)*NOCEE) +(YOCE*CPOYOE) * NOCEE)

WHERE

Combat Efficiency Of Experienced Enemy Per Group = CEOEEPG

Years Of Combat Experience = YOCE

Numbers Of Combat Experienced Enemy= NOCEE

Corresponding Point on Years of Experience = CPOYOE (ranges from +5 for each year)

2.4. Total cumulative combat experience for whole team (enemy/ military) selection (TCCEFWTS)

This is the numerical equivalent of the combat efficiency of the selected team, which is expected to be greater than that of the enemies, based on known information about the enemy. Although the enemy TCCEFWTS computed by the system will not change, because all information about the enemy are known and input into the system, hence will not change. While the TCCEFWTS for the military team will continue to change for each possible team selection information entered into the system.The TCCEFWTS formulae is given below.

Military team:

TCCEFWTS=(∑_(I=1)^4▒ ⟦CEOESPG[1])+MTCE⟧)

WHERE

Total Cummulative Combat Experience Whole Military Team Selection = TCCEWMTS

Combat Eficiency Of Eperienced Soldier Per Group = CEOESPG

I= 1 TO 4, corresponding to the years of combat experience divided into four groups

MTCE=military training combat efficiency obtained with equation (1).

Enemy team:

TCCEFWET= ∑_(I=1)^4▒ ⟦CEOEEPG[1])+ETCE⟧

WHERE

Total Cummulative Combat Experience Whole Enemy Team = TCCEWET

Combat Eficiency Of Eperienced Enemy Per Group = CEOEEPG

I= 1 TO 4, corresponding to the years of combat experience divided into four groups

ETCE=enemy training combat efficiency obtained with equation(2)

2.5. Optimum team selection algorithm

The pseudo-code for selecting the best team from a list of feasible best teams, which optimally utilizes human resources and projects higher mission success, is given below:

- Select the enemy combat efficiency;
- Compare all military team combination combat efficiency;
- Select all military team combination with higher combat efficiency;
- Select the military team with lesser number of personnel but which balances inclusion of recruits and experienced people;
- Un-select any military team with higher number of personnel, higher number of experienced personnel and lower number of recruits;
- Output the best team.

3. SYSTEM DETAILS

3.1. System design

The MCEES was designed with visual basic asp.net tool. It consists of several modules, from introductory module through authentication, to the combat efficiency estimation module, which translates the physical combat efficiency through mathematical operation, into numerical values, for both enemies' and military teams selected. These are further compared, continuously, until all possible military team scenarios are exhausted. As illustrated by the chart below, it begins with first computing enemy combat efficiency, then it move on continuous computation of military team combat efficiency, for every possible combination, with repetitive comparison of their result. If any military team combat efficiency is less than enemy combat efficiency, then a re-entry of another possible team combination is done. Else, if the military team combat efficiency is higher, and there is no more possible team combination with higher or equal combat efficiency, then the military team with the highest estimated combat efficiency is selected as the best team combination suitable for the mission.

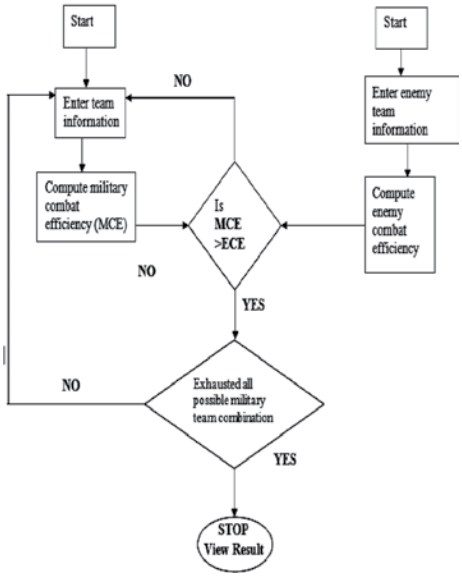

Fig.no.1. MCEES flowchart

3.2. System implementation

The MCEES was designed using Microsoft asp.net technology tools and Microsoft sql server as backend technology for storing each team combinational test data. The system consists of three small modules as shown by the screen shots below: first, there is an introductory module, the next is the authentication module that ensures only duly registered legitimate users have access to the system, and Finally, the main module that performs the logical computation of selected team and enemy team combat efficiency.

The system begins by first computing the enemy combat efficiency, since that is considered constant. Next, there is the computation of the every selected trial team combat efficiency. Also the comparisonbetween the enemy combat efficiency and the military team combat efficiency to outline all feasible optimum military teams for the operation is performed as the next step before the final execution stage. Finally, the most optimum solution with respect to efficient utilization of human resource deployment and mission success is selected using the pseudo code mentioned in **Subchapter 2.5.**

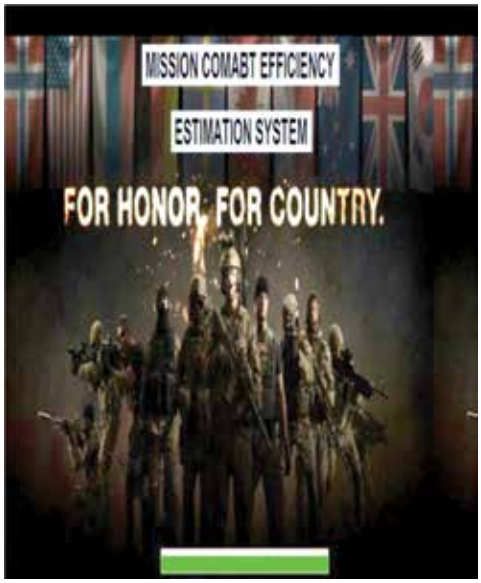

Fig. no. 2. Home screen shot of the MCEES

Fig. no. 3. Authentication screen shot of the MCEES

Fig. no. 4: Combat efficiency estimation module screen shot of the MCEES

4. CASE STUDY

The case study builds up on a mission to combat the ISIL group in Syria with intelligence information estimating its total fighting manpower at five thousand (5,000) with details as follows:

- 2,000 experience fighters existing for the past three years;
- 2,000 new recruits;
- 1,000 experiences fighter having combat experience of 10years as veterans.

To determine the best military team combination that will be optimal in operation performance, human resource utilization, and assures success of the mission the MCEES performs an n-number of possible team combinations, computes their combat efficiency, and compares it with that of the enemy as follows in the table below.

Table 1: Case study data

TEAM	MILITARY TEAM						ENEMY TEAM
	TEAM COMBIANTION					COMBAT EFFICIENCY	Enemy COMBAT EFFICIENCY
	RECRUITS	1-9YRS	10-18YRS	19-27YRS	28-36YRS		
1	**2000 (3months training)**	**2000 (32months exp, 3months training)**	**1000 (120 months exp, 3months training)**	-	-	-	7124000
2	150 (6months training)	-	200 (180months exp, 6months training)	-	50 (348months exp, 24months training)	5225808	-
3	400 (6months training)	-	100 (180months exp, 6months training)	50 (228 months exp, 16motnhs training)	50 (348months exp, 24months training)	7486356	-
4	600 (6months training)	-	50 (180months exp, 12months training)	250 (228 months exp, 16motnhs training)	50 (348months exp, 24months training)	8119356	-
5	450 (6months)	150 (96motnhs exp, 9months training)	85 (216months exp, 18months training)	50 (300months exp, 24motnhs training)	50 (396 months exp, 36motnhs)	7378761	-
6	450 (6months)	150 (96motnhs exp, 9months training)	100 (216months exp, 18months training)	75 (300months exp, 24motnhs training)	40 (396 months exp, 36motnhs)	7954461	-
7	350 (6months)	150 (96motnhs exp, 9months training)	100 (216months exp, 18months training)	75 (300months exp, 24motnhs training)	50 (396 months exp, 36motnhs)	8606061	-
8	200 (6months)	50 (96motnhs exp, 9months training)	20 (216months exp, 18months training)	15 (300months exp, 24motnhs training)	100 (396 months exp, 36motnhs)	7681161	-

Further analysis of the results in **Table1** is presented in **Figure 5**. Clearly team1 is excluded from the possibility of feasible teams due to its lesser combat efficiency in comparison to enemy combat efficiency. Hence leaving just teams 2-7 as the only possible feasible team solution for the operation, since they all have higher combat efficiency in comparison with enemy combat efficiency.

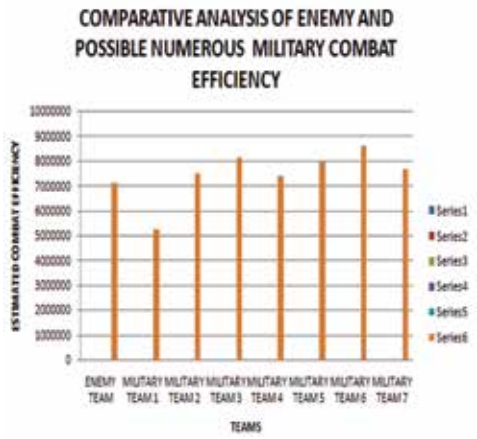

Fig. no. 5. Comparative analysis of enemy and feasible military team combat efficiency

Furthermore, **Figure 6** below shows an analysis of teams' personnel number in different categories and the total number of personnel per group, as well as for both enemy and various military teams. Clearly military team2 and team4 have more personnel drafted for the operation than military team7. Although military team2 and team4 have almost same level of combat efficiency estimated, but military team4 has more personnel drafted for the operation than team2. While both team2 and team4 have almost the same combat efficiency as estimated for team7, team7 requires little personnel for the same operation with slightly higher combat efficiency in comparison with team2 and team4. Military team3 and team5 have almost equal combat efficiency, but by comparison with the enemy their estimated combat efficiency is greater than the enemy's. Nonetheless, military team3 has more personnel drafted for the operation than military team5. Hence, the optimal feasible military teams for this operation are military team5, team7 and team6, which are selected due to its significant lower number of personnel drafted for the operation with higher combat efficiency estimated. Between teams 5,6, and 7, the optimum team will be the one that requires fewer soldiers, effective combination of experienced and inexperienced soldiers and still maintains a combat efficiency estimated above the enemy combat efficiency. Team7 has more experienced personnel and few recruits in comparison with teams5 and 6. Hence, team7 is eliminated. Between team5 and 6, team6 obviously stands out to be the most feasible for this operation since it has the best blend of experienced and inexperienced solders, with a total number of personnel drafted for this operation kept at a minimum and with the highest combat efficiency estimated above all other possible military teams and the enemy team.

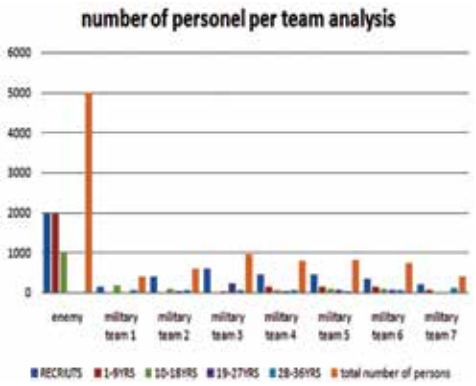

Fig. no. 6. Evaluation of number of personnel per team

The MCEES can be further enhanced by adding other probabilistic combat efficiency and performance estimation components, such as the number of rounds of ammunition, types of weapons, type of mission, skill needed in the military team and skill possessed by the enemy, etc. to further ascertain the highest probability of mission success and failure as a factor of the combat efficiency of the team selected. However the combat efficiency considered in this paper, is highly needed for manpower selection and deployment.

5. CONCLUSSION

In conclusion, a first attempt towards quantifying the combat efficiency of military personnel and enemies'manpower was achieved through the design and implementation of the MCEES. The system was developed using Microsoft asp.net technology and Microsoft sql server for backend. MCEES is a decision support system for top military commanders and military mission planners, saddled with the responsibility of deciding "who" and "how many" will be in a military mission team. MCEES will aid the efficiency and optimality of decision making on the topic of military team selection and combination. This is important for military asset deployment and utilization, especially human resource utilization in addition to the overall mission success with minimal or zero casualty on a military team. The analysis of the case study considered, clearly indicates the optimal character and reliability of the MCEES when utilized for mission team selection planning by top military commanders. Therefore, MCEES promises to ease the military team selection decision-making process by automating it and providing an n-number of possibilities that allow vast team combinations for optimal decision-making.

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